Computer Algorithms and Image Processing

Title: SBIR Phase II: Cilk++

Award Number: 0822896
Program Manager: Ian M. Bennett

Start Date: August 1, 2008
Expires: July 31, 2010
Total Amount: $500,000

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Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to develop software technology to enable C++ programmers to easily program multicore chips produced by the leading processor hardware vendors. Physical limits are driving chipmakers to produce chips containing multiple processor cores, but existing methods for programming multicore chips are error-prone and difficult to use. The potential outcomes of this research project will enable C++ programmers to easily parallelize applications to run on multicore processors without restructuring their legacy applications. Cilk++ is a simple set of language extensions to C++, which, together with a powerful runtime platform, allows multicore processors to be programmed easily. Market research shows that global variables pose a major barrier to parallelizing legacy code. This research project seeks to understand the linguistics, implementation, and applicability of hypervariables, a new construct designed to solve data-race problems created by parallel accesses to global variables. The results of the project include software implementations of hyper-variables in the context of Cilk++, including modifications to the Cilk++ language, compiler, tools and runtime platform. Additionally, the project will produce engineering design documents, user documentation, and training and educational materials, and will evaluate this technology in customer applications. In 2008, the leading processor manufacturers will ship over 100 million processors, with forecasts for over 75 percent of such processors be multicore. On the software side, the C++ programming language has become the standard langauge for developing applications that run on uniprocessor-based platforms. Although C++ programmers number well over 3 million, most lack the specialized training to use create correct, high-performing parallel programs. This research project will allow ordinary developers to multicore-enable legacy code and bring new multicore applications to market, thereby fulfilling the potential of multicore technology to help users of computers and personal appliances be more productive and to take advantage of the increased performance of computers in as diverse areas as health care, shopping, scientific advancement, entertainment, financial planning, and more. This research will advance the understanding of how multicore computers can be programmed effectively. The lessons of Cilk++, and the innovation of hypervariables in particular, will generalize to other programming languages, such as Java, C#, and Fortran. The educational and training materials will educate software engineers in parallel programming and expose them generally to the subtle issues of concurrency.

Title: SBIR Phase II: Algorithms and Visualization Techniques for the Detection of Geographic Aberrations in Crime (GIS)

Award Number: 0750507
Program Manager: Ian M. Bennett

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $467,805

Investigator: M. Cecelia Buchanan, info@avencia.com
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Abstract:

This Small Business Innovative Research (SBIR) Phase II project will further develop HunchLab -- software tools that leverage spatial statistics to enable police personnel to test their theories of criminality against data collected in the day-to-day activities of policing. The preceding Phase I project proved the feasibility of developing HunchLab as a set of innovative software tools that scour the historic data of a police department, search for geographic aberrations expected by the theories or 'hunches' put forth by crime analysts, and apply spatial statistics to confirm or deny the supposition. Preventing crime is a more sophisticated task than simply mapping incidents or arrests and deploying resources accordingly. The ability to detect and analyze changes in the geographic patterns of crime and disorder is an innovation in policing which holds the potential to enhance the organizational capacity of police departments across the country. This Phase II project will refine the application and build additional functionality, including alternate workflows for different user types, expanding the alert infrastructure, and building text mining capabilities. The obvious sector that this product will impact is law enforcement at all levels of government. Additionally the successful outcome will impact federal law enforcement agencies and regional crime analysis consortia. There are roughly 250 municipalities with over 100,000 people in them, and these each have police departments that would find this system of use. The tools will be helping thousands of police officers do their jobs better every day. This efficiency will result in better policing, meaning that criminals will be caught more effectively. Criminals cause damage far in excess of the property and medical costs directly attributable to their activity. Perhaps more importantly, the research will form the basis for other products that operate in realms other than law enforcement. The algorithms and technologies developed in the Phase I prototype are transferable to other datasets that demonstrate similar point pattern processes - events with explicit spatial and temporal attributes. Our Phase I process demonstrated a substantial utility in domains other than law enforcement including fraud detection, real estate, sales and public health. The Phase II work plan includes testing with other data sets to refine that software should address these other markets.

Title: SBIR Phase II: FireScape: A Platform for On-Demand, Browser-Based Incident Command

Award Number: 0750514
Program Manager: Ian M. Bennett

Start Date: March 15, 2008
Expires: February 28, 2010
Total Amount: $491,180

Investigator: Robert Crabtree, crabtree@hyperspectives.net
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Abstract:

This Small Business Innovation Research (SBIR) Phase II aims to prove the feasibility of creating a web-based mapping and visualization application for end-users in wildland fire management communities as an extension to the results of the Phase I work. By partnering with strategic vendors, the project will expand our current application to offer not only advanced remote-sensing data products and customized reports, but on-site, real-time weather data, GPS tracking, and full data transfer and communications networks (including audio and video). The project aims to ultimately provide end-users access to a complete team of expert analysts and engineers to gather, merge, and analyze fire-related data products through satellite communications networking. Our experts will then consolidate and simplify all the available data into custom, real-time data reports with geospatial context and delivery it to end-users to expedite high-level decision making, which can save valuable assets and lives. The platform will be amenable to the networking, visualization and analysis of a great number of issues in not only the natural resources realm, but also homeland security, disaster relief, global monitoring, and hazard mitigation. The ability to quickly and efficiently collect, analyze, and share geospatial data (in particular, time-sensitive environmental data) across the World Wide Web is the cornerstone value proposition for this product. These combined abilities provide a critical and as-yet-unavailable tool for the fire management community. The project has both economic and humanistic benefits in that confinement strategies decided-on and applied during the early stages of fires can significantly reduce the cost of fire suppression by several millions of dollars. This increased information will also allow decisions to be made that keep firefighters as safe as possible. Additionally the project will offer advanced data products in formats designed specifically to address the aspects that influence these decisions. The combination of the hub solution and web browser interface as a flexible architecture, is based on open standards and therefore is agile, dynamically configurable, and interoperable holding significant value for applications such as natural disasters, pandemics, or homeland security. The overlay and visualization of that data will provide analyses of critical importance for decision and policy makers, as well as regular citizens, all seeking the best geospatial information possible and in a form they can use.

Title: SBIR Phase II: User Oriented Character Animation Framework for Producing Believable Motions

Award Number: 0724452
Program Manager: Errol B. Arkilic

Start Date: November 15, 2007
Expires: October 31, 2009
Total Amount: $493,457

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Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes a new approach to the problem of creating and editing premium quality computer-generated character animation that will dramatically reduce the heavy labor penalty associated with animation techniques and software tools currently available. The specific technical innovation consists of a generic animation framework that produces high-quality motion through a reduced set of input parameters (compared to keyframe techniques) while providing a high degree of "directability" for the user. Additionally the proposed innovation affords the ability to capture, store and reproduce stylistic motions with a high level of fidelity and repeatability. Style is encoded in both physically- and behaviorally-based time-variable parameters supporting smooth transitions between styles. The theoretical foundation is similar to spacetime approaches yet has major differences that improve usability, flexibility, and productivity. Successful completion of this project will lead to a product that increases the productivity of experienced animators by simplifying the animation process, and enables novice or non-animators to quickly and easily create animated content. The successful completion of this Small Business Innovative Research phase II project, in conjunction with an appropriately developed user interface, will positively impact the global content creation industry by increasing the ease-of-use for creation of animation compared to the difficult and labor intensive animation processes currently employed. Successful commercialization will expose a much broader consumer market to the art of computer animation. The broader exposure of the solution will allow un-trained and underrepresented groups the ability to express themselves through the art of 3D computer generated character animation that is currently the realm of highly skilled users only. In addition, the increased ease of creating compelling animations will afford the dissemination of animation based information over a broader audience. Finally, the solution will allow animation to be used for applications where it was not previously feasible due to ease-of-use and budgetary constraints opening up new commercial opportunities.

Title: SBIR Phase II: CLEAR-View - A Cost Effective Thermal Imaging Sensor

Award Number: 0724500
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,991

Investigator: Kamil Agi, kagi@ka-wireless.com
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Abstract:

This Small Business Innovative Research (SBIR) Phase II project aims to develop and produce a novel suite of algorithms to enhance the performance of thermal imagers, offering real-time solutions in the automotive, surveillance and other segments of the thermal imaging market. The proposed algorithm is integrated with noise-infested, uncooled microbolometer infrared cameras, elevating their performance and offering manufacturing-cost reductions while adding new features and capabilities. At the heart of the approach is a Scene-Based NonUniformity Correction (SBNUC) algorithm, which works to correct the fixed-pattern noise resulting from nonuniform detector-to-detector responses in the focal-pane array. The novel SBNUC approach relies on exploiting the presence of minute amounts of scene/camera motion in a video sequence, naturally present in almost all applications, to algebraically extract the nonuniformity-noise parameters in a dynamic fashion, without the need for a mechanical shutter, as done conventionally. This approach improves the camera's reliability.

If successfully commercialized, the largest market is in the automotive sector, where the lower cost and improved performance of the device can potentially lead to tens of millions of dollars from new installs of collision-avoidance systems in cars and trucks. The enhanced features and lower costs offered by this technology also offer the potential of expanding the use of thermal imaging in other applications. In the firefighting market segment, equipping every firefighter with a thermal imager will reduce the number of fatalities due to smoke inhalation, heat, and response efficiency. In security applications, more information will be delivered at a higher level of quality.

Title: SBIR Phase II: Algorithms and Hardware for Real-Time H.264 Encoder

Award Number: 0450514
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000

Investigator: Sassan Pejhan, sassanp@vbrick.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop novel algorithms and hardware accelerators, as well as a prototype, for a real-time, high-resolution, H.264-based network video appliance. H.264 is the latest video compression standard, jointly developed by the ITU-T and ISO/IEC (MPEG). It is also designed for transmission over packet-based networks and to achieve significantly superior compression efficiency compared to previous standards and proprietary solutions. This compression efficiency, however, is achieved at the cost of severely increasing the complexity of the encoder. Real-time, high-resolution H.264 encoders are not feasible with current personal computers or DSP-based approaches. The new algorithms and designs for hardware acceleration will be targeted at video compression techniques that were introduced by the H.264 standard for the first time. They are anticipated to improve encoder performance by at least one order of magnitude compared to current implementations

If successful a real-time, network appliance with the compression efficiency of H.264 will have broad applications, particularly in the areas of distance learning, remote training, security and surveillance. The innovations resulting from this should enable implementers to significantly improve the real-time performance of H.264. Limited bandwidth and the resulting poor quality video have so far been an impediment to realizing the full benefits of digital video. A real-time, high-resolution network appliance with the compression efficiency of H.264 will bring digital video in the mainstream by delivering high quality video to the endpoints of the network. This will drive both business and consumer uses. It will provide the visual communication crucial to making distance learning and remote training a superior experience and compelling from an economic viewpoint - and therefore mitigate geography as a barrier to participation in scientific and engineering activities. Students can partake in classes offered at remote campuses while rural K-12 schools can partner with museums in major cities to provide their students with a richer education.

Title: SBIR Phase II: Fast Remote X-ray Screening

Award Number: 0620369
Program Manager: Errol Arkilic

Start Date: September 7, 2006
Expires: August 31, 2008
Total Amount: $500,000

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide development of a new homeland security technology for improving security for crowded venues by integrating a new networked security screening technology and new electronics communications with materials handling automation and computerized process control. New approaches and technologies are needed to provide effective security screening for places having high passenger and high pedestrian traffic. A primary need is to be able to screen persons and their carried items at significantly higher processing rates from those achieved using conventional security checkpoints while maintaining a smooth flow of people through the system. The Phase I project demonstrated technical feasibility. Phase II will complete development of the new high flow security screening system and design, construct, and test a near commercial scale prototype system. It is planned that the prototype system will be tested and evaluated by a TSA-approved, independent third party. Upon successful testing the system will be ready for deployment.

The U.S. transportation industry needs fast effective improvements in its security systems. Improved security technologies for use in transit systems can be applied to many other segments of society as well. In today's world it is vital that our nation's citizenry, transportation systems, institutions, and economy have the best protection possible from those who seek to weaken and destroy our society. The proposed technology will provide smooth flow of people and items through a fast and effective security inspection station with greater than an order of magnitude increase in processing rates compared to current technologies. The new technology will provide a significantly higher level of protection to persons in busy and crowded areas against attacks by terrorists using weapons or explosives than is currently available. Similarly, security at federal buildings, government installations, maritime ports, shippers, mailrooms, and other sensitive locations can be improved by the proposed technology that will allow for a faster and less impeded flow of persons and packages through the security inspection process.

Title: SBIR Phase II: T-Splines for Surface Intersection

Award Number: 0620461
Program Manager: Errol Arkilic

Start Date: August 4, 2006
Expires: July 31, 2008
Total Amount: $499,111

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses what is considered to be a significant unsolved problem in the Computer-Aided Design (CAD) industry; the fact that many CAD models contain numerous small, unwanted holes or gaps. These gaps occur most often along the seams where two surfaces in a CAD model meet, such as where a wing meets the fuselage of an airplane, and result from fundamental mathematical limitations. Software for analyzing a CAD model for physical properties such as aerodynamics, deflection, or stress cannot work unless those holes are repaired; a time consuming process that causes a significant bottleneck in the CAD workflow. Under Phase I funding, a solution to this gap problem was devised that uses a new surface formulation called T-Splines. Tasks to be performed in Phase II include extending the algorithms to work in arbitrary cases, designing and implementing algorithms for converting trimmed-NURBS models into gap-free T-Splines, adding fillets to the surface intersection, and incorporating the core software into two existing CAD packages using the idea of a "plugin."

The gap problem has vexed the CAD industry for over 25 years. The solution to the gap problem conceived in previous efforts involves a new technology called T-Splines, which some researchers in the CAD community believe represents a significant advance in the field of surface modeling theory. This project will help the T-Splines technology to mature and will hasten its adoption into the CAD industry.

Title: SBIR Phase II: Video Mining for Customer Behavior in Retail Enterprises

Award Number: 0548734
Program Manager: Errol Arkilic

Start Date: May 26, 2006
Expires: May 31, 2008
Total Amount: $500,000

Investigator: Satish Mummareddy, smummareddy@videomining.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at developing video mining techniques for automatically generating statistics about in-store shopping behavior to help retail enterprises. These statistics can provide valuable insights for supporting critical decisions in store layout design, merchandising, marketing, and customer service. Further, since it is automated, video mining can become a tool for monitoring the impact of all customer-facing elements in a store. The Phase II research will continue in cooperation with the proposing company's partners and customers, while addressing the remaining challenges for video mining. The proposed tasks include robust person detection, tracking people across multiple cameras, modeling and recognizing complex shopping behavior involving shopping groups and sales associates. The approach will be to use a variety of computer vision and statistical learning techniques under the constraints of a typical retail environment.

Retail enterprises today operate in a hyper-competitive environment characterized by blurring categories, eroding market shares and fickle, but more demanding customers. These challenges have prompted retailers to adopt customer-centered strategies focused on uncovering and matching the needs of customers to gain (retain) market share. These strategies rely heavily on obtaining deeper insights into shopper behavior. Current methods (human observation and manual video indexing) for analyzing shopper behavior are limited in their scope while being expensive and time-consuming. On the contrary, the shopper insights gained from the proposed video mining platform will enable more informed decision-making leading to improvements in retail productivity and business process optimization. The proposing company has plans to immediately incorporate the outcome of the SBIR research into its retail product line.

Title: SBIR Phase II: THz Imaging Focal Plane Array

Award Number: 0548853
Program Manager: Errol Arkilic

Start Date: March 6, 2006
Expires: February 29, 2008
Total Amount: $464,344

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to develop a high-resolution focal plane array for terahertz imagery. THz radiation is a largely unexplored region of the spectrum, but holds great promise for its ability to pass through clothing, packaging and baggage walls (security applications) and for its ability to excite resonant molecular motions according to the composition and conformation of complex molecules such as explosives, illegal drugs and pharmaceuticals (imaging spectroscopy). Present uncooled detector technology is marginal in its ability to sense THz radiation and in video frame rate.

The anticipated results of this work are to demonstrate: (1) a 20 to 40 times improvement in noise-limited radiation detection at operation up to 250 Hz frame rate; (2) a new technique for very low cost manufacture of all-wavelength focal plane arrays; and (3) a high-performance THz focal plane array.

Title: SBIR Phase II: IBARS - An Image Barcode Acquisition and Recognition System for Mobile Commerce

Award Number: 0522144
Program Manager: Errol B. Arkilic

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $499,550

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Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops the concept of using hand-held, mobile devices to link the physical world to information networks using advanced pattern and symbol recognition technology that will be deployed on the mobile device. The proposed mobile symbol recognition technology will enable many opportunities for mobile e-commerce by recognizing bar codes, text on documents and user-customizable icons that are used to carry and convey information. To address these opportunities, technical challenges associated with limited processing power and memory resources, lower-quality optics in cameras, varying available network bandwidth, and the diversified development platforms they represent must be overcome. The advances proposed include the ability to unwarp images to account for distortions due to perspective imaging and lenses, removing imaging artifacts such as non-uniform lighting and highlights, deblurring images caused by fixed focus and motion, and improving the image contrast all within the resource constraints of the mobile devices. Recognition algorithms in the system must be able to automatically identify and decode various barcodes symbologies, handle multiple languages and fonts for Optical Character Recognition (OCR), and be trainable for user customizable icons. Special consideration must be given to cross platform development so algorithms can be efficiently and robustly embedded in different development platforms.

The ability to perform image processing and pattern recognition algorithms on diversified handheld devices will provide advances in fields such as computer vision, mobile computing, and software engineering. This concept is powerful in that it requires no new infrastructure, since it uses popular mobile devices, and existing symbols such as barcode tags, text, and user-customizable icons. The downloadable symbol recognition component will enable many applications. Other than service providers and OEMs, merchants, advertisers, information providers and other service providers are likely partners and customers for our technology. Finally, the technology can be used to help disadvantaged groups (handicapped or visually impaired, for example) get access to product information (prescription drug instructions, for example) or transact commerce activity conveniently, using a device they may already have, or that is easily acquired. These include applications in medical care delivery, military applications, sign recognition for the visually challenged, and others

Title: SBIR Phase II: A Foundation for Emergency Egress Simulation

Award Number: 0521897
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,374

Investigator: Daniel Swenson, swenson@thunderheadeng.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new capability to model emergency egress from buildings. The primary focus of the research is evacuation due to fires, but the software will be designed such that exposure and response to biological and chemical agents can also be simulated. The project will couple egress analysis to time-varying fire conditions (e.g. smoke density, heat, and CO) calculated using a Computational Fluid Dynamics fire simulator. This will enable simulation of emergency situations in which, for example, some exit paths become blocked. In addition to incorporating current human response models, the software will allow researchers to specify more complex individual behavior based on the results of recent studies of observed human behavior during emergencies. Thus, the project will not only result in a commercial product of immediate use to the fire safety industry, but will also provide a framework in which to incorporate future knowledge into a problem of fundamental importance to an urban society.

This research will lead to a product that will facilitate broad use of fire emergency egress analysis and will introduce a new technology (coupling egress analysis with CFD fire modeling) into the present fire safety design and regulation process. In 2003 fire claimed 3,925 American lives and caused direct losses of $12.3 billion, with a total economic cost of $165 billion. Any technology that reduces even a fraction of this cost will be significant. The integration of egress analysis with fire simulation provides new capability to more accurately simulate emergency building evacuation. The engineering time required for the analyses will be significantly reduced by a common user interface and geometry database that will enable the broader application of this technology throughout the fire safety industry. Societal impacts include increased public safety, advancement in fire research, and reduced building costs. Coupling egress analysis and fire simulation will lead to new discoveries and recommendations based on post accident analysis. The software will enable researchers to add their own models of human behavior to the analysis.

Title: SBIR Phase II: Grid Computing for Energy Exploration and Development

Award Number: 0522194
Program Manager: Errol B. Arkilic

Start Date: August 15, 2005
Expires: July 31, 2007
Total Amount: $500,000

Investigator: Dimitri Bevc, dimitri@3dgeo.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a grid-enabled environment where large multidimensional seismic data sets can be rapidly accessed, visualized, and interpreted by geographically dispersed users with heterogeneous local resources. The proposed work will transform the Phase I prototype into production-ready commercial quality software, and demonstrate it on 3-D seismic data. The key technical innovations of the Phase II project are (1) a multi-resolution data visualizer, (2) a data-staging tool, and (3) a multi-channel collaboration tool to support collaborative visualization and data analysis on the grid. The proposed technology will allow multiple users to share and interact with multidimensional grid-dispersed data sets, while viewing independent multiple renderings with resolutions and bandwidths commensurate to their local display and network capabilities. The proposed technology will be enabled by implementing several grid services, and a virtual file system, that make grid deployed data sets appear local to the user. This implementation comprises the bulk of the technical tasks, and leverages the middleware. The immediate outcome of the Phase II project will be a version of Internet Seismic Processing production software (INSP) with specialized features for remote visualization, data staging, and collaborative analysis of seismic images on the grid.

The ultimate objective of the Phase II project is a commercial grid-enabled software product providing scientific data, services, computing power, and visualization on demand, not only to the oil and gas industry but to a much wider range of application areas, such as geographic information systems, education, medical imaging, and battlefield management. The product will push the limits of what can be done, and fully contribute to a new business paradigm, made possible by the advent of the grid, allowing businesses to concentrate on their core competencies and rely on other entities for grid-enabled context technologies, without deterring from their primary objectives. The outcome of Phase II will be a commercial implementation and utilization of the grid, and the toolkit, which up until now, has been used mostly in academic and research applications. This technology will first be commercialized in a strategically important economic sector; namely, for the exploration of new energy resources. Specific to U.S. energy needs, this unique application of high end information technology to an area of economic and national importance will ultimately open up new exploration venues in extremely complicated geological conditions, leading to new discoveries, and decreasing US dependence on imported oil.

Title: SBIR Phase II: Variable Azimuth Wave-Equation Imaging (VAWEM)

Award Number: 0450588
Program Manager: Juan E. Figueroa

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $512,000

Investigator: Dimitri Bevc, dimitri@3dgeo.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will implement and demonstrate the feasibility of a new technology that enables enhance seismic resolution and imaging of deep water complex geologic structures by using variable azimuth wave-equation migration (VAWEM). VAWEM will provide much greater resolution and accuracy than what can be accomplished today for towed marine streamer data, and at significantly less computational cost. The software will be optimized for deployment on Linux clusters, and testing will be conducted to determine the optimal geophysical parameters for obtaining the best possible images. The project involves significant computer engineering to obtain the maximum efficiency required to image terabyte size data sets and significant geophysical work to demonstrate the validity of the approach. This advanced imaging methodology will improve success rate and cost effectiveness for new field discoveries and increase recovery efficiency for the development of existing fields. This technology is a fundamental revolutionary advance, and is a necessary building block in any seismic processing system that images 3-D prestack data using wave-equation methods for imaging deep water, under-salt complex geological structures which are the focus of modern oil and gas exploration.

Societal and economic benefits from the proposed VAWEM technology will accrue directly to the nation by lowering energy costs and reducing dependence on foreign energy sources. Energy is at the core of the U.S. and world economies; therefore, the political, societal, and economic benefits of the proposed technology go well beyond the substantial direct economic benefit that this technology will bring to the proposing company and its customers. Commercial potential of the proposed technology is directly applicable to the fastest growing and strategically most important area of U.S. exploration, namely the deepwater subsalt oil and gas province of the Gulf of Mexico federal waters. It is estimated that most of the Gulf's untapped resources (45 Billion barrels of oil and 207 trillion cubic feet of natural gas) are trapped in deepwater subsalt reservoirs, and in ultra deep (over 15,000 ft) gas deposits. Since exploratory wells in these areas typically cost more than $30 million, tapping these reserves will require advanced imaging technology such as VAWEM to reduce risk and make exploration feasible. Reduction USA's dependence on Persian Gulf sources and the strategic benefits of maintaining strong U.S.A. leadership in oil technology transcend purely financial considerations.

Title: SBIR Phase II: New Algorithms for Pan-Tilt-Zoom (PTZ) Camera Based Object Tracking

Award Number: 0450171
Program Manager: Juan E. Figueroa

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $500,000

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new class of moving object tracking algorithms and software prototype for Pan-Tilt-Zoom (PTZ) cameras in video surveillance systems. In most of today's video surveillance systems, human operators using PTZ cameras perform real-time object tracking manually. This is often stressful and inefficient (an operator can only control one PTZ camera at a time) and causes inconsistent results. The proposed project will develop a new class of algorithms to direct PTZ cameras to track multiple moving objects of interest automatically. Using an optimal filter with new object state and observation models does this. The project outcome will be smart software modules that can be integrated into standard video surveillance systems to improve their capabilities.

Video surveillance systems are important tools in the fight against crime and terrorism. Most of the systems on the market today are relatively standard DVR's (digital video recorders) with few smart features. The proposed innovation (automatic object tracking) is a smart feature that can significantly improve a standard system's capabilities by allowing it to get better and more useful images. Since this feature is demanded by many end-users, it is highly attractive to equipment vendors and integrators. Furthermore, by introducing new models for object tracking , the proposed innovation also advances the state-of-the-art in image processing and computer vision research.

Title: SBIR Phase II: A Decision Support System for the Railroad Blocking Problem

Award Number: 0450504
Program Manager: Juan E. Figueroa

Start Date: December 1, 2004
Expires: November 30, 2006
Total Amount: $532,000

Investigator: Ravindra Ahuja, ravi@InnovativeScheduling.com
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Abstract:

This Small Business Innovation Research Program (SBIR) Phase II project entails developing a decision support system for the railroad-blocking problem, one of freight railroad transportation's most significant optimization problems. The mathematical complexity of railroad transportation problems has precluded the development of optimization algorithms for solving them preventing railroads from benefiting from the advances taking place in the field of optimization; they still rely on manual decision-making processes for most of their planning and scheduling needs. During Phase I, the company developed prototype software for the railroad blocking problem and tested it on the data provided by three major US railroads: CSX Transportation, BNSF Railway, and Norfolk Southern Corporation. In this Phase II project the company will develop a prototype for a commercial decision support system for the railroad-blocking problem by combining state-of-the-art operations research techniques with latest information technology tools. This project will enhance core optimization engines and algorithms using cutting-edge ideas in network optimization, heuristic optimization, data structures, and software engineering. Database connectivity will also be provided. This Phase II project will extend algorithms for the railroad-blocking problem to similar problems arising in postal/package delivery service design and developing prototype software.

Currently, railroads takes months of team effort to determine a blocking plan and undertake this exercise once in several years with intermittent periods of minor adjustments to account for seasonal variations in the traffic pattern. The proposed decision support system would allow a railroad to determine a blocking plan in a matter of a few hours and produce solutions far superior than those obtained manually. The proposed solution will enable a large freight railroad to optimize its blocking plans frequently and reduce cost by at least $10 million annually and hundreds of millions of dollars for railroads companies in the USA and Canada over a few years. The research will establish the efficacy of network optimization and heuristic methodology in solving railroad planning and scheduling problems. The success of this product will lead to a greater acceptance of optimization models and optimization-based software in the railroad industry.

Title: SBIR Phase II: Next Generation Binary Decision Diagrams (BDD)-Based Logic Optimization System

Award Number: 0421993
Program Manager: Errol B. Arkilic

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $500,000

Investigator: Qian Ren, gren@logic-mill.com
Company: LogicMill Technology
41 The Hollow
Amherst, MA 01002
Phone: (413)587-2030

Abstract

This Small Business Innovation Research (SBIR) Phase II project targets the synthesis of very large-scale integrated circuits (ICs) and systems on chip (SoC) in very short CPU time. The expected short CPU time comes from relying on binary decision diagram (BDDs) that replaced the traditional algebraic representations used pervasively in present-day tools. This Phase II SBIR project is devoted to developing further the capabilities of swift and integrating it with a number of commercial tools. The development plan includes new capabilities, such as improving area by adding new logic transformations and improving the speed of processing by implementing novel decomposition algorithms.

This project will significantly advance the theory of modern logic optimization and promote its understanding in industry and academia. It would also promote the inclusion of faster logic synthesis tools in existing Electronic Design Automation (EDA) systems. It would benefit the national EDA industry, and help the US to maintain its competitive advantage against its foreign competitors in this strategically important market.

Title: SBIR Phase II: Computerized Tool for Baggage Screening

Award Number: 0422071
Program Manager: Juan E. Figueroa

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $498,882

Investigator: Edward Sommer, ejsommer@nrt-inc.com
Company: National Recovery Technologies, Inc. (NRT)
566 Mainstream Drive
Nashville, TN 37228
Phone: (615)734-6400

Abstract:

This Small Business Innovation Research Program (SBIR) Phase II research project will develop a technology for improving security checkpoint effectiveness and increasing throughput while reducing labor costs for airports and other sensitive installations by integrating information technology systems incorporating new x-ray image inspection technology, new electronics communications technology, materials handling automation, and database-centric computerization. Current processing rates through a typical security checkpoint are relatively slow and laborious and costs are high. Today's checkpoints take little advantage of computerization thereby limiting their effectiveness. It is planned that the prototype system will be integrated into a TSA approved test site and tested and evaluated by an independent third party Modernization of checkpoint security will improve protection of many other segments of society. In today's world it is vital that our nation's citizenry, transportation systems, institutions, sensitive installations, and economy have the best protection possible. Security has become much more restrictive and time consuming.

If successful this project will develop a product that will be able to increase the security at check bags handling facilities while reducing the time to conduct the checks. The streamlining and improving of security at federal buildings, government installations, maritime ports, shippers, mailrooms, and other sensitive locations can increase confidence in our day-to-day lives and help improve the nation's economic security.

Title: SBIR Phase II: Technology for Integrated Computation and Communication

Award Number: 0349414
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Chitoor Srinivasan, srinivas@cs.rutgers.edu
Company: EDSS., Inc.
Port Saint Lucie, FL 34952
Phone: (772)335-3677

Abstract:

This Small Business Innovation Research Program (SBIR) Phase II research project proposes to develop a prototype product for an innovative parallel program development and execution technology, which can run parallel programs asynchronously in multiprocessors and supercomputers up to 100 times faster than what is currently possible, without using Message Passing Interfaces (MPI). For more than thirty years it had been assumed that the only way to efficiently compile and execute parallel programs was through MPI. Even though it had been recognized that parallel programs would run faster if executed asynchronously on the basis of data availability, technology needed to do that efficiently was not available, until Technology for Integrated Computation and Communication (TICC) came along. This tuning technology eliminates the need for dynamic checking of temporal coordination, and makes it possible to execute control signal exchange protocols in parallel with computations. More than 40 million messages may be exchanged per second. This eliminates communication bottleneck and allows asynchronous execution of parallel programs based on data availability without using MPI. TICC defines the semantics of causal statements and provides a very efficient implementation for them. TICC brings the following additional facilities: (1) Component based parallel program development environment, (2) Dynamic debugging of parallel programs (3) Dynamic monitoring and changing of messages and message traffic, (4) Dynamic repair and failure recovery, (5) Dynamic reconfiguration, and (5) Dynamic evolution parallel software systems. These have the consequent benefit of reducing parallel program development and maintenance costs, making them more easily and widely available.

This, together with decreasing costs of multiprocessors, has the potential to usher in a new era of desktop supercomputing by 2007, with profound impact on science, technology, industry, education, theories of computation and communication, and society in general.

Title: SBIR Phase II: Artificial Intelligence Software for Student Assessment in Chemistry Education

Award Number: 0349630
Program Manager: Sara B. Nerlove

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Benny Johnson, johnson@quantumsimulations.com
Company: Quantum Simulations Incorporated
5275 Sardis Road
Murrysville, PA 15668
Phone: (724)733-8603

Abstract:

This Small Business Innovation Research (SBIR) Phase II project builds Phase I work on development of meaningful interactive tutoring and assessment capabilities for chemistry education software. Despite clearly articulated teacher and student demand for improvement, this area has been repeatedly identified as that where existing offerings are weakest. Quantum Simulations proposes a new and different approach, adapting and incorporating new concepts from artificial intelligence (AI). More than just assigning a grade, meaningful opportunities will be created for students to learn directly from the assessment itself. The proposed technology will benefit all students; however, it is specifically targeted to help those who have the greatest need--such as students of average or marginal performance and students from historically underserved groups-- by lowering barriers to accessing high-quality science instructional software. Quantum Simulations has partnered with members of the Department of Education's STAR Schools program to further these goals.

Quantum Simulations' customers include textbook publishers, software providers, hardware vendors and distance learning companies. A prominent textbook publisher, Holt, Rinehart and Winston, has entered into a long-term contract and has partnered with Quantum Simulations to commercialize this Phase II technology, resulting in rapid dissemination to an established end user base.

Title: SBIR Phase II: Adaptive Personalization and Context Management for Location-Based Mobile Devices (AdaptTribe)

Award Number: 0349778
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $467,609

Investigator: Daniel Greening, greening@bigtribe.com
Company: BigTribe Corporation
330 Townsend St Ste 209
San Francisco, CA 94107
Phone: (415)995-7150

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops personalized user-interfaces for location-based services. This adaptive proximity-based personalization algorithm recommends nearby venues based on predicted user interest and distance. It will further develop a highly distributed algorithm that allows handsets to perform part of the calculation, dramatically reducing computation costs that central servers would otherwise bear. This context-based user-interface allows users to chain operations, concentrating activities by proximity, and avoiding retyping. This project will expand the user- interface advancements to include personalizing categories, and a user-interface approach that mixes categories with individual venues. In addition it will explore algorithms that mix different types of venues on the same screen. Identity federation will help retailers and portals more readily deal with intermediary services. Self-service retail interfaces can allow traditional "brick-and-mortar" retailers to cost-effectively provide "click-and-mortar" services to consumers. A SOAP-based web-service will allow portals to filter data and configure look-and-feel more precisely. However, the proposedtag mechanism will likely be good enough for most portals, as the output format can be configured easily through CSS, and filtering can be performed through the company's self-service portal interface

The end result of this project is a product that can be incorporated in enterprise logistics applications that help field personnel find, reserve, use and store resources while being able to improve the speed that consumers navigate user-interfaces, even when location is irrelevant. The in-handset personalization may ensure better privacy and security, even in non-location based applications. The product will use proximity to maximize value: building business-consumer relationships, enhancing social harmony and strengthening communities, as a result.

Database Management

Title: SBIR Phase II: SaaS-Based Procurement and CRM Systems for Local Food Markets

Award Number: 0822889
Program Manager: Errol B. Arkilic

Start Date: August 15, 2008
Expires: July 31, 2010
Total Amount: $500,000

Investigator: Heather Hilleren, heather@greenleafmarket.com
Company: Hevva LLC
PO Box 5155
Madison, WI 53705
Phone: (608) 395-4990

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new methodology for data interchange in the agricultural industry. GreenLeaf Market is developing application program interfaces to enable the automated transfer of data to enterprise resource planning systems through a representational state transfer interface interchangeable with a webservice. This platform automatically identifies and aggregates agricultural market information while enabling this information to be integrated into the purchaser's business systems. If successfully commercialized, the application stands to significantly reduce post-harvest spoilage costs, now in the tens of billions of dollars for the United States. It will increase productivity for purchasers, assist the producer in identifying emerging markets, reduce the distance agricultural products must travel, boost the local economy, improve the food security of the US, and lower the overall cost of food by reducing the gap between supply and demand.

Title: STTR Phase II: Integrating Online Analytical Processing (OLAP) and Ontologies to Discover Inconsistencies in Expectations for Supply and Demand

Award Number: 0750543
Program Manager: Errol B. Arkilic

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $512,000

Investigator: Peter Moore, peter@clados.com
Company: Clados Management LLC
133 Saint Matthews Avenue
San Mateo, CA 94401
Phone: (650) 231-0494

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project aims to produce a software application that dramatically improves a manager's ability to allocate resources to productive uses. With advances in Online Analytical Processing (OLAP) and ontology technology, the tool has the potential to enable the discovery of future supply and demand imbalances for teams of business analysts. The objective is to produce at least one Investable Inconsistency per day by the end of the research period. The Phase I project produced unanticipated innovations that may have broad utility in both the OLAP field and the ontology field, and with these innovations, the software platform shows promise for transforming the essential practice of analysis in the field of market research in support of investment decisions. The Phase II project, if successful will result in technology that extends this promise to a broad audience, educating users in best practices for investment analysis and enabling them to materially improve their allocation of resources.

Title: STTR Phase II: Disciple Technologies for Development, Utilization, and Maintenance of Regulatory Knowledge Bases

Award Number: 0750461
Program Manager: Ian M. Bennett

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $500,000

Investigator: Tomasz Dybala, tom.dybala@exprentis.com
Company: Exprentis, Inc.
4031 University Drive, Suite 200
Fairfax, VA 22030
Phone: (703) 272-7702

Abstract:

This Small Business Innovation Research (STTR) Phase II project as a continuation of the Phase I effort, will develop alpha versions of the Regulatory Knowledge Base (RKB) products. The Regulatory Knowledge Bases will be tailored to classes of compliance problems within the financial services space, such as broker or trading compliance, or anti-money laundering. Addtiionally, they will include a complex regulatory ontology specific to the financial services industry and rule bases that reflect the latest regulations and best practices that govern analysis of alerts and compliance cases. The Regulatory Knowledge Base products will be sold in various formats and standards so they can be directly deployed on various commercial off-the-shelf reasoning engines. Regulatory demands, as well as the increasing costs associated with financial crime, are placing increasing cost pressures on financial institutions. The burden of compliance is driving up operational costs. Financial services firms are seeking to improve the effectiveness, efficiency and return on investment of their compliance and risk management systems. The current knowledge management technologies and software tools cannot offer efficient customized procedures to deal with specific compliance cases. Therefore, there is a need for flexible knowledge-based systems, like Disciple-FS, and for Regulatory Knowledge Base products, that can offer help in solving specific cases while ensuring compliance with all the rules and regulations. These systems should also be capable of acquiring reasoning skills of their users to adapt their capabilities to deal with new cases. The prototype built during Phase I proved that the Disciple Technologies have the required functions and abilities to support development, utilization, and maintenance of regulatory knowledge bases. The prototype also helped to identify research and development goals for Phase II that we present in this proposal.

Title: SBIR Phase II: Universal Nanoparticle Taggants

Award Number: 0548756
Program Manager: Errol Arkilic

Start Date: February 16, 2006
Expires: February 29, 2008
Total Amount: $511,495

Investigator: Robert Haushalter, bob@parallel-synthesis.com
Company: PSTI
3054 Lawerence Expy
Santa Clara, CA 95051
Phone: (408)749-8308

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide a system that is capable of easily labeling documents, with millions of unique optical signatures that provide a means of distinguishing these documents from other similar objects. Since there are no suitable commercial alternatives, both a scanning spectrometer and hyperspectral imaging system will be constructed and evaluated. The compatibility of developed materials with current screening technology, and the large number of distinct resolvable optical codes available, provides a level of authentication that will be difficult to replicate or decrypt.

Since there is a strong and continuing need to authenticate and verify documents, objects or people, the benefits of this technology will be broad-based and will influence authentication, sorting and identification of many items such as documents, pharmaceuticals or biological samples. The commercially available multiplexing level (number of distinguishable optical signatures) for optical encoding technology is currently limited to 100, so there is immediate need for a technology to provide a means of optically distinguishing very large numbers of similar objects.

Title: SBIR Phase II: The Visual Database: Portable, Extensive Markup Language (XML)-Based Middleware For Media Representation, Interaction and Exchange

Award Number: 0450513
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $470,500

Investigator: William Schroeder, will.schroeder@kitware.com
Company: Kitware Inc
28 Corporate Dr # 204
Clifton Park NY, 12065
Phone: (518)371-3971

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will create a portable representational and interaction metaphor for digital media embedded in a 3D context. Popular document technologies remain text oriented-that is, content is organized into pages and viewed in reading order. The company is creating a novel information exchange paradigm that is generally applicable to information that is best understood in an interactive 3D environment. Applications of this technology include embedded routes on maps, electronic medical records, biological atlases, digital tours of 3D environments such as buildings, and mechanical assembly/disassembly diagrams. Analogous to a PDF file, but designed for a 3D interaction environment, the proposed solution defines an open, portable schema that can be efficiently represented using the portable Extensible Markup Language XML. In Phase II the company will specialize the editor for geospatial application, atlas creation, and assembly planning; addressing such technical challenges as large data and user interaction.

If successful the technology will enhance the ability of researchers, teachers, businesses, and consumers to record, describe and exchange complex 3D content. This innovation has the potential to improve the productivity of individuals and firms that create and communicate with such information; and to enhance the effectiveness of researchers and teachers to convey abstract concepts to others. This project defines a novel metaphor for working with information that goes beyond traditional organizational metaphors such as books and web pages. The proposed product supports complex 3D information; and takes advantage of recent developments in 3D graphics and visualization technology. The representational schema is simple enough to be supported by small portable devices such as PDA's, and sophisticated enough to support complex human/computer interaction in a 3D visualization environment.

Title: STTR Phase II: Location-Based PDA Bird Field Guide

Award Number: 0422158
Program Manager: Juan E. Figueroa

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,386

Investigator: Giles Timms, giles@pulluin.com
Company: South Dakota Health Technology Innovations, Inc.
109 Austin St.
Vermillion, SD 57069
Phone: (605)624-9792

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop and test an electronic field guide for North America that will facilitate bird identification in the field combining images, audio, geographic information, and descriptive data. The system will include 1000 birds of North America, uniquely presented audio content, expanded GIS features, support for Windows CE devices, and the wireless transfer of data. The highlights of this software are the mobility offered by the PDA, database searches to aid species identification, access to multimedia and GIS data in the field. The proposed software will provide significant benefits to the education and research communities by allowing multiple PDA users to upload their observations to CLOs (Cornell Lab of Ornithology) eBird server (www.ebird.org) via desktop software or wireless Internet connection.

The availability of PDA-based software for use by students will facilitate student learning and enable students to play a key role in data collection for national and international research projects. The availability of this software to birders and amateur naturalist will promote citizen participation in science and conservation. The data collection and GPS features of the system will help researchers to accurately record scientifically useful data. The portable data collection and data transfer features will facilitate the gathering of data and timely reporting of that data to researchers.

Title: SBIR Phase II: HIVbase, Data Integration Software to Support the Study of Chronic Viruses

Award Number: 0349669
Program Manager: Errol B. Arkilic

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $499,812

Investigator: Susanna Lamers, susanna@genejohnson.net
Company: Gene Johnson, Inc.
4 Milton St.
St. Augustine, FL 32084
Phone: (985)493-3487

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide HIV researchers with progressive approaches to manage and analyze genetic data. There is a crisis developing in biology, in that completely unstructured information does not enhance understanding. Today's HIV investigators possess massive amounts of research information in user-hostile formats, error- filled spreadsheets, outdated databases, and directories containing thousands of individual files. These researchers need advanced protocols for extracting value from their disorganized information. Phase I feasibility study proved that the proposed solution provides a quality link between collection and the analysis of data that has never before been available to HIV researchers. This link helps HIV researchers do their job and ultimately promotes understanding for the most deadly and costly epidemic of our time. This project aims to solving researchers problems through the development of software that combines the power of unique data storage and integration with novel applications for data mining, analysis, and data retrieval. The goal is to provide researchers with a combination of modern querying, database, and analysis approaches.

The initial target market for the proposed product is made of HIV researchers and their associated facilities. This market is large, growing in multiple directions, and in need of this product. HIV infects an estimated 40 million people and is being funded at record levels from both government and private organizations. The major significance of the proposed product is in its ability to assist accelerate the efforts of the many scientists, epidemiologists and pharmacologists to make important discoveries relating to this on-going and tragic epidemic.

Title: SBIR Phase II: Web-Based International Trade Knowledge Discovery System (TradingCube)

Award Number: 0349464
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,895

Investigator: Carlos Sanchez, csanchez@tradingcube.com
Company: TradingCube Inc.
819 Florida Avenue
Pittsburgh, PA 15228
Phone: (412)624-2690

Abstract:

This Small Business Innovation Research Program (SBIR) Phase II project will focus on applied research for the development and implementation of a commercial Web-Based International Trade Knowledge Discovery System. It will address the significant need for organizations supporting international trade and for small and medium-sized business to have improved access to information and dynamic analyses of world markets in a single source. This product will provide subscribers with dynamic analyses of world markets for baskets of goods allowing them to extract actionable information to make strategic and tactical decisions while enabling the functionality of a novel combination of tools including knowledge discovery, data management technologies, web technologies, international trade economics and strategic analysis. This project will focus on: (1) Implementing a prototype based on the results of the Phase I feasibility study within a web portal framework, (2) Developing a library of international trade analyses, interactive maps and graphics, (3) Developing a meta-business directory and implement an international trade search engine, and (4) Developing personalization features and snapshot reports.

The proposed product will contribute to applications of knowledge discovery in the international trade domain, data warehousing, information hierarchies, and clustering-indexing techniques to support analytical queries. In addition it advances research in the application of Scalable Vector Graphics (SVG). SVG is a language for describing two-dimensional dynamic and interactive graphics in XML. The product addresses one of the fundamental areas on which trade promotion can have a significant impact --access to actionable information that will help businesses maximize export potential. In the process it will contribute to economic growth, education and participation of small businesses and underrepresented groups in international trade. The development process and product will involve researchers and students from several disciplines. The potential market includes any commercial, private or public organization with the need to find and evaluate international trade opportunities.

Title: SBIR Phase II: Discovery Analyst: A Data Mining System for Image Databases

Award Number: 0349736
Program Manager: Juan E. Figueroa

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Stuart Blundell, sblundell@vls-inc.com
Company: Visual Learning Systems, Inc.
1280 S. 3rd Street West
Missoula, MT 59801
Phone: (406)829-1384

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a highly innovative data mining software tool that is capable of mining imagery and spatial information stored in a database management system (DBMS). Billions of dollars have been spent in converting the world's vast supply of paper maps into digital, geographically referenced, data for geographic information systems (GIS) applications because location matters in almost every instance of decision-making for both government agencies and private sector businesses. The proliferation of relational, spatial, and now visual data from high-resolution satellites, all stored in a common DBMS architecture, offers organizations the opportunity for knowledge discovery in databases; however, the technical challenges of maintaining, navigating, and mining these data are formidable. Current workflow approaches are disjointed and exclusive of image data. The product resulting from this project will allow all of the data to be queried and mined in a holistic workflow approach yielding potential useful discoveries through its primary innovations not presently available in data mining software; 1) Seamless integration of data mining and feature extraction workflows, 2) Mining content of high-resolution earth imagery stored in spatial databases, 3) Cleanup of GIS databases, and 4) Advanced query generation and data mining technology. Market research confirms that companies are investing in data mining software and high- resolution commercial satellite imagery.

The proposed product will have commercial applications in both traditional GIS application areas (forestry, defense, civil government, agriculture) and emerging vertical markets for GIS applications (banking and financial, telecommunications, security, manufacturing, retail and healthcare. There is a powerful demand for the knowledge acquisition vital to all location-based government decision-making processes. This significantly impacts the quality of management in our national security, resource handling, and the quality of our environment.

Title: SBIR Phase II: Automatic Information Awareness

Award Number: 0349724
Program Manager: Sara B. Nerlove

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $499,560

Investigator: Yves Schabes, schabes@teragram.com
Company: Teragram Corporation
236 Huntington Ave
Boston, MA 02115
Phone: (617)369-0100

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to study and implement a large-scale information awareness system which will fuse, present and provide an alert as to the existence of newly available information from large bodies of documents based on each user's profile. The amount of information available electronically has been growing at such a rate that it is not only impossible for people to identify the nature of the information content as it is made available, but it is even more out of the question for people to absorb the actual information content. Thus, awareness of and synthesis of the content of information has now become the real challenge. This project will enable users to specify their interests and to detect new information trends matching each individual user's interests, based on the relevance and importance of newly available information. By extracting information from unstructured texts, categorizing it, and fusing it, each user will be presented with a unique view of the content.

Teragram profiler technology allows users to specify information needs for the future. It will provide an alert mechanism based on user specified interests contained in user profiles, measurement and formulation of information speed, volume, decay; and fusion of information found in multiple documents. Such techniques will enable the next generations of information retrieval systems in which information will be tailored to the users' interests thus enabling easy access to relevant information found in large repositories.

Data Storage

Title: STTR Phase II: Next Generation Digital Data Recovery System

Award Number: 0822980
Program Manager: Ian M. Bennett

Start Date: September 1, 2008
Expires: August 31, 2010
Total Amount: $489,525

Investigator: Anandabrata Pal, PashaPal@aol.com
Company: Digital Assembly LLC
Best
Brooklyn, NY 11201
Phone: (917) 482-0211

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II research project proposes to research and bring to market the next generation digital data recovery techniques. The problem of restoring lost data from a damaged digital device arises routinely in digital forensics and data recovery. In many advanced cases of digital storage failure currently available file recovery techniques based on disk storage information fail. During the Phase I of this project a software framework was developed for file carving. Using this framework a software library and a user interface to carve fragmented files from a disk image, called Adroit was implemented. Adroit currently supports carving of JPEG fles, structured documents (such as HTML, source code, plain-text fles, etc.), and Microsoft office documents. In tests conducted, Adroit recovers more files than tools currently available in the market. Furthermore, the validation and user interface component built into Adroit excels at allowing the user to guide the technology to recover more data with much less effort. The problem of recovery of information from bits and pieces of digital data, in the absence of storage meta-information to tie the pieces together, is equivalent to the problem of having hundreds/thousands of jigsaw puzzles mixed into together. The challenge of identifying if a piece of data belongs to a specific file or file type is daunting. The preliminary research conducted in Phase I has demonstrated the viability of developing domain specific techniques to identify the type of data fragments and the use of file type specific algorithms to reconstruct files. The broad impact of this technology and its commercialization are: 1) it will change the nature of the data recovery market and make possible unprecedented recovery of data in a variety of situations; 2) it will save countless users the agony of losing valuable data. Be it important data that is needed for a company's survival or an emotionally valuable photograph of a proud parent or child; 3) it will provide law enforcement officials with an increased ability to gather evidence and prosecute their cases more effectively; 4) it will provide counter-terrorism experts the ability to glean crucial evidence that they may have otherwise missed.

Title: SBIR Phase II: Scalable Location Data Management

Award Number: 0822777
Program Manager: Errol B. Arkilic

Start Date: August 1, 2008
Expires: July 31, 2010
Total Amount: $500,000

Investigator: Karthikeyan Ramasamy, karthik@cs.wisc.edu
Company: Locomatix, LLC
48 Washington St., #8
Santa Clara, CA 95050
Phone: (408) 249-8845

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to design, implement, and test scalable methods for providing location-based services, with a special emphasis on mobile cell phone applications. Examples of such applications include continuous monitoring of static and dynamic geo-fences, building dynamic mobile social networks, and mobile e-commerce. The Phase II effort will develop methods to push the efficiency of the location-based computation techniques, and develop methods for more sophisticated features such as privacy management and mobile power management, which will be crucial for the wider adoption of location-based applications. Location data is currently generated by continually moving physical objects equipped with location-based sensors, such as GPS and Wi-Fi based tags. Data management methods for these datasets require dealing with high update rates, large volumes of historical location data, and location-based triggers that raise an alert when the location of a moving object meets certain criteria (for example, if an object is beyond a well-defined boundary). Existing methods for supporting applications that have these requirements are not scalable. The broader merits of this project include the development of a technology that has a potentially large commercial value and addresses an emerging market need. For example, for the cell phone market, these location-based services are projected to grow from $464M in 2007 to over $11B by 2011. If successful, the potential impact in both consumer and enterprise markets for location-based services could be substantial.

Title: STTR Phase II: Splintered Topologically Close-Packed (TCP) Offload Engine for Grid Computing and Bandwith-Delay Product (BWDP)

Award Number: 0822744
Program Manager: Ian M. Bennett

Start Date: August 1, 2008
Expires: July 31, 2010
Total Amount: $488,128

Investigator: James Awrach, jma@seafire.com
Company: SeaFire Micros, Inc.
39 Dodge St #319
Beverly, MA 1915
Phone: (978) 317-1831

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II research project addresses the challenges of networks with extreme bandwidth delay products. Bulk data transfer over such networks used by national research laboratories and aerospace companies need to be provided with the endpoint resources required to ensure high performance in a cost effective manner. The outcomes of this project attempts to provide compatibility with present and future versions of GridFTP. The project addresses these challenges through the use of a novel offload engine. During the Phase I project, the feasibility of deriving and simulating the offload engine architecture, firmware, and creation of intellectual property (IP) for low-cost, high-performance field programmable gate array (FPGA) subsystems was completed. Successful results from this research will significantly advance the state of the art for off-load engines used in grid computing. Immediate applications include accommodating the e-Science community's need for scalable 10-100 Gbps off-load engines, while supporting present and future versions of GridFTP. Other applications include the use of our ultra high-speed offload engines for grid and cluster computing, utilizing our open source firmware. The FPGA code resulting from this project has the potential to be used as intellectual property that could then be marketed to off-load engine manufacturers. These IP cores would accrue cost-effective savings for existing engine firms and would accelerate products to the market.

Title: SBIR Phase II: Zero-Remanence Tamper-Responsive Cryptokey Memory

Award Number: 0724306
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,809

Investigator: James Deak, jdeak@nve.com
Company: NVE Corporation
11409 Valley View Rd
Eden Prairie, MN 55344
Phone: (952)996-1636

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project is to develop a more secure encryption key for non-volatile memory. Secure ICs often utilize encryption to protect non-volatile memory contents. A clever engineer can recover the key after decapsulating and probing the semiconductor die. NVE intends to produce an innovative non-volatile spintronic cryptographic key memory that will self-erase without data remanence in the event of tampering and without applied power. The main research objectives of this work involve development of a fully integrated 256-bit embedded tamper resistant magnetic random access memory.

The technology proposed in this Phase II SBIR program is intended to provide a defense against theft of intellectual property and to protect sensitive data stored in an integrated circuit. Identity theft has become a very large issue for society in general and particularly in the more computerized societies. This is more than a problem of economics, as US military systems have also been reversed engineered by both friendly and unfriendly nations to gain access to US weapons capability. The technology proposed under the Phase II program addresses the need to provide a tighter level of security for data stored on integrated circuit (IC) and IC assemblies. Commercially, this provides an extra layer of protection on IC-based assemblies such as smart cards, cash machines etc. In addition, the proposed program would render a system inoperable in the event of physical tamper. This may be a very useful tool in stemming the tide of fraudulent usage, compromises, and reverse engineering of IC-based instruments as well as certain types of identify theft.

Title: SBIR Phase II: Novel Coded High Density Optical Disk Data Storage

Award Number: 0450531
Program Manager: Juan E. Figueroa

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $485,058

Investigator: Jianwen Yang, jjyang@nsotech.com
Company: New Span Optotechnology Inc
9380 SW 72nd St Ste B180
Miami FL, 33173
Phone: (305)275-6998

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to develop a high-density optical disk storage prototype based on a new coding concept that will result in the prototype development of a compact packaged high-density optical disk storage system that is back compatible with current optical disk. Using such coding concept can significantly increase the disk data storage density and data access rate based on a modification of existing optical disk recording/readout hardware architecture. The new high density disk drive allows back compatibility with the current DVD disk and has advantage of easier market acceptance for product roll out than other developing storage technologies such as holographic and near field storages. The near term objective is to achieve 50 GB/disk capacity and more than 100 GB/disk is the next foreseeable product goal.

If successful, the outcome of this project will enhance the availability of high-density low cost storage for many social applications, increasing US based data storage technologies, and increasing US jobs. It will have extensive commercial and military applications such as computer data storage, on-line storage, library archival applications, image storage, and processing for medical applications, and military target identification and fast access to large intelligent databases. Educational impacts include advancing library archive storage for educational uses and benefiting university research in astronomy, meteorology and others that require huge data storage

Engineering Analysis & Modeling

Title: STTR Phase II: Condensing Ejector for Second-Step Compression in Reversed Rankine Cycle

Award Number: 0822525
Program Manager: Cheryl F. Albus

Start Date: July 1, 2008
Expires: June 30, 2010
Total Amount: $499,873

Investigator: Mark Bergander, mjb1000@aol.com
Company: Magnetic Development, Inc.
68 Winterhill Rd.
Madison, CT 6443
Phone: (203) 421-3562

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project seeks to continue the research and analysis of condensing ejectors for second stage compression in a refrigeration cycle. A condensing ejector is a two-phase jet device that produces outlet pressure higher than either of inlet pressures. The project combines theoretical and experimental models in order to design the condensing ejector for use in more efficient refrigeration systems. The results thus far show that the new design is capable of improving the efficiency of vapor compression refrigeration cycle by approximately one-third with R22 refrigerant. The goal is to draw closer to this ideal value with environmentally friendly refrigerants like R410A. The application of critical two-phase flow devices will lead to development of more efficient thermodynamic cycles for refrigeration and A/C and in the future possibly for propulsion and power generation. The broader impact/commercial potential from this project will bring considerable economic and societal benefits by reducing our nation's dependence on foreign oil, improving safety of nuclear reactors and natural gas pipelines, and better understanding of phenomena of two-phase flow. Applications of the condensing ejector theory in heat pumps might promote use of renewable geothermal energy sources in the remote communities with limited energy choices. This project leads to enabling technologies by providing the technology platform for a new approach to evaluating two-phase flows. The capability to handle rapid phase change simulations has generated interest from the automotive industry to simulate flash boiling in automotive fuel injection. This project also provides the basis for establishing fundamentally new engineering and designing methods for equipment operating on two-phase flow.

Title: SBIR Phase II: Virtual Prototyping Tool for Complex Flows of Polymers and Suspensions

Award Number: 0750465
Program Manager: Cheryl F. Albus

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $497,699

Investigator: Ilya Staroselsky, ilya@exa.com
Company: Exa Corporation
3 Burlington Woods Drive
Burlington, MA 1803
Phone: (781) 676-8587

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an engineering design level simulation tool for non-Newtonian fluid systems used in advanced materials engineering/process design. The project will implement innovative physics modeling of rheological properties and will leverage the full computational strength of the company's PowerFLOW simulator, including automatic grid generation for arbitrarily complex geometry and perfect parallel scalability on cluster computers using hundreds of million computational cells. This project will convert the hydrokinetic software resulting from Phase I project into a stable and robust technology platform that can be fully commercialized. The broader impact/commercial potential from the technology will be virtual design tools to overcome physical and/or engineering limits in flow simulations of chemicals, food products, pharmaceuticals, and nutritional processing, disk drive manufacturing, environmentally benign processes, semiconductor equipment, anti-icing aircraft sprays, etc. The tool for non-Newtonian flow prediction will open new commercial markets for the PowerFLOW technology. Key advantages include grid generation and set up times, thus enabling shortened product/process development cycles, optimization to improve yield and energy efficiency, and environmental improvements.

Title: SBIR Phase II: Engine Combustion Simulator

Award Number: 0750406
Program Manager: Cheryl F. Albus

Start Date: January 1, 2008
Expires: December 31, 2009
Total Amount: $488,721

Investigator: Glen Ko, ghk@resgroupinc.com
Company: RES Group, Inc.
11 Cambridge Center
Cambridge, MA 2142
Phone: (617) 834-2416

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop the Engine Combustion Simulator (ECS), an innovative software product that will enable researchers to develop and apply accurate chemical reactions for the design, control and optimization of the automotive engine and exhaust gas after-treatment devices. The ECS will reduce the costly and time-consuming experimental testing, as well as enable the researcher to probe concepts that are difficult or infeasible to test experimentally. These developments will accelerate the development of more fuel efficient and environmentally cleaner automobiles. At the core of the ECS is a suite of advanced database technologies and computational algorithms that enable the user to easily build accurate reaction mechanisms, and quickly perform simulation studies using these mechanisms. The broader impact/commercial potential from this technology will result in cleaner and more fuel-efficient vehicles. Even a small gain in fuel efficiency can translate to billions of savings in fuels as well as reduced dependence on foreign oil. Less fuel consumption directly scales to reduction in emissions thus lowering of greenhouse gases while improving the human health. The ECS will be made available at no-charge for use in education and research in academia and some of the key components will be made available as an open-source to the research community to foster collaboration between researchers.

Title: SBIR Phase II: Strategic Model for Manufacturing Organizations (DSMMO)

Award Number: 0646275
Program Manager: Ian Bennett

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000

Investigator: Lia DiBello, lia@wtri.com
Company: WTRI
1425 Russ Blvd.
San Diego, CA 92101
Phone: (619)232-8054

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project proposes a dynamic modeling technology that helps decision makers visualize and calculate the top and bottom line financial impact of changes made at the strategic, tactical, and operational levels of a business. The proposed research will make intellectual contributions regarding how technologies extend complex cognitive capabilities in high-performance business settings. The resulting tool promises to address two well-known problems faced by business executives: decision-making rigidity and the inability to think simultaneously on strategic and tactical levels.

The broader impacts of the proposed technology have already been indicated by the increased use and measurable success of these models in client engagements. However, the models in their current form, are not widely or easily accessed although demand for them is high. This tool will have important pedagogic value to university programs because it will enable students to think through the multi-level issues in organizations. The models themselves may also add to the understanding of how the different levels and functions in an organization interact.

Title: STTR Phase II: Parallel Lattice Kinetic Software for High Mach Number Fluid Dynamics

Award Number: 0620490
Program Manager: Ian Bennett

Start Date: August 25, 2006
Expires: August 31, 2008
Total Amount: $500,000

Investigator: Hudong Chen, hudong@exa.com
Company: Exa Corp.
3 Burlington Woods Drive
Burlington, MA 01803
Phone: (781)676-8587

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will produce a novel parallel dynamic rule-based software tool for simulating high Mach number flows of interest for the ground transportation, aerospace and power generation markets. This work couples a multi-disciplinary interplay between algorithm design, modern cluster/grid computer architecture, parallel processing, and software engineering, and employs Lattice-Boltzmann Methods (LBM) with automatically generated grids with up to 100 million computational cells.

This new technology will enable virtual design within the ground transportation industry. Secondly, the ability of the parallel lattice kinetic software to address high Mach/Knudsen number problems should open important markets in aerospace, power generation, automotive, and other industries. Additionally, this new technology should establish markets for computer aided engineering (CAE), by numerical simulation of vehicles and powertrain components whose complexity have forced design/optimization using either physical experimentation or semi-empirical rules. The research will help to demonstrate the linkage between fundamental research and industrial applications, and emphasize the importance of non-equilibrium statistical physics methods as a core component in the commercial simulators.

Title: STTR Phase II: Modular Feedforward Adaptive Noise Control

Award Number: 0620496
Program Manager: Errol Arkilic

Start Date: August 23, 2006
Expires: August 31, 2008
Total Amount: $499,827

Investigator: Robert Collier, robert.d.collier@dartmouth.edu
Company: Sound Innovations
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White River Junction, VT 05001
Phone: (802)280-3020

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project seeks to develop an inexpensive, multi-purpose active noise reduction (ANR) module and associated software evaluation tools with broad commercial application to many occupational environments. This project will develop signal processing algorithms that improve the computational efficiency for ANR. The current Phase II objectives include: (1) developing a multi-purpose ANR module and associated ANR software modules capable of single- and multi-channel ANR for two markets: "quiet zone" ANR in commercial vehicle cabins and active noise abatement products for the noise consulting industry; (2) developing a corresponding suite of software tools to be used by noise consultants for turnkey retrofits of noisy environments with active noise abatement products, and (3) conducting full-scale in-situ evaluation of the ANR module, software, and tool suite in demonstration projects with the support of commercialization partners. The expected technical outcomes of Phase II include: (1) a manufacture-ready ANR hardware module with associated modular ANR software, (2) a suite of ANR evaluation tools for the noise consulting industry, validated through in-situ testing and (3) experimental results of the modular ANR concept from several full-scale demonstration projects.

The strong pull for new noise control technologies is the result of increasingly strict government and community regulations, industry standards, the growing body of scientific evidence of on noise-induced hearing loss (NIHL), and the multimillion dollar cost of occupational hearing disability compensation. The current business model is based on partnerships in which the proprietary 'Plug-and-Play' ANR module represents a branded embedded component for products manufactured and marketed by other industrial organizations and for installations by acoustical consultants.

Title: SBIR Phase II: Development of ModelGlove - A Virtual Clay Modeling System Using Force/Position Sensor

Award Number: 0620509
Program Manager: Errol Arkilic

Start Date: August 23, 2006
Expires: August 31, 2008
Total Amount: $500,000

Investigator: Kevin Chugh, chugh@tactustech.com
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4250 Ridge LEA Suite 39
Amherst, NY 14226
Phone: (716)898-5923

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a Virtual Clay system comprised of a patent-pending sensor-enabled glove (called the ModelGlove), and a physics-based simulation engine which presents the user with a virtual 3D representation of modeling clay. The glove enables a designer to mold and shape the virtual clay with his or her fingers and hand, just as he or she would with physical clay. Clay modeling was pioneered by General Motors in 1914, and remains a popular technique. Since the early 80's, the computer aided design (CAD) market has grown dramatically, and 3D CAD has become the most technically-advanced tool for designing complex shapes. However, very little work has been done to merge the physical clay and CAD environments. Virtual Clay aims to fuse these environments, blurring the line between art and engineering and giving designers a unified modeling tool at all stages of development.

By advancing the state of the art in design and opening new worlds of design to mechanical engineers designing and modeling products, broad impacts are anticipated. The Virtual Clay system represents a significant advancement in wearable computing, where the user directly manipulates a virtual object with his or her hand. Further, a physics-based simulation of clay in a design environment promises to open new areas of exploration in the CAD world. By giving control to the user of not only the design, but the simulation environment itself (the user can control how soft or hard the clay is, for example), a whole new way of thinking about how simulation and CAD can evolve. Further, artists and engineers will benefit from being able to watch and decipher every manipulation that an expert modeler has completed on the virtual clay. Bringing a physical medium to a digital environment will thus open up numerous possibilities in design, assessment and analysis, testing, and collaboration.

Title: SBIR Phase II: Multi-Environment Probability Density Function (PDF) Method for Modeling Turbulent Combustion Using Detailed Chemistry

Award Number: 0548752
Program Manager: Rosemarie Wesson

Start Date: February 10, 2006
Expires: January 31, 2008
Total Amount: $500,000

Investigator: Qing Tang, tang@reaction-eng.com
Company: Reaction Engineering Intl
77 W 200 S STE 210
Salt Lake, UT 84101
Phone: (801)364-6925

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will extend the applicability of the multi-environment probability density function (MEPDF) method to model turbulent combustion problems with realistic chemical kinetics within comprehensive Computational Fluid Dynamic (CFD) simulations of practical combustion equipment. The project aims to further advance the MEPDF method by extending it to simulate industrially relevant single-phase and two-phase combustion systems, such as chemical process furnaces fired with lean pre-mixed gas burners; oil fired utility boilers and industrial furnaces; and coal gasification equipment.

The proposed activities for extending the MEPDF method to simulate practical combustion systems using complex chemical kinetics would result in a tool that will enhance the scientific and engineering knowledge base for these processes. The advanced simulation tools produced from this project would provide a means for companies in the power generation, chemical process, mineral process, and incineration industries to improve product designs and services, which in-turn would benefit the environment, global competitiveness and national/homeland security.

Title: SBIR Phase II: Web-Based Manufacturing Performance Management with Multi-Objective, Multi-model Optimization using Meta-Modeling

Award Number: 0548731
Program Manager: Ian Bennett

Start Date: January 13, 2006
Expires: December 31, 2007
Total Amount: $512,000

Investigator: Thomas Knight, tknight@invistics.com
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5445 Triangle Parkway Suite 300
Norcross, GA 30092
Phone: (770)559-6386

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop a new Flow Path Management System (FPMS) representing an innovation in manufacturing software that: (1) Extends existing Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Manufacturing Execution Systems (MES) software by incorporating 'Lean Manufacturing' principles into a set of innovative simulation-based optimization algorithms; (2) Provides millions of dollars in inventory savings to existing and targeted manufacturing customers; and, (3) Is more available to virtual enterprises and smaller manufacturing companies than existing systems in that it can be delivered via the World Wide Web. The focus of this research project is the development of a meta-model-based simulation software for the analysis, prediction and optimization of manufacturing and supply chain processes. This software applies Kriging spatial optimization models - a proven interpolation-based response technique employed successfully in geo-statistics to solve complex and computationally intense manufacturing and supply chain problems.

The technology will be commercialized as a new module within the company's existing software suite, called the Flow Path Management System, and sold through three distribution channels: (1) on-site intranet installations at large companies; (2) delivery as a web service via the Internet to smaller companies; and, (3) licensing the algorithms to larger ERP/SCM/MES customers for incorporation in their software suites.

Title: SBIR Phase II: A Decision Support System for the Train Schedule Design Problem

Award Number: 0548666
Program Manager: Sally Nerlove

Start Date: December 29, 2005
Expires: December 31, 2007
Total Amount: $512,000

Investigator: Ravindra Ahuja, ravi@InnovativeScheduling.com
Company: Innovativs Scheduling
4548 SW 97th Terrace
Gainesville, FL 32608
Phone: (352)336-1257

Abstract:

This Small Business Innovation Research (SBIR) Phase II project entails developing a decision support system for the train schedule design problem, one of the freight railroad transportation's most significant optimization problems. Train scheduling is an important part of a railroad's operating plan that enables efficient movement of railcars. Designing such an operating plan is a very large-scale and very complex multi-objective optimization problem that, to date, has defied solution. Consequently, operating plan development at railroads is a lengthy, manual, and cumbersome process that may involve five to ten persons for a period of three to six months. Using cutting-edge operations research techniques, Innovative Scheduling, is developing a software product that can obtain a new operating plan within two weeks using two-three employees and can save a typical Class I US railroad over $50M annually. The train schedule design problem determines: how many trains to run; the origin, destination, and route of each train; the train arrival and departure times for each station at which it stops; the weekly operating schedule for each train; and the assignment of blocks of cars to trains. The train schedule must satisfy numerous practical constraints and business rules and achieve the minimum cost of transportation. This problem is a very large-scale multi-objective integer-programming problem containing trillions of decision variables. The proposed research will develop decomposition-based customized algorithms using state-of-the-art network optimization and heuristic techniques so that this problem can be solved within two hours of computer time on a workstation. These algorithms will be packaged into a web-based decision support system with attractive and friendly graphical and geographical interfaces, which will allow sufficient user control. The proposed research and development requires significant advances in modeling, algorithmic, and implementation technologies and will provide much needed software to schedule freight trains worldwide. This research will further be extended to develop a decision support system for passenger train scheduling. BNSF Railway, a Class I US Railroad, which is a Development Partner in this project and is providing supplementary funds, data and manpower.

The train scheduling decision support system is likely to be used by all freight railroads in their operating plan development process. A computerized method for train scheduling will make a railroad more responsive to traffic changes and enable it to change its schedule frequently. Optimal and timely train schedule will introduce greater efficiency in the system and significantly lower costs. Further, optimal train schedules require significantly less train miles, crew hours, locomotive hours, and railcar hours to transport the same set of shipments, thereby increasing our nation's energy efficiency and reducing pollution. The success of this product will lead to a greater acceptance of models and operations research techniques in railroad planning and scheduling. Railroads are then anticipated to embrace operations research models and introduce decision support systems in a variety of business processes including tactical operations and commercial strategy. The railroad industry will then be in a position to achieve a new level of productivity, resulting in lower freight charges for end users, and making America's products more competitive on the world market.

Title: SBIR Phase II: Applications of Morse Theory in Reverse Engineering

Award Number: 0521838
Program Manager: Errol B. Arkilic

Start Date: July 15, 2005
Expires: June 30, 2007
Total Amount: $500,000

Investigator: Michael Facello, facello@geomagic.com
Company: Raindrop Geomagic Inc
617 Davis Dr.
Durham NC, 27713
Phone: (919)474-0133

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will investigate applications of Combinatorial Morse Theory in Reverse Engineering, a field that focuses on converting physical objects into a digital representation suitable for CAD, CAM, and CAE. The biggest challenge in this field is to automate the conversion process while producing a model that meets all the requirements of downstream applications. These requirements include both an accurate representation of features and a high degree of smoothness. Combinatorial Morse Theory relies on a single mathematical approach: the definition of a continuous function on a polygonal model and the decomposition of the surface based on the gradient flow of that function. One advantage of this over earlier approaches to the conversion problem is its flexibility obtained by adapting to and combining different analysis criteria. Morse theory is the key to computing patch layouts that naturally adapt to and follow the shape of the surface, a property that is difficult to achieve but necessary to automatically construct high-quality NURBS surfaces of scanned or triangulated CAD models.

The proposed algorithms will allow users to easily create accurate representations of scanned physical parts, thereby providing an efficient closed-loop between physical and digital at any phase of a product life cycle. This project will make strong research contributions in computer science and mechanical engineering by dealing with the practical applications of Morse Theory, automatic feature detection and patch layout. It will also make strong advances in the amount of information that can be extracted from a polygonal model. Commercial applications include design and analysis of complex shapes such as turbine blades, transmission housings, and engine blocks, creating digital inventory of legacy parts, historical preservation, mass customization and biometric shape reconstruction. These applications will allow manufacturing companies to be more competitive globally because it enables product differentiations and existing processes to be carried out efficiently, cost-effectively, and automatically. The societal impact of this technology includes the improvement of work environments due to reduction of dust, noise, and work-related injuries associated with traditional processes, prevention of loss of lives and equipment by enabling sampling based inspections as well as improvement of the quality life through customized medical devices, and apparel that conform perfectly to the wearer.

Title: SBIR Phase II: An Integrated Software Tool for Modeling and Model-Based Control of Semiconductor Manufacturing Equipment

Award Number: 0450482
Program Manager: Juan E. Figueroa

Start Date: June 1, 2005
Expires: May 31, 2007
Total Amount: $500,000

Investigator: Jon Ebert, jle@scsolutions.com
Company: SC Solutions Inc
1261 Oakmead Pkwy
Sunnyvale CA, 94085
Phone: (408)617-4550

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a commercial prototype of a novel software tool for integrated model-based control design for Rapid Thermal Processing (RTP) systems. Semiconductor process engineers and RTP equipment design engineers will use the tool. Currently, the design and development of advanced process controllers is a relatively slow and complicated process. There is no high-level tool that allows the process engineer to design, tune and deploy advanced controllers and develop low-order, fast physical models to be used for control. Based on customer feedback and its own experience the company has found a strong need for an integrated modeling and control tool that can be customized for a specific process. Phase I results proved the feasibility of such a tool by closed-loop simulations of a generic RTP chamber using a proof-of-concept version of the proposed tool. This Phase II will further develop and implement relevant model-order reduction algorithms, implement the algorithm for speeding up the Monte Carlo ray tracing calculations, develop the user interface, and integrate the tool components. The company will work closely with its industrial partner in testing the prototype tool in the design of next-generation RTP equipment.

If successful the proposed software package will result in a tool that will substantially reduce the development time of RTP equipment and processes. The tool also provides components for development of advanced techniques in virtual sensing and fault detection. RTP is the company's initial focus, but will leverage the modular nature of the product to extend its capabilities to other semiconductor equipment (e.g., CMP, CVD, etch, etc.) and even equipment used in other industries. Moreover, devices for MEMS and new nanoscale electronics technologies (e.g. spintronic and molecular computing) are expected to be commercialized using CMOS-like manufacturing processes. Hence, by creating a new way of designing and developing equipment and processes efficiently, this tool will have an impact far beyond RTP. The software will serve as a teaching and training tool that can be used in universities and government laboratories of NIST, DoD, DoE, etc.

Title: SBIR Phase II: Creating Functionally Decomposed Surface Models from Measured Data

Award Number: 0450230
Program Manager: Ian M. Bennett

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $489,179
Investigator: Tamas Varady, varady@geomagic.com
Company: Raindrop Geomagic Inc
617 Davis Dr
Durham NC, 27713
Phone: (919)474-0133

Abstract:

This Small Business Innovation Research (SBIR) Phase II project deals with the problems of reconstructing complex free-form shapes from measured data. Raindrop Magic's primary interest is to produce well-structured, high-quality CAD models. Several techniques exist to reach this goal; unfortunately, automatic surfacing systems provide only rough approximations and do not capture the original design intent, while manual segmentation methods are not very stable and require tedious work. Using functional decomposition, objects are built up as a collection of large, independent primary surfaces being connected by smaller, dependent feature surfaces, such as fillets or swept surfaces. In Phase I, semi-automatic methods were elaborated to create good segmenting curve nets. Exploiting the specific properties of different feature types, the research team proposed algorithms to compute optimal surface representations for each. In Phase II, the team envisions transforming and extending their theoretical results into robust and efficient computational algorithms. Five subsystems are proposed: Surface-Indicators, Constrained-Fitting, Curve-Tracing, Fairing, and Feature-Fitting. New core technologies are developed for creating different geometric entities, which are eventually integrated to obtain high-quality surface models. This technology should significantly shorten lead-time in related industrial design and manufacturing processes and produce aesthetic objects, having a positive impact on the whole society.

The proffered technology has broader impacts in two key market sectors: reverse engineering and advanced surfacing. At the research front, the proposed project deepens the understanding of computer-aided geometric modeling working with scan data, a field that has not received much attention from the large CAD companies, but is an active area of research. It combines the knowledge of both discrete and continuous mathematics and takes advantage of the strength of both approaches. On the technology front, it introduces a new paradigm that will significantly improve the current commercial systems of reverse engineering with better engineering features and advanced surfacing through simpler operations. The main applications will be product design, including automotive, aerospace, consumer products, and medical devices. The improved product will help the US manufacturing industry to be more competitive in the world market, providing a way to introduce design on demand and engineering on demand services. The proposed project will help US companies to increase customer-focused production and reduce the time between product iterations.

Title: SBIR Phase II: Rapid Application Development Architecture for Product, Process, and Cost Configuration Across Manufacturing Verticals

Award Number: 0450308
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $499,999
Investigator: Nainesh Rathod, nainesh.rathod@imaginestics.com
Company: ImaginesticsLLC
1220 Potter Dr Ste 124
West Lafayette IN, 47906
Phone: (765)464-1700

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop prototype architecture of an engineering advisory system and validate its application. Although the cost of product design could be only about 5% of the total product cost, decisions made during the design stage can contribute as much as 70-80% to the final product cost. Inappropriate design decisions made without sufficient manufacturing knowledge, or information, increases iterations in the product development lifecycle, causing significant costs to both the original equipment manufactures (OEMs) and the lower tier manufacturers. A survey by Purdue University indicated that 90% of the engineers/designers had very little process knowledge, thus indicating that there is a serious design-manufacturing knowledge gap. The aims and responsibilities of the Phase II project are to bridge the design-manufacturing knowledge gap through the development of an engineering advisory system to be used in early design. The system would be analogous to a spell-checking tool, advising engineers/designers on manufacturability and cost. The system will perform Dynamic Design for Manufacturability (DFM) analysis, evaluate part geometry in order to provide advice on the manufacturing aspects of the part, especially tooling and process related parameters in part design, help in estimating relative manufacturing costs for a part by mapping the geometric and non-geometric parameters of the part to a cost-based manufacturing process model, integrate 3D Shape Search Engine (licensed from Purdue University) with Part/Tooling/Cost Advisor & Knowledge Reuse Agent, seamlessly integrate with commercial Computer-Aided-Design (CAD) system using sophisticated geometric reasoning algorithms and a hybrid B-rep-voxel approach, and extract manufacturing feature-based geometric information.

If successful this product will enable engineers/designers make informed decisions early in product design about processes and part/tooling for manufacturability while serving as an on-demand manufacturing "what-if" educational tool for engineers/designers. It will reduce non-value added design features so optimal and economical processes can be considered, thus lowering tooling costs while minimizing the risk in the quotation process for both OEMs and tooling firms. The outcome of this research also have an educational impact in engineering schools by introducing students to manufacturing processes and design for manufacturability concepts. The company will provide the engineering advisory system to universities to use in their engineering curriculum. The outcome of the proposed research can improve product design, lower cost and positively impact the local economy by linking local suppliers in early design directly through an engineering advisory system.

Title: STTR Phase II: Integrated Software and Systems for Large-Scale Nonlinear Optimization

Award Number: 0422132
Program Manager: Juan E. Figueroa

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,929

Investigator: Richard Waltz, waltz@ziena.com
Company: Ziena Optimization Inc.
2615 Hartzell Street
Evanston, IL 60201
Phone: (847)869-3269

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will address the design and creation of integrated nonlinear optimization software that combines complementary approaches to nonlinear optimization to achieve robust performance over a wide range of application requirements. The work will concentrate on the area of smooth nonlinearly constrained optimization, which arises directly in numerous applications and as a sub-problem in mixed-integer nonlinear programming and global optimization. The work will employ both mathematical convergence analyses and extensive testing on problems of practical interest. Results of the research will take nonlinear optimization software to a new level, based on an adaptive and versatile collection of algorithms in contrast to the single-algorithm approaches employed by current optimization packages. Nonlinear optimization models arise in diverse areas of science such as medical imaging, oceanography, crystallography, and climate modeling, and in almost all areas of engineering, chip feature placement for semiconductor manufacturers to energy management for electric and gas utilities.

Nonlinear optimization is also rapidly becoming a key tool in decision analysis in such areas as finance and revenue management. By enabling optimization packages to be more fexible and more reliable, this research will lead to stronger support for current nonlinear optimization applications while making new, more ambitious applications possible.

Title: SBIR Phase II: Meshless Petrov-Galerkin Geo-Environ Technology For Wide Scale Field Uses

Award Number: 0321651
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $379,038

Investigator: Sumant Gupta, cfest@cfest.com
Company: Consultants for Environmental System Technologies
2 Corporate Park, Suite 202
Irvine, CA 92606
Phone: (949)724-1696

Abstract:

This Small Business Innovative Research (SBIR) Phase II proposes to develop a Meshless Petrov-Galerkin Geo-Environ Technology For Wide Scale Field Uses. Groundwater supplies are increasingly threatened by organic, inorganic, and radioactive contaminants that are introduced to the environment by improper disposal or accidental releases. Estimates of remediation costs at U.S. government sites alone totals into the billions of dollars. Computational mechanics and aerospace advances in meshless Petrov-Galerkin provide easy means for stable accurate simulations of large groundwater reservoirs without grid generation. The proposed software package Meshless Groundwater Model-Petrov Galerkin (MGM-PG) will be designed for advanced hydrologists as well as for groundwater basin managers, purveyors, and field hydrologists. Current software advancements will be interfaced for easy conceptual model development for various applications. MGM-PG potential market includes: (i) groundwater reservoir quantity and quality management; (ii) cleanup of contaminated sites; (iii) storage of wet year surplus surface water underground and its uses for extended draught periods (ASR projects); (iv) safe disposal of treated effluents by rapid infiltration and extraction projects (RIX projects); (v) conjunctive uses of surface and subsurface water; (vi) landfill sites; and (vii) cleanup of large contaminated Federal Facilities.

This technology has applicability to thousands of EPA National Priority List for expedited clean up of contaminated sites and also for groundwater management projects that are implemented at a cost of billions of dollars by federal agencies, State, counties, petroleum facilities, and chemical industries. Worldwide only 4-5 geo-environ codes have been developed for wide variety of societal needs. MGM-PG will be a new technological advancement and will promote training of new graduate students in meshless advances rather than old methods.

Title: SBIR Phase II: Integrated Fire Modeling Software

Award Number: 0349759
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $498,900

Investigator: Brian Hardeman, hardeman@thunderheadeng.com
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Abstract:

This Small Business Innovation Research (SBIR) project will develop an integrated fire modeling software package for use in building design and accident analysis. This will increase public safety by providing widespread access to state-of-the-art fire simulation. Modeling fires using a rigorous scientific approach makes it possible to predict the course of an evolving fire and its impact on the building occupants, contents, and structure. The software will help designers implement new fire safety codes and standards that allow the use of Performance-Based design as an alternative to Rule-Based design. Performance-based design and post-accident analysis offer the potential to reduce injury, loss of life, property damage, and the overall cost of constructing and maintaining buildings through advanced technology. This project will accelerate the introduction of new fire simulation technology into the fire safety industry. In the United States, the total cost of fires is over $100 billion annually, with a loss of more than 4,000 lives. Driven by the availability of the Fire Dynamics Simulator (FDS) from NIST and new performance-based fire safety standards, the fire safety industry is responding to these costs by adopting greater use of fire simulation. As a result, there is an emerging market for fire simulation software that is powerful, yet easy to use.

The potential market includes fire safety engineers (design), companies involved in accident review and litigation, Authorities Having Jurisdiction (regulation), and fire service personnel (suppression and investigation).

Title: SBIR Phase II: Relational Bayesian Modeling for Electronic Commerce

Award Number: 0349497
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $450,056

Investigator: Bruce D'Ambrosio, dambrosi@cleverset.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will focus on scale-up and validation of the company's relational model discovery technology, with specific application focus on web-visitor behavior modeling. In Phase I research the company developed a modeling paradigm based a synthetic variable language for relational Bayesian modeling. Its synthetic variable language is the first comprehensive effort to develop a principled way to represent, discover, and perform probabilistic inference with mixed intra-table, cross-table, and multi-table relational features. This capability provides the basis for construction of comprehensive, integrated models of relational data. Models constructed capture the rich detail of web visitor behavior and can be used to make inferences about web visitor intent (e.g., whether or not a purchase in planned) in real- time. These results are not obtainable by any other modeling technology. The technical objectives for the Phase II project are to: (1) develop a complete language to establish solutions to outstanding issues in our synthetic variable capability, (2) engineer the infrastructure needed for commercial deployment, (3) construct deployable models of web visitor behavior to identify opportunities for intervention, and (4) conduct field-trials of model-based interventions to establish the business value of our approach. A paradox of modern society is that we possess so little knowledge relative to the amount of data we collect and store. E-commerce provides a paradigmatic example of this paradox. E-Commerce platforms collect unprecedented amounts of information about customer interactions, yet today's E-commerce applications do not provide the service expected by customers or the performance demanded by online retailers. Online retailers are demanding increasingly sophisticated marketing and merchandising technologies.

The proposed product will empower online merchants and service providers by enabling efficient and integrated understanding of online consumer behavior and will bring in a new class of customer centric (instead of page-centric) web-based interactions that will contribute to the evolution of the World Wide Web as a communication medium. The company's technology also applies to offline scientific analysis as a method for hypothesis generation in complex relational data as in the E-commerce domain. This technology enables scientists to make better use of the data at their disposal.

Enterprise Systems

Title: SBIR Phase II: Software Platform for Quality-by-Design Implementation

Award Number: 0750063
Program Manager: Ian M. Bennett

Start Date: March 15, 2008
Expires: February 28, 2010
Total Amount: $511,771

Investigator: Paul vanEikeren, paul.van.eikeren@bluereference.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a novel Quality-by-Design (QbD) software platform directed at the needs of FDA's QbD initiative, a framework for innovative pharmaceutical development, manufacturing and quality assurance. QbD is implemented at four levels: process understanding; quality by design; monitor, predict and control; and continuous improvement. QbD implementation is hampered by the lack of a reusable and extensible QbD Software Platform for assembling QbD tools that execute, document and integrate QbD workflow. In the Phase I program, we successfully demonstrated 'proof-ofconcept' for the QbD Software Platform for application to the first QbD level workflow. This project will extend research to the other levels and enhance the QbD Software Platform in three principal ways: 1) increase capabilities for managing QbD data-set objects; 2) enlarge the pool of QbD workflow objects; and 3) add collaboration capability in conjunction with a centralized repository. We will test, evaluate and validate the QbD Software Platform through use scenarios developed in conjunction with pharmaceutical-company research collaborators. The ultimate goal of the program is to develop a commercial QbD software toolkit that enables scientists and engineers to implement QbD for increased manufacturing efficiency with regulatory flexibility. The health of our nation's citizens depends on the availability of safe, effective and affordable medicines. Pharmaceutical companies need to employ innovation, cutting-edge scientific and engineering knowledge, and the best principles of quality management to respond to the challenges of new discoveries (e.g., complex drug delivery systems and nanotechnology) and individualized therapies or genetically tailored treatments. The FDA and global pharmaceutical community are laying the foundation for a regulatory policy revolution, Quality-by-Design (QbD), that provides a framework for allowing regulatory processes to more readily-adopt state-of-the-art technological advances in drug development, production and quality assurance. QbD shifts focus from 'quality by testing' to 'quality by design', i.e. build quality into the process rather than rely on resource-intensive quality control systems to prevent defective products from leaving the factory. The Quality-by-Design (QbD) Software Platform of the present proposal enables scientists and engineers to implement state-of-the-art multi-variate analysis and machine learning to manufacturing quality. Additionally, given that manufacturing represents 25% of drug cost, equipment utilization is below 40%, and batch quality failures range from 5 to 15%, the effective implementation of QbD will enable improved efficiency providing lower drug costs and increased competitiveness for the US pharmaceutical industry.

Title: SBIR Phase II: Parts Forecasting for Configurable Products

Award Number: 0723832
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,905

Investigator: Roy Marsten, rmarsten@emcien.com
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Phone: (770)621-5877

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop a new methodology for parts forecasting for discrete manufacturing. Emcien is developing a software suite to enable a product manager to better manage a configurable manufactured product. This suite includes a method for forecasting the demand for a configurable product at the full configuration level of detail. This means forecasting unique configurations, each with an expected volume. The method depends on extracting customer buying patterns from the sales history for the product. The mathematical algorithms for extracting and representing these patterns, and forecasting using these patterns are the main contributions of the research. The set of parts needed to build a configurable product generally depends on combinations of options, so it is not possible to plan parts requirements from an aggregate forecast. By using a configuration level forecast, it is possible to expand each unique configuration into component parts, and then use the associated volumes to produce a complete parts forecast.

American manufacturers are specializing in complex, configurable, high-end products, as mass produced commodity products move offshore. Allowing customers to customize a product results in significant numbers of alternative product configurations. This variety increases costs in many ways. One important way is the increased difficulty of planning parts requirements. The current practice of basing parts planning on a few popular variants leads to excess inventory of some parts and shortages of others. Excess inventory incurs both holding and obsolescence costs. Shortages can interrupt production and cause both lost sales and quality problems. Emcien has developed a methodology that, among many other benefits, can improve the accuracy of parts planning.

Title: SBIR Phase II: Supply Chain Optimization and Product Explorer

Award Number: 0620233
Program Manager: Errol Arkilic

Start Date: August 1, 2006
Expires: July 31, 2008
Total Amount: $499,995

Investigator: Nainesh Rathod, nainesh.rathod@imaginestics.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will achieve higher retrieval accuracy for shape-based search for both the web and the enterprise. The proposed work in Phase II is to achieve higher retrieval accuracy supported by three key components: 1) pose determination for 3D models: bridging the space gap between 2D and 3D shapes by finding three intuitive and robust orthogonal orientations for 3D models; 2) 2D orthogonal view generation: representing a three orthogonal views along the pose orientations; 3) similarity measurement between 2D shapes: finding 2D and 3D shapes based on the user's query. A framework will be developed by focusing on three important modules: 1) 2D constraint detection and use of implied constraints with initial application in 2D and 3D views; (2) Enhanced multiple level-of-details in 3D representations, and (3) Human assisted system classification of large datasets.

Traditional options of finding part suppliers using catalogs, trade shows and prior business relationship limit the choice of suppliers. Current text-based search to find suppliers face challenges, such as context and language sensitivity, and is inadequate in overcoming the technological challenges posed by variations in how product or part information is specified across a global supply chain. The current effort proposes to use shape, which is the lowest common denominator, to link the OEMs and suppliers. This technology can also aid the current trend among companies in aerospace, automotive, medical equipments and other industries towards 3Ddata standards for fast retrieval, as it can provide a significant leap in terms of accuracy, speed and relevance in the search and retrieval of information. If successful, this technology can contribute significantly to research in areas where shape is important, such as bio-technology and pharmaceutical sectors, where rapid identification of molecules and their docking features help reduce time and cost involved in drug development. For the medical industry due to increased usage of CT scans and 3D imaging technologies, 3D shape search can be used for local feature identification in colonoscopy or other exploratory procedures, brain angiography, reconstruction, projection of malformation or location of polyps and ensure better and rapid diagnosis of disease. Development of methods for automatically parsing human sketches and determining constraints will enable many other research activities and broadly help in a more natural human machine interaction.

Title: SBIR Phase II: Reducing Lead Time and Inventory by Using Optimized Product Configurations

Award Number: 0620269
Program Manager: Errol Arkilic

Start Date: July 25, 2006
Expires: July 31, 2008
Total Amount: $499,818

Investigator: Roy Marsten, rmarsten@emcien.com
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Atlanta, GA 30308
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the impact of product variety on the customer order fulfillment process. It aims to help the manufacturers of highly configurable products with many possible "variants" or "configurations" to maximize product availability and order fill rates. Prior research by Emcien has created a methodology for representing product variants, modeling customer demand, and computing an optimal set of product configurations to maximize margins. These stockers are optimal in the sense of satisfying the most demand while maximizing profitability, but they assume unlimited product inventory. In previous research, Emcien built a prototype simulation model to determine how well these optimal stockers would perform in practice. The prototype simulation model was used successfully by two of Emcien's clients. The Phase II project will turn this prototype into production quality software that will become a part of Emcien's suite of products that address product variety.

More manufacturers are moving in the direction of "mass customization", which means allowing each customer to choose the features and options they want. Mass production of a uniform product, or one with a small number of variants, is evolving into flexible production as more and more choices are offered to the customer. But customers not only want to customize their product, they also want to get it quickly. Pure build-to-order systems can result in unacceptably long customer lead times, especially when demand has seasonal ups and downs. This forces manufacturers to build partially finished or fully finished units for inventory, in order to smooth production and reduce customer lead time. This requires a delicate balance between the extra revenue and the extra costs of offering more variety. Emcien's mission is to help manufacturers profit from product variety as a competitive advantage, rather than being overwhelmed by the extra costs of supporting too much variety.

Title: SBIR Phase II: Advanced Planning and Scheduling Tools for Extended Enterprise Systems

Award Number: 0450552
Program Manager: Juan E. Figueroa

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $394,965

Investigator: Guining Li, guining@yahoo.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build upon the successful development of the Phase I project that developed models and algorithms for planning and job scheduling systems. The software tool described in this proposal will allow organizations to schedule their operations in real-time to generate the optimal plan to maximizing their operational targets. During Phase I, the team created new planning and scheduling algorithms and successful empirical studies using recent innovative research in the areas of large-scale optimization and the newly developed methodology of Nested Partitions. In Phase II the team plan to further develop the concept to create successful implementations in several manufacturing firms. The technology to be developed in Phase II will greatly enhance the capability of the current planning and scheduling software tools. This innovation brings the state-of-the-art decision and optimization methodology to the Advanced Planning and Scheduling software market. In addition, planning systems developed with the proposed methodology will add new levels of flexibility for companies to more quickly adapt to changing material, operational, and market conditions.

This SBIR project will make new planning and scheduling tools broadly accessible to virtually any manufacturing firm. The proposed scheduling and planning tools will enable them to communicate, collaborate, and integrate their planning and scheduling functionalities to obtain optimal results throughout their enterprise and their entire supply chain. It is expected that coordinated use of these tools will eventually create an integrated cyber-infrastructure for American manufacturing firms and create more efficient supply chains that will enable these firms to be more competitive in the global marketplace. Moreover, if successful, the development of this proposed tool will lead to fruitful attempts to develop and commercialize an advanced planning and scheduling software tools that can be used for many other sectors of the economy.

Title: SBIR Phase II: Uncertainty Analysis of Manufacturing Process Models

Award Number: 0348771
Program Manager: Juan E. Figueroa

Start Date: May 1, 2004
Expires: April 30, 2006
Total Amount: $499,235

Investigator: Ellen Meeks, emeeks@reactiondesign.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to create a robust software system for performing uncertainty analysis of process simulations for manufacturing. For simulations that are large or that contain many parameters, even the best Monte Carlo, or importance-based sampling methods for uncertainty analysis can be prohibitively expensive. Consequently, systematic uncertainty analyses are rarely implemented for complex systems. This proposal presents a plan to produce a commercially viable package of a new method for quantifying simulation uncertainty, based on polynomial chaos expansions. The method can determine the probability density functions of black-box model responses and can identify quantitatively which of the parameters contribute most to uncertainties in responses for multivariate inputs and outputs. The unique sampling approach enabled by the use of polynomial chaos expansions allows more accurate resolution of probability distribution functions at a very small fraction of the cost to achieve similar results with more traditional uncertainty-analysis methods.

While illustrative examples from the chemical manufacturing industries will be used to demonstrate the software functionality, the methodology has broad application to such fields as circuit design, risk management, allocation of experimental resources, chemical plant design and operation of production systems. Due to the ability to handle arbitrary or black-box simulations, the methods can be applied as easily to economic market analysis, or global climate modeling, as to chemical process design.

Title: SBIR Phase II: Evolving Object Neural Networks

Award Number: 0349604
Program Manager: Errol B. Arkilic

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $499,642

Investigator: David Fogel, dfogel@natural-selection.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will investigate the problem of generating evolutionary object neural networks for controlling characters in classes of entertainment software, with consideration given to genres of massively multiplayer online games. The objective of the research is to identify and develop general self-adaptive routines and software tools that can be incorporated in a software developer's kit (SDK) that is suitable for licensing to third-party developers. A series of experiments conducted within a statistical framework will identify first- and second-order effects of parameter choices for the evolutionary control of game characters, which will be incorporated into the SDK. R&D will be aimed at generating the most rapid evolutionary learning for game characters while having the smallest code "footprint." Additional research will facilitate automatic play testing and optimization of artificial intelligence in games. The scientific and technical understanding of hybridizing evolutionary computation and neural networks will be enhanced by the careful study of the nonlinear effects of parameter choices in the studied settings.

If successful this product will ease the transition of video games from development to products. The development of an SDK that will help reduce the time and cost of segments of video game production by 50-80%. The software developed may serve as educational classroom aids in university courses. Furthermore, the strong correlation between video games and military simulations suggests important contributions to dynamic planning in combat simulations, as well as extensions to optimizing courses of action in business operations, such as supply-chain management.

Title: SBIR Phase II: Lean Physics: Streamlining the Supply Chain Using Factory Physics

Award Number: 0349659
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Keith DiAngelis, diangelis@factoryphysics.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project involves the creation of an innovative Methodology and software Toolkit that can substantially improve the supply chain of virtually any manufacturing firm. The proposed Support Tools offers a comprehensive system that combines the best of the "software only" and the "best-practices" approaches with a framework to create a new paradigm for production system improvement. Algorithms based on this framework will provide important diagnostic and analysis tools that show how and where major improvements to the supply chain should be made. Execution algorithms that "bolt onto" existing supply chain management systems will provide the means to improve productivity, reduce inventory, and increase customer responsiveness without having to replace existing implementations. The toolkit can also be delivered over the Internet, providing a cost effective alternative to smaller companies.

Commercial versions of this innovation could enable widespread adoption of a new and more effective paradigm of manufacturing logistics. With the loss of 2.3 million jobs in the last three years, the issue of manufacturing productivity is critical as is the need for supply chain tools which integrate production software systems with operational initiatives to improve productivity and cost competitiveness. Widespread adoption of this methodology and tools could have a profound influence on the competitiveness of U.S. industry.

High Speed Networking

Title: SBIR Phase II: Implementation, Testing and Refinement of a Hybrid Distributed / Traditional System for Broadcasting Live and Pre-Recorded Content to Large Online Audiences

Award Number: 0750136
Program Manager: Errol B. Arkilic

Start Date: February 15, 2008
Expires: January 31, 2010
Total Amount: $512,000

Investigator: Mike O'Neal, mike@nft-tv.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project has two technical goals. In Year 1 the focus is on increasing the video quality (bit rate) of NFT delivered broadcasts, while keeping bandwidth costs low. In Year 2 the focus shifts to expanding product support to Mac and other non-Windows systems. Network Foundation Technologies (NFT) has developed a patented distributed broadcast technology that overcomes many of the current bottlenecks. The key difference between the NFT approach and the traditional approach is that with NFT the computers and Internet connections of the viewers watching a broadcast help deliver that broadcast on to other viewers. Network Foundation Technologies' products and technology have the potential to significantly impact the way television-style broadcasting is conducted over the Internet, greatly increasing the number of voices that can be heard. While NFT's near term goal is "to bring television to the Internet", the long term goal is to give ordinary citizens their own "online television stations."

Title: SBIR Phase II: TRX Sentinal First Responder Tracking System

Award Number: 0750498
Program Manager: Ian M. Bennett

Start Date: February 1, 2008
Expires: January 31, 2010
Total Amount: $512,000

Investigator: Carole Teolis, carole@technosci.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the critical problems of tracking and monitoring firefighters or other first responders inside structures. Whereas many available systems such as GPS fail indoors or require an overwhelming number of access points to obtain accurate information, our system requires only a base station that can be quickly set up at a command post outside (or inside) a building and small devices worn by the responders. Our system sets up a mesh network to communicate data amongst responders, as well as between the responders and the command post base station(s). The mesh network extends the range of the base station by allowing data to be relayed through another team member if a responder goes out of range. Our prototype system has been demonstrated to provide accurate tracking and location of personnel performing simple motions in complex structures from a base station outside of the structure. This project will focus on improving tracking algorithms such that complex motions can be recognized and accurately tracked. The expected outcome of the project is a much improved interface between the typical command center and the first responders. The initial market impacted by this project development is firefighter location and monitoring. Firefighting is one of the most dangerous jobs in the US. An average of 95 firefighters have been lost every year over the past decade. Some of these deaths could have been prevented if only the firefighter's distressed condition and exact position were known. No commercial technology currently exists that pinpoints the location of a downed firefighter. Critical time can be wasted before a downed firefighter is even first detected. Subsequently, critical resources are often diverted in frantic searches in hazardous conditions and extremely poor visibility. The seconds saved by knowledge of firefighter alarms and their positions could mean the difference between minor and severe injuries or death.

Title: SBIR Phase II: Hardware Support for 10 Gbps Intrusion Detection

Award Number: 0521902
Program Manager: Errol B. Arkilic

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $498,205

Investigator: Livio Ricciulli, livio@metanetworks.org
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will dramatically advance performance breakthroughs achieved by utilizing a Multiple Instruction Single Data (MISD) processing model applied to high-speed Intrusion Detection and Prevention System (IDPS) hardware. A multiple-chip implementation of the MISD processing model will further demonstrate the scalability and cost-effectiveness of the technology by increasing IDPS processing capacity to levels while reducing costs for the existing system. Current line speed stateful computations are limited by the cost and scalability of currently available content addressable memories. Ideas derived from memory caching architectures will be adapted to build a novel memory subsystem specifically designed to cost-effectively support critical, stateful, 10 Gbps security applications such as TCP stream reassembly and protocol normalization. Finally, the development of open-source interfaces will extend the use of these innovations to a large community of users who will certainly contribute to the advancement of IDPS technology through inter-organizational collaborative efforts.

Next-generation applications require high-speed network connectivity. For example, supercomputer clustering, medical image delivery, data storage networking, video conferencing, and tele-presence applications all need 10 Gigabit and higher speeds. Unfortunately, public and private communication infrastructures are today being destabilized by security compromises. Network viruses, worms and other attacks can propagate very quickly over the Internet and private networks, disabling commerce and resulting in significant productivity loss. The ability to detect and prevent these attacks from traveling through high speed links is a crucial requirement for fostering their adoption across organizational boundaries. Without proper intrusion detection and prevention, high speed links will introduce severe attacks in information systems and limit the commercial viability and far-reaching benefits of high bandwidth, next-generation applications. This Phase II project will dramatically improve the cost-effectiveness, openness and scalability of high-speed IDPS technology. This will facilitate a broader use of inter-organizational, high-speed connectivity and impact social, economic and educational progress.

Title: SBIR Phase II: Scalable and Reliable Storage Infrastructure for Network Storage Environments

Award Number: 0450528
Program Manager: Juan E. Figueroa

Start Date: February 1, 2005
Expires: January 31, 2007
Total Amount: $500,000

Investigator: M.Firas Malouhi, firas@datareliability.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build a scalable and reliable storage system for network storage environments. This outcome of this project is a revolutionary system that employs a combination of unique ideas to address the main challenges encountered in today's demanding storage environments namely scalability, availability, performance, and manageability. The ideas of this proposed solution are applied as a disk-based solution for the time-consuming network backup/restore problem. With the rapid growth of data-driven network services, traditional storage solutions are not able to keep pace with the rapidly expanding storage requirements. Unlike traditional solutions the proposed solution employs a new architecture that allows for independent and practically unlimited scalability of capacity, file access performance, and namespace access performance. The proposed product utilizes a unique, very fast coding technique called PND to ensure fast, reliable, and highly available access to data. It offers the opportunity of applying a more effective block-level edge caching technique, which enhances the performance and achieves better utilization of the valuable cache memory. It takes advantage of Data Reliability, Inc.'s innovative RAISTM storage engine to cost-effectively aggregate distributed islands of independent storage resources into a single virtual shared pool of storage. Project Phase I has clearly demonstrated the above advantages.

Many applications will exploit the competitive advantages of the proposed product including Web server farms; multimedia network services, content management, document storage and delivery, digital imaging, and file transfer services. In addition, the expected solution's ideas can be expanded to build general-purpose file servers that are not subject to performance bottlenecks and capacity limitations. Therefore, these ideas will have an important impact on building next generation NAS devices. The PND technique, pioneered by this project, provides a new class of codes that are expected to result in scientific advances in coding theory. In addition, the PND technique will contribute to enhanced performance and architectures of disk arrays. Applications of PND coding in areas other than data storage include mobile communications, reliable multicasting, audio/video streaming, and digital fountain systems. The company is partnering with Jackson State University (JSU) and will offer JSU students a tremendous educational experience. Since Jackson State University is an HBCU (Historically Black College and University) in the underrepresented state of Mississippi, the project will foster continuous collaboration and will increase the participation of underrepresented and minority groups in science and technology.

Title: SBIR Phase II: Commoca Internet Protocol Phone - Making Communications Personal

Award Number: 0450436
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $500,000

Investigator: Carlos Velez-Rivera, carlosvelez@comoca.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a suite of server based infrastructure software and applications to empower service providers with the ability to deploy, monitor, customize content, debug, and upgrade their VoIP (Voice over Internet Protocol) terminals remotely. The proposed Transactional Applications Delivery System (TADS) will allow service providers to define new revenue generating applications and corporate IT departments and third-party IT solution providers to develop vertically integrated, productivity enhancing data-voice applications. The proposed system will also provide a cost-effective means for service providers to move high-end VoIP terminals into the home consumer market, through, for example, multi-year service contracts in exchange for subsidized phones (the new revenue generating opportunities will allow service providers to do this). By addressing these needs, TADS will allow tighter integration between telephony features and IT based systems, taking better advantage of unified messaging (voice mail, e-mail, video mail, instant messaging, etc), collaboration, conferencing, presence, etc. It will also allow end-users access to ubiquitous features across different networks and different locations.

This project will define, develop, and deploy a complex software platform that will significantly accelerate the time to market of revenue generating and productivity enhancing advanced VoIP applications and services. In addition, the development of the proposed TADS technology will lead to new knowledge in the areas of human computer interaction, data mining, IP information appliances, and networking. The results to be obtained from this project will have a significant impact on the structure of the VoIP consumer market and the way converged voice-data applications are developed and deployed in the enterprise market.

Title: SBIR Phase II: Automated Personalized Rich Media Broadcast Generation

Award Number: 0349740
Program Manager: Juan E. Figueroa

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $494,723

Investigator: Robert Rubinoff, robert.rubinoff@streamsage.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will create a prototype system that will cut through the overload of audio/video (rich media) content by generating personalized broadcasts from a library of rich media documents. Building upon existing expertise in dealing with rich media, the proposed research will apply and refine the techniques discovered in phase I to organize relevant material using both the context of the documents and the topics of the selected material. The prototype will also apply the phase I results to identify and fill in the critical gaps between segments of material extracted from the source documents with bridging text that will provide necessary context and structure, allowing the system to present the relevant material as a single coherent broadcast. This research will result in new techniques that allow separately obtained passages of audio/video (or even text) to be joined together coherently. It will also provide techniques for organizing information based on both contextual and topical cues. These techniques will be applicable in any context in which information in natural language form is being extracted from a source collection. Furthermore, the research results will provide cost efficiencies for a number of specific important vertical markets (e.g. finance, broadcast news monitoring, etc.).

The resulting software products will dramatically reduce the costs of the currently manually intensive information extraction process employed by firms in these markets. More generally, the software products that are derived from the company's current technology platform will also increase individuals' ability to find and absorb relevant information from diverse information sources, many of which are entirely intractable today. This ability is important in a wide range of communities such as academic institutions, intelligence agencies, homeland security agencies, financial institutions, and news broadcasters.

Title: SBIR Phase II: Advanced Proxies for Shared Wireless Internet Access

Award Number: 0348440
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Norman Abramson, nabramson@hokupaa.com
Company: Hokupaa Technologies, Inc.
521 Lake Street
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop advanced forms of transparent network proxies for both satellite and terrestrial broadband wireless communications to the Internet. Shared wireless access links to the Internet often exhibit what has been called a traffic / cost anomaly. While almost 90% of the traffic in the network can flow from the Internet to the user, almost 90% of the cost of the access links can be attributed to the channel transmitting packets from the user to the Internet. Wireless Internet access from the user to the Internet is often implemented by means of some variation of a random access ALOHA channel. The interaction of ALOHA channels with TCP and other high level protocols used in the Internet can limit the effectiveness of both TCP and ALOHA for such access. The goal of this NSF SBIR research program is to understand this awkward interaction of standards in the high cost random access channel and to develop a strategy of migration to a more sensible access architecture based upon transparent proxies.

The societal and commercial impact of this project will be to increase the capacity of broadband wireless Internet multiple access channels thereby decreasing the cost per user of the channel. This decrease in the cost per user when shared with customers can increase the market for broadband wireless access to the Internet while increasing the profitability for wireless Internet Service Providers. These fast proxies will make wireless Internet access affordable for under-served and un-served end users in rural areas in the United States and in much of the rest of the world. Additionally the technical innovations of this research will serve to advance the current level of understanding of how TCP/IP protocols interact with other protocols in wireless data networks.

Human/Computer Interface

Title: SBIR Phase II: Multi-Party Peer-to-Peer V3oIP

Award Number: 0750558
Program Manager: Errol B. Arkilic

Start Date: January 15, 2008
Expires: December 31, 2009
Total Amount: $495,154

Investigator: Milton Chen, milton.chen@vsee.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project extends the PI's Phase I to create a theoretical bandwidth and latency efficient multimedia streaming framework for communication. The ultimate goal is a software system that achieves less than 150 msec one-way end-to-end delay (the typical delay of telephone) for a 10-30 site meeting supporting wideband audio, full motion video, and application/desktop sharing over broadband networks. The industry norm to achieve multiparty video/web conferencing is the client-server architecture. Client-server architecture is expensive to deploy due to the number of servers required and the bandwidth required at the server nodes. Peer-to-peer approaches have been successfully used for large scale file sharing. However, peer-to-peer approaches have been relatively unexplored to scale the number of participants in a single meeting. This research combines real-time network sensing and the domain knowledge of video and web conferencing to create a scalable and cost effective peer-to-peer streaming algorithm. The maximum number of sites in a multiparty videoconferencing is typically 4-6. Given the limited screen resolution of a laptop/desktop, methods for showing 10-30 full motion video and a shared application are relatively unexplored. Poor user experience from inadequate user interface is a major barrier to the adoption of previous video/web conferencing tools. This research combines recent human factor discoveries to create a novel user interface that intuitively supports multiparty communication. Since AT&T invented videoconferencing in 1927, videoconferencing has been one commercial failure after another. The PI's previous research suggests that such failures are rooted in inadequate knowledge of the human factor requirements of videoconferencing. Based on previous research, they are developing a commercial software system which will make substantial impact on telework, remote education, and humanitarian operations. This project aims to create a low-cost peer-to-peer alternative to client-server architectures for large scale meetings. If successful, the architecture proposed in this effort could have significant commercial impact.

Title: SBIR Phase II: Development of a Tunable Filter for Mini Hyperspectral Imager

Award Number: 0724494
Program Manager: Juan E. Figueroa

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,421

Investigator: Dennis Zander, dennis.zander@infotonics.org
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Canandaigua, NY 14424
Phone: (585)919-3029

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project will address the need to see beyond ordinary human vision, which is critical to improvements in health care delivery, development of precision agriculture methods, guarantee of front-line responder safety and protection, and processing a safe food supply. Hyperspectral imaging, with its ability to capture hundreds of continuous spectra, delivers a valuable tool that provides enhanced visualization and analysis. Current systems tend to be space- or air-borne, large bulky modules that do not lend themselves to portable or hand-held solutions. This mini hyperspectral imager has at its core a novel MEMS monolithic, Fabry-Perot tunable filter and optical system and will be portable and handy, similar in size to a zoom camera in a cell phone.

This research and development effort will develop a family of innovative miniature hyperspectral imaging systems that potentially can have a significant impact. These systems can alert our modern war fighter and emergency first responders by seeing beyond our vision and identifying terrorist threats. It can safeguard our nation's water and food supplies by utilizing affordable hyperspectral systems to identify e-coli and other bacterial contaminations before they are consumed.

Title: SBIR Phase II: Robust Speech-to-Text Messaging

Award Number: 0724271
Program Manager: Ian Bennett

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Ashwin Rao, ashwin@travellingwave.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II research project proposes to develop techniques for the hands-free input of text to mobile devices. Specifically, this project extends the results of the Phase I effort to produce a speech-recognition system for mobile devices and personal appliances that is robust in the presence of background noise. To increase the speech recognition accuracy, four techniques are employed: 1) Spellation where the users have to speak and partially spell the words as they dictate, 2) VoiceTap which requires that, for each character, the user says that character and the following character in the alphabet, 3) Voice Predict where the user has to say the word and input the first character of the word using the keyboard or VoiceTap, and 4) multi-modal speech to text, where the user speaks and uses the keyboard simultaneously. The research effort will focus on developing modules that allow speech to be dictated using a combination of whole words and spelled words.

The outcome of the proposed research has significant commercial potential. Because the front end or client-side can be ported to a variety of operating systems and processors, the flexibility of this technology should enable wide licensing of the technology to telecommunication device manufacturers. The mobile wireless industry is very large and growing industry, and multi-modal input technology is important to mobile customers who demand more efficient and accurate methods for communication. Improvements in accuracy could be very significant and would potentially have widespread applicability.

Title: SBIR Phase II: Artificial Intelligence and Character Animation

Award Number: 0548723
Program Manager: Errol Arkilic

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $499,996

Investigator: Michal Hlavac, michal@ingeeni.com
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Cambridge, MA 02139
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to build and launch simple and intuitive software tools that allow for the creation of interactive 3D graphics within Macromedia Flash (a 2D vector graphics package). Combined with the existing technology, this collection of technologies will provide the first version of the revolutionary Artificial Intelligence Platform for the creation and delivering of interactive animated characters with emotional intelligence. The systems provide the characters with autonomous behavior selection (what should I do?), emotion (how do I feel?) and learning (have I seen this before?). Such a unique blend of technologies opens opportunities for the study of the theories of the human mind and creates an entirely new class of interactive media.

The broader impacts of this work are scientific, educational, and economic. The technologies advance discovery and understanding of the workings of the human mind by giving a rapid prototyping environment for computational theories of the mind. Scientists and non-scientists alike can create AI networks and see the resulting characters "twitch" on screen in real time. This work promotes teaching, training and learning as Ingeeni will work with UC Irvine and MIT Media Lab to develop curriculums for Synthetic Characters classes that use the platform. Massive adoption of Ingeeni's technologies is the company's main goal, and it is developing libraries of detailed step-by-step tutorials freely available online.

Title: SBIR Phase II: The Delivery of Content-Rich Traffic Information to Improve Driver Decision Making

Award Number: 0522320
Program Manager: Errol B. Arkilic

Start Date: October 1, 2005
Expires: September 30, 2007
Total Amount: $500,000

Investigator: Randall Cayford, rcayford@intellione.com
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Atlanta GA, 30309
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop user interfaces, routing algorithms, and driver notification systems necessary to deliver content-rich traffic information to travelers en route. Large volumes of traffic data, of varying types over large areas, is being gathered by public and private agencies. To be useful to a driver while traveling, this data must be reduced to small amounts of information and delivered in a way that allows easy comprehension with minimal distraction. Key driver behaviors benefiting from traffic information are pre-trip departure time changes, pre-trip and en-route route changes, and en-route anxiety reduction through drivers knowing the estimated arrival time. These behaviors depend on collecting and analyzing the planned route under changing traffic conditions and comparing that route with possible better alternatives. This research will develop user interfaces to collect origin, destination, and route information from drivers, pre-trip via the web and en-route via cell phone. Algorithms to determine alternate routes will be developed through analysis of field collected route data. Notification methods that present the salient information with minimal distraction will be developed and tested. The research will result in the development of better traffic information services that truly support the decisions drivers make as they travel.

The results of this research have potentially broad impacts on society. Traffic congestion is a growing problem in U.S. cities. In some areas, it has become a limiting factor on economic growth. Emphasis has shifted in recent years from providing additional capacity to better utilization of the existing infrastructure. Broad dissemination of traffic information in a form suitable for making optimal routing and trip decisions allows efficiency improvements based on the decentralized decisions of many drivers. Trip modifications based on traffic information can save drivers an estimated $3.9 billion in lost productivity, 225 million hours of travel time, and 340 million gallons of fuel, per year. It is believed that such savings could support a viable commercial marketplace for personalized traffic information. Similar savings are possible for commercial travel through improvements in delivery routing, on-time delivery, and more efficient dispatching. Congestion management by public agencies strives for efficient use of the public infrastructure by shifting motorists onto less congested roads and would benefit from better interfaces between the traffic data collected and the individual drivers on the roads. The examination of route choice will advance the scientific understanding of how drivers choose their routes and how they alter those routes under changing external conditions.

Title: SBIR Phase II: Automatic Classification of Magnetocardiograms

Award Number: 0349580
Program Manager: Errol B. Arkilic

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $486,749

Investigator: Karsten Sternickel, karsten@cardiomag.com
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Schenectady, NY 12304
Phone: (518)381-1000

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will incorporate machine-learning techniques into agneto-cardiography (MCG) that measures minute magnetic fields emitted by the heart's electrophysiological activity, based on SQUID technology and operable in typical (magnetically unshielded) hospital rooms, for early non-invasive diagnosis of heart disease. The overall objective of this project is to identify and localize, using MCG, cardiac ischemia, the leading cause of death in the US. The focus will be on excellent predictability, ease of tuning, and user transparency of machine learning tools. Upon successful completion of this project MCG has the potential to become the new gold standard for the detection of cardiac ischemia in patients presenting with suspicion of acute coronary syndrome. Worldwide, the lack of inexpensive and non-invasive cardiac diagnostic techniques causes unnecessary delays in the recognition of acute coronary heart disease and its treatment. The feasibility of MCG to diagnose heart disease has been demonstrated. Machine learning tools provide quantitative methods for the automated diagnosis of heart disease.

After successful completion of this project, physicians and nurses in leading U.S. hospitals can be trained in automated MCG diagnosis. It will also usher the use of machine learning tools for medical diagnosis in general.

Information Management and Retrieval

Title: SBIR Phase II: Mobile Visual Search Engine

Award Number: 0822713
Program Manager: Errol B. Arkilic

Start Date: August 1, 2008
Expires: July 31, 2010
Total Amount: $500,000

Investigator: Gerald Pesavento, gerry.pesavento@iqengines.com
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davis, CA 95616
Phone: (530) 219-2192

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a biologically-inspired image search and recognition technology to provide rapid object information retrieval from a mobile phone camera. The end result is that potentially any object in the real world is now "clickable": a picture of an object provides a hyperlink to the Internet. The proposed system utilizes a new method for sparse, multi-scale image representation based on the monogenic signal, a 2D generalization of the analytic signal that is robust to image transformations. By 2010, it is estimated that there will be over 1 billion mobile phones with cameras.The mobile phone is becoming an important connection between people and the digital world. The applications for mobile search technology are enormous and include national homeland security, product information retrieval (such as environmental ratings, pricing, or specifications), vision support for the blind, accessing object information for the disabled, and general purpose information retrieval including remote visual data analysis and inspection. Search technology has brought about many profound societal, educational and scientific benefits in the past decade. The proposed mobile image search technology will extend those benefits to a broader base of users and applications.

Title: SBIR Phase II: OpenBio Workbench for Sharing of Mathematical Models in Drug Discovery

Award Number: 0822975
Program Manager: Errol B. Arkilic

Start Date: July 1, 2008
Expires: June 30, 2010
Total Amount: $496,357

Investigator: Taeshin Park, tspark@alum.mit.edu
Company: RES Group, Inc.
11 Cambridge Center
Cambridge, MA 2142
Phone: (617) 834-2416

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative software platform called OpenBio Workbench that will enable researchers in drug discovery to easily access and share mathematical models and model results. Modeling is becoming increasing important, motivated by the FDA's drive to modernize the drug discovery process and the advent of emerging fields such as Systems Biology. A broad adoption of modeling has been limited, however, because the current practice requires programming and computational skills not typically possessed by experimental researchers in biological sciences. In the Phase II project, the tool's capabilities will be augmented by allowing users to calibrate models by including experimental data, adding innovative advanced modeling tools such as model building. The potential commercial value of this workbench is high as the pharmaceutical industry is investing significantly in mathematical modeling and Systems Biology aiming to overcome both the high costs of drug development and the stagnation in the discovery of new drugs since the 1990's. Further, aging populations in developed countries are going to cause sharp increases in health care costs, while at the same time there are serious budgetary pressures (both from government and private insurers) to keep health care costs under control. Thus, methods that speed up the research cycle and reduce development costs for new drugs and treatments are going to become increasingly important.

Title: STTR Phase II: Integrating Online Analytical Processing (OLAP) and Ontologies to Discover Inconsistencies in Expectations for Supply and Demand

Award Number: 0750543
Program Manager: Errol B. Arkilic

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $512,000

Investigator: Peter Moore, peter@clados.com
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Phone: (650) 231-0494

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project aims to produce a software application that dramatically improves a manager's ability to allocate resources to productive uses. With advances in Online Analytical Processing (OLAP) and ontology technology, the tool has the potential to enable the discovery of future supply and demand imbalances for teams of business analysts. The objective is to produce at least one Investable Inconsistency per day by the end of the research period. The Phase I project produced unanticipated innovations that may have broad utility in both the OLAP field and the ontology field, and with these innovations, the software platform shows promise for transforming the essential practice of analysis in the field of market research in support of investment decisions. The Phase II project, if successful will result in technology that extends this promise to a broad audience, educating users in best practices for investment analysis and enabling them to materially improve their allocation of resources.

Title: SBIR Phase II: Collaborative Patent Drafting Software

Award Number: 0750550
Program Manager: Errol B. Arkilic

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $500,000

Investigator: Rocky Kahn, rocky@teampatent.com
Company: Team Patent LLC
5832 Birch Court
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Phone: (510) 601-7625

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a patent-drafting software tool which addresses two critical problems currently preventing inventors from closely collaborating with patent attorneys: 1. Attorneys need tools to hold their comprehension of and manipulate the relations in the document while ensuring they're used correctly and 2. Inventors need an ability to share the attorney's comprehension of the relations, review the application at any time, and author parts of the specification without requiring extensive oversight or rework by the attorney. The project will entail prototyping a set of collaborative knowledge representation methodologies, which are not currently available on any platform and which require cutting-edge, broadband-enabled infrastructure. The U.S. economy relies heavily and increasingly upon intellectual property, and patents are the primary currency of this economy. 500,000 utility patent applications will be filed in 2008 with the U.S. Patent and Trademark Office (USPTO), a quantity that has been growing annually at 7.5% for a decade. As patents become more significant in the operations and outcome of U.S. businesses, it becomes increasingly important to assure that the system can be efficiently traversed by high-technology startups, which will provide the next-generation of innovations. A U.S. patent application typically costs $10,000 and requires either specialized knowledge or the time to learn how to navigate the process. The large expense and difficulty of patents leads companies to triage protection for their innovations, leading to curtailment of promising activities due to the lack of a budget for patent protection. They must decide whether to divert precious capital and engineering resources from product development to patenting. The proposed patent-drafting software tool will encourage greater participation in the intellectual property economy by reducing costs, increasing relevance, and allowing inventors to actively participate in drafting the application.

Title: SBIR Phase II: Automated Community and Sentiment Mining for Global Media Preference Understanding

Award Number: 0750544
Program Manager: Errol B. Arkilic

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $500,000

Investigator: Tristan Jehan, tristan@echonest.com
Company: The Echo Nest Corporation
48 Grove Street
Somerville, MA 2144
Phone: (617) 628-0233

Abstract:

This Small Business Innovation Research (SBIR) Phase II project applies data mining and machine learning techniques to both natural language description and Internet link graphs to model communities in order to predict preference, taste and sentiment for different kinds of media (music, TV, online media, video games, books). Current contextual information mining approaches that scan the text on a page for advertisement or recommendation ignore valuable community connections inherent in most self-published Internet discussion. Sentiment and opinion extraction systems operating on full text create challenging language parsing problems are fraught with issues of scale and adaptability. The identification systems can automatically categorize anonymous Internet writers or website visitors into specific demographic communities based on their tastes in many kinds of media. The Phase II research project approaches opinion extraction with a bias-free learning model based on training from known online corpuses that can be adapted to different languages and learns in real time as more data becomes available for high accuracy. Current personalization and marketing approaches either look at the "clickstream" of an anonymous user, leading to equally anonymous recommendations for popular movies and music -- or by scanning a surface-level overview of the text, leading to keyword advertisements with limited contextual understanding of entertainment content and community sentiment. The project plans to fully integrate people-focused community and sentiment analysis technologies into an autonomous, learning and scale-free "media knowledge service" for digital entertainment providers and marketers that can change the way digital content is marketed and sold.

Title: SBIR Phase II: The Media Fusion Project: A Distributed Architecture for Mega-Pixel Displays

Award Number: 0750202
Program Manager: Errol B. Arkilic

Start Date: March 1, 2008
Expires: October 31, 2009
Total Amount: $499,999

Investigator: Christopher Jaynes, cjaynes@mersive.com
Company: Mersive Technologies, LLC
137 West Vine
Lexington, KY 40507
Phone: (859) 806-0398

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and deliver a software media architecture that removes a critical barrier to the widespread use of multi-projector, high-resolution, ultra definition displays. The approach defines a set of layered abstractions from the low-level display driver to higher-level protocols including multi-user display use and security. This model is the bedrock of a new display architecture that will not constrain future display innovations, allow content developers and producers to communicate to current and future display systems, and acts to isolate the underlying complexities of new display technologies from users. Building on this new architecture, the Phase II project will implement a software-based Display Operating System. The project is motivated by the perception that we will soon live in a world where displays cease to be individual discreet devices but rather become an extension of our environment; a limitless fabric of pixels. The potential impact of this innovation is significant, by removing the usability and cost barriers normally associated with ultrahigh-resolution displays, applications once available to only a select few can become commonplace. This has the potential to change the advanced visualization, media interaction models, as well as the way in which we interact with our computational environments.

Title: SBIR Phase II: SAFE: Behavior-based Malware Detection and Prevention

Award Number: 0750299
Program Manager: Errol B. Arkilic

Start Date: March 1, 2008
Expires: February 28, 2010
Total Amount: $500,000

Investigator: Hao Wang, hwang@novashield.com
Company: Novashield, Inc.
1200 John Q Hammons Dr
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Phone: (608) 833-2610

Abstract:

This Small Business Innovation Research (SBIR) Phase II project has the objective of implementing a commercially-competitive, host-based, malware detection and prevention system. During Phase I, a host-based malware detection system that demonstrated the practicality of detecting a malicious process by dynamically monitoring its system events was developed. The prototype called SAFE (Secure Activity Filtering Engine) filters system events using a stateful policy engine whose policies specify malicious behavior and the appropriate response. Because the technology does not rely upon the detection of "signatures" (i.e. patterns of bytes), it can detect previously unseen malware. During Phase II a number of significant enhancements to the policy engine including a checkpoint/rollback capability will be developed. The proposed functionality removes file system and registry changes associated with a process when a policy violation is detected. The ability to delay detection of malicious behavior until detailed system events are observed provides a just-in-time detection capability that increases the accuracy of the detection process while reducing false positives. The SAFE technology has the potential to demonstrate an effective approach to combating at least two of the dominant trends in the threat landscape. One such trend is the crafting of blended threats which use multiple infections vectors like email readers, web browsers, and messaging software to infect a host computer. Another trend is the popularity of "malware toolkits" which can be used by malware writers to quickly generate multiple variants of the same virus. The rapid proliferation of obfuscated variants is a potent threat to traditional signature-based solutions on two fronts: the rate of malware infection may overwhelm efforts to produce signatures to detect these variants and the logarithmic increase in the size of signatures databases reduces the performance of signature scanning. The SAFE technology addresses both of these trends. The stateful policy engine can correlate non simultaneous events across multiple sub systems and processes and thus detect and block blended threats. If successful, the architecture of the proposed system will have the potential to address a myriad of security threats and make a commercially-significant impact.

Title: SBIR Phase II: Visualization Toolkit for 3D Photography

Award Number: 0724338
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Siavash Zokai, zokai@brainstormllc.com
Company: Brainstorm Technology LLC
514 West 24th Street, 3rd Floor
New York, NY 10011
Phone: (516)668-1393

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to develop a comprehensive 3D photography toolkit for importing the geometry of existing large-scale urban structures into the computer. The goal of the project is to minimize the effort of building models of high geometric and photometric accuracy that are suitable for efficient rendering, manipulation, and analysis. The proposed Phase II work will build upon the feasibility study conducted in Phase I. The Phase I effort introduced a novel algorithm that successfully integrated multiview geometry with automated 3D registration to produce realistic visualizations of complex, reconstructed, real-world 3D models with minimal human interaction. The goal is to build approximate lightweight 3D models directly from a collection of photographs of the scene. The proposed workflow treats a photograph as tracing paper upon which 2D shapes are defined prior to extruding them into 3D models.

The commercial application of this Phase II project is the introduction of a comprehensive software toolkit for 3D photography. The ultimate goal is the reconstruction and visualization of detailed models of urban sites, i.e. digital cities. The creation of digital cities drives other areas of research as well: visualization of very large data sets, creation of model databases for GIS (Geographical Information Systems) and combination of reconstructed areas with existing digital maps. Other applications include video game development, entertainment, architecture, virtual tourism, fire/police/urban planning, urban design, disaster prevention, archaeology, and historical preservation.

Title: STTR Phase II: Nonintrusive Electrical Monitor (NEMO)

Award Number: 0646585
Program Manager: Errol Arkilic

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $500,000

Investigator: John Rodriguez, NEMOmetrics@aol.com
Company: NEMOmetrics
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Charlestown, MA 02129
Phone: (617)242-0050

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop and qualify a Non-Intrusive Electrical Monitor product (NEMO) to provide inexpensive, accurate, in depth monitoring of electrical usage, permit expanded energy savings and provide additional information, like potential equipment faults and failures. NEMO increases the amounts and kinds of diagnostic information that can be gleaned from a single set of electrical measurements, thus lowering the cost of monitoring building energy management systems. By analyzing the transient signatures produced when different electrical equipment draws power, NEMO can identify which of multiple loads turn on and off and assess their condition. The objectives of the research are to determine: the reliability of NEMO algorithms in the presence of multiple loads, prioritize several possible diagnostic analyses for the commercial product, and maximize the automation of NEMO data analysis while minimizing the need for human scrutiny and intervention. Phase I demonstrated the value of NEMO systems in monitoring and diagnostics with air conditioning units. The Phase II research plan calls for continuing the development work and installation of a qualified prototype in commercial buildings.

Data analysis will reveal inefficiencies in building operation and effectiveness of the algorithms themselves. This project will develop a system for non-intrusive detection and identification of multiple electrical loads with major energy conservation and other benefits. Time of use data can be used to create new automated algorithms that minimize energy use and optimize heating, ventilation, and air conditioning system operation without affecting occupant comfort, while electrical health diagnostics can signal when a motor is nearing failure or a valve has jammed. A reduction in the cost of in-depth monitoring allows more commercial facilities to reap energy and maintenance savings from these algorithms and the NEMO product that contains them. Actual measurement rather than estimation of initial and ongoing electrical power consumption of electrical equipment within a commercial building enables verification of upgrade performance. It also facilitates design and operation of intelligent, energy efficient buildings and assists in attaining Leadership in Energy Efficient Design (LEEDTM) certification. By promoting energy efficiency in buildings, NEMO will enable customers to reduce their energy costs, reduce or eliminated unscheduled maintenance and increase profitability.

Title: SBIR Phase II: Surface Enhanced Raman Scattering (SERS)-Based Nanoparticles as Covert Taggants for Anti-Counterfeiting Applications

Award Number: 0548687
Program Manager: Errol Arkilic

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $499,624

Investigator: Sharron Penn, sharron.penn@oxonica.com
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Mountain View, CA 94043
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will continue the development of an anti-counterfeiting solution for the brand security market, built around a series of covert, nanoscale taggants, called SERS nanotags. Three technical hurdles remain for the innovative tags to be accepted by customers: (1) ability for to develop cost-effective, commercial scale manufacture; (2) the demonstration of a handheld reader; and, (3) seamless integration into printed products.

Because of its mushrooming growth and profound economic impact, the FBI has called counterfeiting "the crime of the 21st century". Part of the problem is that current anticounterfeiting technologies offer extremely limited performance and are themselves easy to counterfeit. SERS nanotags embody all of the features of the, much needed, next generation of anti-counterfeiting technologies. Therefore, if successful, this technology will have an impact across many commercial and government sectors.

Title: SBIR Phase II: Unsupervised Extraction of Relational Data from the Web

Award Number: 0548699
Program Manager: Errol Arkilic

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $499,936

Investigator: Steven Minton, minton@fetch.com
Company: Fetch Technologies
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El Segundo, CA 90245
Phone: (310)414-9849

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enable software systems to make use of data on the Web that is embedded in HTML pages. The semantic web is intended to allow data to be shared and used by software applications. Unfortunately, in the present world, data on the Web is generally inaccessible to most applications because it is presented in a format intended to be usable by humans, as opposed to computers. The goal of this project is to create a relational view of data on the Web, so that applications can access Web data based on entities and their relations. The approach uses unsupervised machine learning to extract data from web sites for conversion into relational form. This project will result in a new generation of Web harvesting technology that has clear commercial value.

Web harvesting is an area of growing commercial interest for a variety of vertical markets, including Sales Intelligence, Market Intelligence, News Aggregation, and Background Search. However, web harvesting technology is limited today, since the collection of rich, detailed data must be done on a site-by-site basis. The approach described here, if successful, will enable a new generation of intelligent web harvesting technology that can scale to the entire Web. Ultimately, our approach will enable applications to query the entire Web as if it were a relational database. This has tremendous commercial value, and will enable many new types of web applications to be developed. In addition to the commercial value, the technical approach is novel and has significant merits on its own. If it is successful, the proposed method should generalize to other complex domains (such as scene understanding and natural language processing) where multiple heterogeneous types of structure must be analyzed to discover underlying meaning.

Title: SBIR Phase II: Improving Infection Control Through Radio Frequency Identifier (RFID)-Based Patient Tracking

Award Number: 0548737
Program Manager: Errol Arkilic

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $495,856

Investigator: Daniel Kokotov, dkokotov@vecna.com
Company: Vecna
5004 Lehigh Rd B
College Park, MD 20740
Phone: (301)864-7253

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will provide hospitals with a way to analyze and prevent hospital-associated infection outbreaks based on integrating a location tracking system with live hospital microbiology data, building on research done in Phase I. The goal is the design, implementation, deployment and clinical validation of two tools: (1) a visualization and analysis tool for investigating propagation dynamics of past and current infection outbreaks; and, (2) a simulation tool for evaluating response measures to potential outbreaks. The research will center on clinical acceptance and usability. The involvement of medical and infection control experts will ensure that the models of infection spread are accurate, the visualization and analysis tools are intuitive, and the simulation tools cover the important infections and scenarios.

Every year tens of thousands of lives, and billions of dollars, are lost to infections acquired in health care facilities. The envisioned product will give hospitals powerful tools for reducing these numbers, allowing them to better understand why infections happen and what counter-measures are effective. Hospital-associated infections' impact goes beyond the immediate sickness they cause, forcing treatment of the infection in addition to the underlying illness, and dissuading many from seeking necessary care because of the fear of acquiring infections.

Title: SBIR Phase II: Building a Large-Scale, Effective, Self-Maintainable and Customizable News Metasearch System

Award Number: 0522271
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000

Investigator: King-Lup Liu, kliu2002@yahoo.com
Company: WebScalers L.L.C.
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Abstract:

The Small Business Innovation Research (SBIR) Phase II project develops a metasearch capability engineered for news searching. Searching is the second most popular activity on the Internet behind emailing and it already has a multibillion dollar advertising market. News searching accounts for a major percentage of all searches. News items are available from a large number of online sources but the current technologies for news search are not scalable to effectively cover all of these sources in a timely manner. This project is to develop a new technology to tackle this problem via constructing a large-scale, highly effective, self-maintainable and customizable news metasearch engine. High effectiveness is achieved by automatically selecting the most appropriate search engines to access for each user query and by effectively identifying the correct meanings of the terms in each query. By employing highly automated techniques to incorporate search engines, this system can automatically adapt to changes that are made to the connected search engines and users can customize by adding their favorite news search engines.

Highly automated solutions employed herein reduce labor costs for development and maintenance, which translate to lower advertising costs and make online advertising more affordable for "small players", including small, local media Websites, individuals and small companies. This project advances large-scale information integration, large-scale distributed information retrieval, information extraction, automatic system self-maintenance, and customization on demand. The proposed technology empowers ordinary users in their search for more relevant and more up-to-date news items from a large number of news sources. It also empowers them to customize the search system to suit their information needs

Title: SBIR Phase II: Assessing Status and Trends of Threatened Species from Uncertain Monitoring Data: Methodology and Software

Award Number: 0514541
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,785

Investigator: H Akcakaya, resit@ramas.com
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Setauket NY, 11733
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop and implement as software methods for entering, processing, and analyzing species distribution monitoring data, which is one of the most basic forms of biological information that comes from surveys, censuses, and other routine assessments. These methods will use basic monitoring data to (1) assess the status and trends of the monitored species at the population-level, and (2) estimate the input parameters for the more advanced quantitative models, thereby increasing the use of these models, which include population viability analysis models, habitat models and other GIS-based methods, and quantitative risk criteria, such those used by the World Conservation Union (IUCN) and the NatureServe. One of the major innovations of the proposed software will be its treatment of uncertainty. Ecological data are often scarce and uncertain, including spatial and temporal variation, measurement and sampling errors, and demographic variance. The methods to be implemented in the proposed software will account for this uncertainty and incorporate it into the assessment of status and other outputs produced.

Broader impacts of the project will include standardization of the monitoring process for a broad spectrum of species, significantly reducing the cost of processing and analyzing monitoring data and increasing the use of advanced quantitative models in relation to environmental issues. This will, in turn, increase the use of scientific information in environmental decision-making and policy formulation. The methods developed in this project will also allow incorporating data uncertainties in an objective, transparent, and credible way, thereby providing scientifically credible and sound summary of the status and trends of the species monitored. The proposed methods will be implemented as software. Expected commercial applications include software sales and contracts for specific applications of the software.

Title: SBIR Phase II: Speculative Compilation for Energy Efficiency

Award Number: 0348966
Program Manager: Errol B. Arkilic

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Csaba Moritz, andras@bluerisc.com
Company: BlueRISC Labs
28 Dana Street
Amherst, MA 01002
Phone: (413)545-2442

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop energy-aware compiler techniques to reduce power and energy consumption in microprocessors, without affecting performance. Over the past few years, energy consumption by computers has emerged as a major area of intellectual and commercial activity. A key principle behind this approach is to use speculative information available at compile time to reduce power and energy consumption. The key qualifier is speculative: the information does not have to be provably correct. Speculative information that turns out to be correct will enhance energy reduction; if it is incorrect, the worst that will happen is that a penalty (in terms of energy) will have to be paid. The use of such speculative compile-time information opens up a largely unexplored dimension in compilers and computer architectures, to target energy efficiency.

The outcome of the proposed effort will not merely be a set of products, but also a vastly increased understanding of the means by which compile-time information can be exploited for energy savings. It is expected that this development effort will have a considerable impact on the theoretical underpinnings of compilers and compiler-architecture interaction, as well as a significant commercial impact. With the increasing prevalence of battery-powered computing devices such as PDAs, mobile telephones, and notebooks, power-aware computing is becoming increasingly important commercially.

Title: SBIR Phase II: Authentication of Mobile Video Recordings (MVRs) Based on Real-Time Hybrid Digital Watermarking

Award Number: 0349602
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Zhenyu Wu, zhenyu.wu@ieee.org
Company: MY EZ Communications LLC
580 Lake Drive
Princeton, NJ 08540
Phone: (609)713-3465

Abstract:

This Small Business Innovation Research (SBIR) Program Phase II project is aimed at the refinement and commercialization of the authentication technology developed during Phase I that enables the deployment of digital Mobile Video Recordings (MVR) system. A very large fleet of patrol vehicles operated by the law enforcement community that record events involving contact with civilians collects MVR data daily. Due to staggering costs associated with operating current analog, non-indexing system, there is an overwhelming needs for a computerized digital MVR technology. However, its deployment is hindered by legal acceptance, because digital medium can be easily altered. Authentication plays a critical enabling role by providing an effective means to safeguard the integrity of MVR content. To capitalize upon this emerging trend of digital MVR, the company proposes as a commercialization strategy to market the innovative technology in a package in an authenticated acquisition system, consisting of a digital video camera and a software suite for on-the-fly video watermarking, off-line MPEG compression and watermark verification. This compact and low-cost acquisition system leverages on existing in-car laptop for processing and storage, and is specifically designed to meet stringent operational requirements set forth by next generation MVR system. It integrates seamlessly with existing IT infrastructure and computerized MVR management systems. MVR has provided an effective way of protecting law enforcement agencies, their officers and the public they serve.

The MVR authentication provides an enabling technology for the acceptance and deployment of cost-saving computerized MVR technology for the law enforcement community nationwide. It allows for safe elimination of the labor-intensive process associated with safeguarding the integrity of MVR content, because watermarking is done on the fly and there is no time window at which MVR data are ever unprotected. With the deployment of digital MVR system equipped with watermark authentication technology, the costs associated with operating the system will be greatly reduced allowing for the savings to be redeployed to other law enforcement endeavors. Within the next three years a comprehensive national digital facial database will be created to support Homeland Security. As an integral component of the in-car laptop, this technology will serve as the front line in capturing the data for submission to the national database.

Title: SBIR Phase II: A Hydro Optical Analysis System (HOPAS) for Environmental Monitoring of Water Quality

Award Number: 0349581
Program Manager: Errol B. Arkilic

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $491,760
Investigator: Francis O'Brien, fjobrien@cox.net
Company: System Science Applications, Inc.
121 Via Pasqual
Redondo Beach, CA 90277
Phone: (310)375-9803

Abstract:

This Small Business Innovation Research (SBIR) Phase II research proposes to complete the development of an environmental information system - the Hydro-Optical Analysis System (HOPAS). HOPAS combines an advanced radiative transfer model with a powerful nonlinear programming algorithm to enable transforms of optical water measurements into information on the composition and concentration of materials that effect water quality. For the first time, measurements of the light field from satellites, aircraft, moorings, and ships can be rapidly inverted to obtain accurate estimates of phytoplankton, suspended mineral particles, and dissolved materials. HOPAS will enable scientists, environmental engineers, and aquatic resource managers to use easily obtained in situ or remotely sensed optical data to understand and manage aquatic ecosystems.

HOPAS will alleviate the need for expensive, labor-intensive laboratory analysis of water samples for use in addressing water quality issues, including microbial growth in drinking water supplies, surface pollutants from farms, industries, vessels, and domestic sources, algal blooms, fisheries and mariculture, and protection of coral reefs and sea grass beds.

Title: SBIR Phase II: Animated Real-Time Road Traffic Visualization for Broadcast and the Internet

Award Number: 0349460
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $510,000

Investigator: Andre Gueziec, andre@trianglesoftware.com
Company: Triangle Software
1265 W. Knickerbocker Dr
Sunnyvale, CA 94087
Phone: (408)893-8798

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at 2D/3D visualization of real-time traffic/traveler data (incidents, speed/density, public events) and computer traffic simulations. The rapid production of data-driven, information-rich animations has previously proved very difficult. With the notable exception of weather forecast animations, requiring highly expensive complex multi-computer systems, quality animations are routinely produced weeks ahead of time for television documentaries. Traffic/traveler data represents particular challenges such as the fact that data changes very frequently and becomes stale in minutes. Much of this data is in textual form, as reported on-scene by police or emergency crews. Reliability and utility to the traveler are concerns. Consequently, the four major weather broadcast companies have scarcely addressed the traffic market. This project will develop traveler data processing algorithms for predicting travel time, mining large databases of traffic information, and intelligent text- processing. It will also develop traffic micro-simulations, automating data-driven animation, and exploiting programmable graphics hardware for broadcast-quality real-time informative animations.

The expected results of this project are: (1) algorithms providing useful information to travelers/commuters from raw real-time police reports and sensor data; and (2) a product animating real-time traffic/traveler information for TV broadcast and the Internet, exploiting gradual improvements of raw data, as departments of transportation equip highways with speed/density sensors, and enforcement agencies open their servers. The Federal Highway Administration reports that the cost of traffic congestion in 1999 came to $78 billion nationwide, including 4.5 billion hours of lost time and 6.8 billion gallons of fuel wasted. Most transportation experts estimate that the ability to quickly provide accurate traffic information as proposed in this project has many benefits: (1) for drivers to plan alternative routes, keep on their schedules, and to reduce stress; (2) for overall congestion and better road maintenance; (3) for safety and road-rage mitigation; and (4) for improved pollution control.

Teaching & Learning

Title: SBIR Phase II: Artificial Intelligence Tutoring and Assessment for Teacher Development

Award Number: 0822696
Program Manager: Ian M. Bennett

Start Date: July 15, 2008
Expires: June 30, 2010
Total Amount: $500,000

Investigator: Benny Johnson, johnson@quantumsimulations.com
Company: Quantum Simulations Incorporated
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Murrysville, PA 15668
Phone: (724) 733-8603

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project focuses on bringing the power and benefits of artificial intelligence tutoring technology to the arena of teacher professional development (PD). The proposed innovation is a teacher professional development system built on the principles of artificial intelligence, and delivered via the Internet. Similar to a flight simulator, this technology will offer a realistic but benign opportunity to test and expand a teacher's preparedness through practice with realistic classroom situations. A key objective is the creation of a classroom simulator which incorporates a virtual master teacher, to help teachers deepen their content understanding, learn to respond to student questions more effectively, practice proven pedagogical techniques for improving student understanding and conduct self-monitoring and assessment before getting in front of a live class. An increasing number of schools are forced to rely on new or out-of-field teachers to fill the gap for teaching science and mathematics, often resulting in a substantial decline in quality, depth and individual attention students receive. Because of the well-documented problems of teachers teaching out of their content areas, and low-performing schools having greater percentages of lesser-qualified teachers, states have established stronger criteria for in-service teachers and newly qualifying pre-service teachers. Middle and high school science and mathematics are the areas where most out-of-area teaching is occurring. In the National Center for Education Statistics (NCES) report, 'The Condition of Education', a key finding is that high school students in high-poverty, high-minority schools were more often taught science, mathematics and English courses by out-of-field teachers than their peers in low-poverty, low-minority schools. This research is expected to impact these issues and in addition address the goals of the American Competitiveness Initiative and the requirements for highly qualified teachers identified in the 'No Child Left Behind' initiative.

Title: SBIR Phase II: OptDiverse: Innovative Technology to Enhance Workforce Diversity, Capabilities, and Performance

Award Number: 0750045
Program Manager: Ian M. Bennett

Start Date: April 15, 2008
Expires: March 31, 2010
Total Amount: $439,646

Investigator: Fred Glover, glover@opttek.com
Company: OptTek Systems, Inc.
1919 Seventh Street
Boulder, CO 80302
Phone: (303) 447-3255

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to refine an algorithmic approach and develop prototype software for workforce optimization with a focus on diversity planning and management. This project is expected to achieve the following four major objectives: 1) further enhance and extend the core technology created during Phase I and endow it with added capabilities that will be valuable for marketability as well as effectiveness; 2) enhance external communications - the software must communicate effectively with the user and database systems. In Phase I, rudimentary communications were established. During Phase II, the system will be greatly enhanced to allow for more effective use; 3) develop software as a service architecture - for greatest market penetration, the software will be deployed via the web. The system architecture will be redesigned to accommodate this requirement; and 4) perform alpha-testing - internal and external testing is critical to releasing a high-quality product. The Phase II research will strengthen the technical aspects of the product while significantly improving its ease of use, producing a system ready to enter the market. The commercial applications anticipated for the software system are to first enhance the performance of workforce diversity planning and then evolve to supporting the optimization of the entire workforce. The technology is expected to have a significant impact on the broader inclusion of under-represented talent in the workforce. We also expect the technology to lead to improved organizational performance by enabling better decisions in recruitment and retention of all employees. The software will permit an organization to model and simulate critical patterns between policies, programs, initiatives, as well as other factors such as practices and compensation. The impacts of this research include the potential to: 1) design a more effective approach (simulation/optimization) to diversity planning and workforce optimization, increase workforce diversity, capabilities, and performance; 2) support a significant social and economic initiative; 3) become appealing to attract investments as it significantly increases return and minimizes risk in diversity and workforce planning; 4) add to the body of knowledge in human resource management and decision sciences that may be leveraged to permit additional research and development.

Title: SBIR Phase II: A Standards-Based High School Symbolic Geometry System

Award Number: 0750028
Program Manager: Ian M. Bennett

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $527,500

Investigator: Philip Todd, ptodd@saltire.com
Company: Saltire Software Inc
12700 SW Hall Blvd
Portland, OR 97223
Phone: (503) 968-6251

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an interactive symbolic geometry system that integrates algebra and geometry and focuses on high school mathematics. The absence of such a system has led to a technology gap in mathematics education between the geometry year in high school and the college level calculus sequence. The result of this project will be a software system along with learning materials which fills that gap. The National Council of Teachers of Mathematics (NCTM) standards include the visualization of three-dimensional figures and the mapping between certain three-dimensional surfaces and their two-dimensional unfolding or projection onto the plane. To address this, the project will create a three dimensional symbolic geometry system and in the process will break new ground both from an algorithmic and a user interface perspective. The creation of geometric models dependent on discrete but possibly indeterminate parameters, for example, a general n-gon, is an important pedagogic device for the study of the limits of geometrical figures. Such a facility poses new design and user interface challenges ranging from the definition of the general form of the dependence to the display of a geometrical figure with an indeterminate number of primitives. This Phase II project addresses the need for solid mathematics skills required for college-bound students and for those going directly into the workforce. Specifically, this project focuses on the learning of algebra, and its linkages with geometry. To date, no application exists that integrates algebra and geometry. The integration of technology itself within the learning of mathematics is one of the NCTM's six key principles of school mathematics. The project will incorporate geometrical constraints in addition to geometrical constructions and hence, unlike any other current educational system, directly address the workforce/professional requirements of a geometry system.

Title: SBIR Phase II: 3D Human Functional Anatomy for Middle and High School Education

Award Number: 0750352
Program Manager: Ian M. Bennett

Start Date: March 15, 2008
Expires: February 28, 2010
Total Amount: $493,537

Investigator: Robert Levine, rlevine@archiemd.com
Company: ArchieMD, Inc
1602 Alton Road #126
Miami Beach, FL 33139
Phone: (305) 981-4830

Abstract:

This Small Business Innovative Research (SBIR) Phase II Project combines 3-D computer graphics and gaming technology to provide a non-linear, immersive learning environment for science education in the human anatomy and physiology domain. Modern computer-simulations present a unique ability to present scientific information in an easy to understand manner. Technology advances in computer graphics present opportunities to present higher quality visual models in an interactive fashion that can convey the scientific process in a way which makes learning science fun and interesting for the students while capturing their enthusiasm for science. The proposed project will develop a toolkit consisting of 3-D visualizations for teaching human anatomy and physiology and interactive simulation environments for exploring the human body from a first person point of view. It is envisioned that simulations will be used in conjunction with traditional lectures while the interactive environments will provide immersive reinforcement learning. Phase II development will be validated by an independent evaluation that measures the products effects on achievement and interest in science. This project will play a role in increasing achievement and interest in science. In order for the nation to remain competitive in the life sciences, the nation must produce an adequate number of students who pursue degrees in life sciences. The proposed research is targeted at improving students' interest and achievement in science, and thus greatly impact the disturbing drop in recent years in United States' student interest in pursuing science education and careers, and the rapid increase in demand in the labor market for science-based degrees for the labor market.

Title: SBIR Phase II: Online Chapter Marketplace for Biology Learning Materials

Award Number: 0749862
Program Manager: Ian M. Bennett

Start Date: March 15, 2008
Expires: February 28, 2010
Total Amount: $499,999

Investigator: Eli Meir, meir@simbio.com
Company: SimBiotic Software
148 Grandview Ct
Ithaca, NY 14850
Phone: (212) 658-9104

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an electronic replacement for reading materials currently used by the majority of biology undergraduate students. This replacement will combine smaller reading sections with more active learning components such as simulated experiments. The system to be developed will be open to contribution from a wide variety of authors and subject matter experts. Textbooks are currently used in most college biology environments to present material to students. However, learning through textbooks occurs primarily through memorization. This project is developing new innovative ways to facilitate productive learning techniques, and for configuring take-home assignments of biology students to be more active, without losing the content needed for understanding biological systems. This project has the potential to transform one of the pillars of science education, the textbook, from a passive reading instrument to an active learning tool. This could contribute to the improvement of learning gains for the at least one million students per year that participate in college level biology classes each year in the U.S. On a broad scale, this project eventually could help improve learning across all the sciences.

Title: SBIR Phase II: A Visual Language for Mathematical Model-Making

Award Number: 0750432
Program Manager: Ian M. Bennett

Start Date: March 1, 2008
Expires: February 28, 2010
Total Amount: $532,000

Investigator: Christopher Hancock, ch@tertl.com
Company: Tertl Studos LLC
1 Hopkins St.
Montpelier, VT 5602
Phone: (802) 223-3044

Abstract:

This Small Business Innovative Research (SBIR) Phase II project continues the development of a visual interface that allows students to construct and investigate mathematical models. This research is undertaken with the goal of creating a general-purpose environment in which students, teachers, and content developers may benefit from being able to create such models for classroom use. The specific research objectives for this project address the following issues: 1) the underlying algorithmic support to achieve a concrete user interface; 2) the completion of the core functionality; 3) classroom usability and curricular integration; and 4) learning outcomes. The innovation embodied in this project responds to a national need for improved algebra education, and to increased emphasis on, and demand for, environments that provide visual, dynamic access to mathematical ideas and thinking processes.

Title: SBIR Phase II: Adaptive Authoring for Compound XML Documents: Collaboration Tools and eLearning Content Creation for STEM

Award Number: 0750520
Program Manager: Ian M. Bennett

Start Date: April 1, 2008
Expires: March 31, 2010
Total Amount: $499,920

Investigator: Samuel Dooley, sam@integretechpub.com
Company: Integre Technical Publishing Company, Inc.
4015 Carlisle NE, Suite A
Albuquerque, NM 87107
Phone: (505) 889-8189

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to develop rich-media adaptive authoring tools for e-learning content creation for collaborative documents for science and mathematics. The proposed objective is to remove technical barriers that impede development and deployment of e-learning content, and to advance tools that create structured content from multiple cooperating document types. The research objectives of this Phase II project will extend the Lexicon adaptive authoring framework developed in Phase I, as measured by compound document authoring issues exhibited by the QTI XML binding, which we will use as a vehicle to advance the adaptive authoring framework. The project will elaborate the Lexicon operator declarations to provide conventional authoring behavior needed for QTI markup elements, according to a progressive schedule of regular project milestones. At the end of the project, it is anticipated that the Lexicon will represent an adaptive authoring tool for rich-media collaborative documents with full language support for QTI markup, as a means for authoring and delivering e-learning content. Additional configuration language improvements and configuration authoring tools will position Lexicon to adapt to a wide range of compound XML document types for e-learning content, and extended programming interfaces will enable Lexicon to embed into a wide range of collaborative e-learning applications. Education in the U.S. is currently undergoing a transition to the digital age that will impact every aspect of teaching and learning. The current generation of collaboration tools are text-based,and do not support the notation needed to communicate mathematics. This project seeks to develop a suite of collaboration tools that have native support for mathematical notation, so that students and instructors can communicate scientific and mathematical concepts more effectively. This Phase II project aims to will extend the Lexicon adaptive authoring framework developed in Phase I, to support embedded semantic markup needed to deliver rich instructional content, and to position Lexicon to support a series of collaborative e-learning applications that are enabled by a relatively small amount of semantic markup: MathIM, an instant messaging application, prototyped during Phase I, that allows users include mathematical notation in person-to-person chat messages; MathWiki, a web-based forum application that supports communities of users who share an interest in topics that require mathematical notation; MathSpace, an online authoring environment for creating student worksheets; and MathME, or the Math Media Environment, a 'virtual notebook' in which students can record the work they are doing online.

Title: STTR Phase II: Intelligent Instruction Systems using Augmented Reality

Award Number: 0646587
Program Manager: Ian Bennett

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $499,022

Investigator: Jayfus Doswell, juxtopia@hotmail.com
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6581 Hickman Terrace
Alexandria, VA 22315
Phone: (703)989-1199

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project investigates the creation of intelligent instruction systems that exploit adaptive software mechanisms (i.e. intelligent software agents) and augmented virtual reality (AVR) techniques. Since it is common that production-line employees are required to wear goggles, intelligent agents could transfer their instructions via goggle-like wearable computers (i.e. AVR) that overlay the actual visual field with text and computer graphics. The proposed techniques will facilitate the real-time assessment of employees undergoing training and will allow the software agents to automatically and proactively reinforce weaker areas based on these assessments. An overall assessment model of all employees can characterize the entire workforce for a particular facility. For example, this overall assessment can be used to enhance resource management triggered by absenteeism or other factors, allowing planners to use such assessments for optimizing manufacturing processes by refactoring traditional, perhaps obsolete, production processes.

The broader impacts of the technology result from the use of intelligent agents to manage and direct the cross-training of employees in typical work environments where absenteeism and workforce turnover are important issues. Additionally, this technology, through workforce training broadly impacts the workforce to become more adaptive and agile with the resulting positive impact on overall product quality and productivity.

Title: SBIR Phase II: Understanding the Nature of Science

Award Number: 0620590
Program Manager: Ian Bennett

Start Date: September 15, 2006
Expires: August 31, 2008
Total Amount: $499,930

Investigator: Timothy Erickson, tim@eeps.com
Company: BigTime Science
5269 Miles Ave
Oakland, CA 94618
Phone: (510)653-3377

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will deliver simulations over the web for secondary and post-secondary science instruction which focus explicitly on students coming to understand the "nature of science." The nature of science implies that both the underlying logic of scientific discovery and the way that science is organized around the acquisition and dissemination of data and ideas. This is the big picture in science learning -- establishing the relationship between experiments and hypotheses; the idea that theories are models and not reality, and that the test of a theory is its predictive power. The research focuses on the careful design and testing of both the simulations and the lessons in which they are embedded, to ensure that they are as effective as possible.

Tomorrow's citizens need to know how science works. This project will help erase dangerous misconceptions about the origins and extent of scientific knowledge, and give students tools to evaluate scientific (and quasi-scientific) claims more effectively. This project also probes unusual models for both delivery of instruction and commercialization in the education world: it will use the Internet not to deliver content but to mediate a simulation and promote inter-group communication, usually within a single classroom rather than more widely; and will do so using subscriptions - a way that is cost-effective to the teacher in the short term.

Title: STTR Phase II: Lifelike Virtual Tutors to Support Authentic Learning

Award Number: 0620486
Program Manager: Ian Bennett

Start Date: August 24, 2006
Expires: August 31, 2008
Total Amount: $497,843

Investigator: Edward Sims, eds@vcom3d.com
Company: VCOM3D, Inc.
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Orlando, FL 32817
Phone: (407)737-7310

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop proof-of-concept, Web- or CD-delivered Virtual Reality (VR) simulations that incorporate lifelike virtual tutors, capable of demonstrating and performing science experiments and communicating in written or spoken English or sign language, for Grades 5-8 curricula.

This project provides an opportunity to broaden participation of under-represented groups in authentic learning experiences, through the use of lifelike virtual tutor avatars. Originally conceived as a means to explain concepts visually and with sign language to deaf students with low English skills, these virtual tutors will benefit a broader range of learners who are otherwise isolated by language or reading barriers, or by lack of access to laboratory equipment.

Title: SBIR Phase II: Providing Tools for Richer eLearning Assessment

Award Number: 0620380
Program Manager: Ian Bennett

Start Date: August 3, 2006
Expires: July 31, 2008
Total Amount: $500,000

Investigator: Linda Chaput, lchaput@thinkfive.com
Company: Agile Mind
1100 South Main St
Grapevine, TX 76051
Phone: (817)424-2863

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will study effective models for carrying out assessments employing challenging puzzle-like questions that incorporate distractor analyses in which meaning is assigned to complex responses. Such distractor analyses apply where there is the possibility that the test taker can give alternative correct, partially correct, and incorrect answers. Metadata and distractor analyses will be combined to provide in-depth reports on student test performance. This new rule-based solution to distractor analysis meets a significant challenge in being able to include engaging problems in assessments of student progress in quantitative courses, such as Algebra and Geometry. The research will further develop question authoring and test construction tools.

As a consequence of this work, educators using these new technologies will be able to move beyond online testing based solely on multiple-choice, single-answer questions that are known to be unmotivating for many students. The goals are twofold: to provide varied, interesting, and even gamelike learning interactions that incorporate motivational and pedagogically valuable feedback; and to do so in a form in which empirical evidence can be used to improve the assessment corpus - both the metadata and the rules used for defining distractor analysis, especially where the items are novel question types.

Title: SBIR Phase II: Creating New Learning Opportunities: Platform-Independent, Wireless, Task-Oriented Communities

Award Number: 0620327
Program Manager: Ian Bennett

Start Date: August 3, 2006
Expires: July 31, 2008
Total Amount: $499,958

Investigator: Michael Curtis, curtis@goknow.com
Company: GoKnow
2084 South State St
Ann Arbor, MI 48104
Phone: (734)929-6602

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aimes to design and develop a challenging and critically important layer of communications' software that enables K-12 educational software developers to incorporate explicit support for collaborative learning activities into their existing applications quickly and at low-cost. The Elmer Software Development Kit (SDK) will enable students to collaborate using a broad range of handheld (or even desktop/laptop) computer platforms (Windows CE & XP, Linux, Mac OS X) since classrooms, as they are already beginning to experience, will be using non-homogenous computers side-by-side. The Intellectual Merit of this proposed effort stems from the need to construct new algorithms to automatically detect other devices, to reformat communications' messages to enable cross-platform (and cross-operating system) communication on a range of platforms. The outcome of this effort should be a software development kit that engenders the incorporation of collaborative learning strategies.

K-12 education is the cornerstone of America's democracy. As No Child Left Behind (NCLB) act acknowledges, America has some serious work to do in reinventing how we educate our children in order for America to continue to provide its people with the standard of living that is the American Promise. Technology is today's generation's tool of choice outside of school; we need to make technology an integral tool inside of school, too. Advocating for technology is the easy part - making the technology accessible, useful, and enjoyable remains the challenge. Our SBIR project goes directly to the core of helping K-12 realize the vision of technology positively impacting teaching and learning. In particular, the proposed research will enable educational software developers to create, quickly and at low cost, collaboration-enabled applications that teachers demand and that students find enjoyable and productive.

Title: SBIR Phase II: Visualization of Massive Multivariate Adaptive Mesh Refinement (AMR) Data

Award Number: 0548729
Program Manager: Sally Nerlove

Start Date: January 23, 2006
Expires: February 29, 2008
Total Amount: $430,385

Investigator: Lisa Avila, lisa.avila@kitware.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the lack of visualization technology for hierarchical structured grids created through an advanced simulation process known as Adaptive Mesh Refinement (AMR). Although the AMR structure makes possible simulations that are too computationally expensive using a uniform grid approach, it leaves the scientist with a lack of visualization tools to properly render the resulting volumetric data. With the successful completion of this Phase II effort, Kitware will meet this need by developing visualization tools that are focused on efficiently and effectively rendering the large, multivariate, time-varying data produced using the AMR technique. The primary technical accomplishment of the Phase II effort will be the development of a high performance volume rendering strategy for AMR data that runs across a variety of platforms from a standard desktop system to a large cluster of high-end workstations. Advanced transfer function techniques will aid scientific discovery by allowing scientists to visualize relationships in their data. Packaging these visualization tools into a user-friendly application will make this complex technology accessible to researchers. In addition, Kitware will adapt this technology to the clinical medical visualization market, where large, multivariate, hierarchical data will become commonplace in the near future.

The state-of-the-art AMR visualization technology developed during this Phase II project will be donated to the scientific community as part of two open-source packages. This technology will be available to software developers through the Visualization Toolkit (VTK), a C++ class library of visualization, graphics, and image processing algorithms. This technology will also be incorporated into the end-user scientific visualization application ParaView, which can run on a desktop computer or across a high performance cluster. Through the use of extreme programming principles, these open source packages are developed, tested, and released daily, allowing Kitware to deliver the latest technology for immediate use by the scientific community. In return, this provides Kitware with continual feedback from users and developers that will help the firm to improve not only the open source software, also the firm's commercial products that are built on top of this code base. Kitware intends to leverage the Research Opportunities for Undergraduates (REU) and Research Opportunities for Teachers (RET) programs to build a team of students and teachers who will generate educational material from the software including lesson plans, presentation materials, animations, and suggested projects. This material will be distributed to educators at the high school and undergraduate levels.

Title: SBIR Phase II: Advancing an Interactive Learning Platform by Integrating Multiplayer Game Technology

Award Number: 0548732
Program Manager: Sally Nerlove

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $500,000

Investigator: Douglas Seifert, douglas.seifert@syandus.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project advances Syandus's interactive learning platform by integrating multiplayer game technology. Syandus's current interactive delivery platform allows pharmaceutical firms and content experts to communicate complex concepts to physicians and patients through interactive presentations, discussion groups or self-directed learning. The addition of network-enabled collaboration afforded by this proposed project creates the opportunity for interaction between users and content experts without the constraints of geography. The integration of multiplayer game technology into Syandus's platform requires the innovative application of this technology to serve a new purpose. This proposal will support modification of the existing platform to function in a collaborative setting, building a collaborative engine to synchronize application data between users, integration of a third party multiplayer networking solution and development of a prototype application to test collaborative functionality. Syandus has completed projects with several of the top 20 pharmaceutical companies for the delivery of innovative medical education products based on the existing platform. In the first business application derived from this proposed concept, physicians will be able to remotely connect with nationwide content experts to interactively learn the latest best practices and medical science in a more compelling way than currently available.

The pharmaceutical industry strives to communicate medical science innovation and new treatment methods through an information cascade from international and national level thought leaders, to regional physician thought leaders, to practicing physicians and their patients. The anticipated results from the proposed concept will be a learning tool for pharmaceutical companies that allow groups of physicians nationwide to have an interactive dialog about a disease state and appropriate treatment. Longer term, in the educational realm, Syandus's technology could be used to develop more sophisticated collaborative learning environments that allow students, regardless of geographical location, to assemble in a virtual biological world or system (such as a cell or organ) and work together as individuals or in groups to solve problems and optimize processes. A highly rewarding learning experience can be created through the free exchange of information and ideas enabled by a collaborative network coupled with compelling visuals, rich interactivity and the underlying intelligence of mathematical models. Transforming Syandus's existing platform with multi user capability adds rich human interaction into the remote learning process, brings scientific models to life, and allows greater dissemination of knowledge.

Title: SBIR Phase II: Incorporation of Knowledge Base into Statistical Machine Translation

Award Number: 0548763
Program Manager: Sally Nerlove

Start Date: January 11, 2006
Expires: December 31, 2007
Total Amount: $500,000

Investigator: Yookyung Kim, kim@sehda.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project embodies an innovative approach to machine translation. The proposed model aims to overcome two important bottlenecks in the development of a high quality statistical machine translation (SMT) system: (1) inability to handle structural problems and (2) dependence on huge amounts of parallel texts. The inability of statistics to sufficiently handle grammatical problems such as word order becomes more evident when the language pair is very different in structure and morphology, such as with English and Korean. The dependence on a huge amount of parallel texts is a great challenge especially to speech translation. Based on successful tests in the Phase I project, this project proposes a method to learn linguistic knowledge crucial to handling word order and non-local dependencies automatically from input and incorporate it into SMT along with simple transformations, maximizing the strength of both knowledge-based approaches and statistical approaches, and minimizing the need for ever-increasing amounts of bilingual data. The proposed approach aims to build a syntactic-phrase-based statistical machine translation engine that not only is more accurate than the existing word-based ones, but also can decrease the need for large data sources.

The primary impact of the proposed project is the potential for achieving automatic translation quality as high as the quality of the best knowledge-based machine translation engines; but with a minimum of handcrafting of knowledge and therefore at a much lower cost in terms of development time and human resources. While the research is specifically concerned with MT between English and Korean, the resulting translation models would potentially be usable for translation between any pair of languages. The result of the research will be used to develop a speech translation device, in particular to overcome language barriers in communication with patients in hospitals. It will provide a key technology that will accelerate development of speech translation applications in order to reduce costs of healthcare providers and to enhance the quality of healthcare. Additionally, the proposed method of learning linguistic features will have an impact on many different applications including speech recognition, search engines, genre and topic detection, and document search and query. Finally, the proposed research will have beneficial impacts nationally and globally by helping to solve the 'automatic translation' problem, an area of paramount importance to the economic welfare and security of the United States and the rest of the world.

Title: SBIR Phase II: Developing a Cost-Effective Method for Creating Cognitive Models for Cognitive Tutors

Award Number: 0548754
Program Manager: Sally Nerlove

Start Date: January 9, 2006
Expires: December 31, 2007
Total Amount: $509,999

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will make the creation of effective intelligent tutoring systems (ITSs) easier, and it will enable the dissemination of that technology to a broader audience than currently realized. ITSs have proven to be highly effective in delivering computer-based instruction, but they have historically been expensive and difficult to build, requiring specialized skill in artificial intelligence and production systems programming. Building upon Clearsighted's Phase I accomplishments, the firm will: (1) finish a fully-functional software development kit (SDK) that will allow non-cognitive scientists to create the cognitive model that powers an ITS; (2) develop technology that will enable an ITS to communicate to the vast majority of third-party software; (3) develop techniques that will allow an ITS to work with an institution's existing on-line learning system; and (4) evaluate the research team's work with respect to both time-savings in building ITSs and customers' return on investment. Two main results are anticipated: (1) a two- to three-fold decrease in the amount of time it takes to author an ITS; and (2) an estimated savings to customers of 30% per hour of the cost of traditional training time.

The success of ITSs is well documented (e.g., Koedinger, Anderson, Hadley, & Mark, 1997; Corbett, 2001; Morgan & Ritter, 2002). However, ITSs have not been broadly deployed, due to the high level of expertise needed and the cost to create. Furthermore, lack of viable options to interface the cognitive model of an ITS with already existing software impairs wider dissemination of that technology. By increasing technological understanding of how to reduce the amount of the expertise needed to create an ITS and how to accomplish interfacing ITSs with existing software, the result of this supported work will be a wider distribution of ITSs. Clearsighted is well poised to become a market leader in on-line technical training by leveraging this technology. Clearsighted has partnered with Carnegie Learning, the ITS leader in K-12 education to assist in these goals, and it has the additional expertise needed to perform the required work. By transitioning ITS technology from its currently very small market to a wider audience that includes not only education, but also corporate and industrial applications, the costs to the many companies and institutions that do on-line training will greatly decrease, and the productivity of their workers will increase.

Title: SBIR Phase II: Cognitive Agility Assessment Tool

Award Number: 0548631
Program Manager: Sally Nerlove

Start Date: January 6, 2006
Expires: March 31, 2008
Total Amount: $532,000

Investigator: Lia DiBello, lia@wtri.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an assessment tool that will enable users to profile a decision-maker's cognitive agility and expertise in high-level business situations. It is appropriate for evaluating decision makers in organizations and students who aspire to leadership roles. This version of the product can also be self-administered. It is based on results from recent basic research conducted by Workplace Technologies Research Inc. (WTRI) that revealed the cognitive mechanisms involved in the thinking of highly accomplished experts in business. It uses knowledge elicitation technology that WTRI has developed over several years to support research on the identification of intuitive expertise (in the sense of Dreyfus 1997). The proposal outlines a plan to develop an on-line Internet based version that is self-scoring and tested among well-known experts. The product will be field-tested for its ability to predict general vs. industry specific expertise. The expected outcome is an easy to use tool for professional evaluators, professors, students or individuals, which will assist in staff development and education. The profiles generated by the product will identify hidden strengths, areas of weakness, and suggestions for further development. The long-term goal is distribution by recruiters, coaches, universities and consultancies.

In the current climate of rapid workplace change, decision-makers need to continually evaluate their ability to adapt to changes and re-invent their organization's value and competitive future. Few assessment tools address the cognitive underpinnings of the skill set involved. Rather, they evaluate personal traits or sub-skills that have some correlation with leadership, broadly defined. Using an empirically verified model of expertise in business strategy development and performance prediction, the research team at WTRI has built an assessment tool that locates an individual with regard to this model; much like chess players are evaluated against a notion of a Chess Grand Master. When applied to individual client situations, this tool has been shown to have powerful predictive capability and thus has successfully informed staff development efforts. Its distinctive feature is assessment of the ability to analyze disparate sources information in order to make strategy level decisions and supporting tactical plans. Making the tool more widely available and usable by non-scientists could importantly contribute to efforts to increase the performance of both organizations and decision makers. Organizations, distributors and several institutions of higher learning have expressed interest in this technology, which they consider to be addressing an area of unmet need.

Title: SBIR Phase II: Customizable Question Answering System for Homeland Security and Commercial Applications

Award Number: 0450599
Program Manager: Ian M. Bennett

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $499,717

Investigator: Munirathnam Srikanth, srikanth@languagecomputer.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will result in a novel question-answering technology. The features of this technology are as follows: (1) Automatic filtering of questions. During Phase I, Language Computer Corporation (LCC) developed a system that decomposes high-level questions into low-level, fact-seeking questions. Some of these questions, however, turn out to be nonsensical. In Phase II, the firm proposes to submit all of the decomposed questions to a knowledge-based system, which will eliminate questions that are inconsistent with tacit knowledge. All of the questions that survive filtering will be passed back for processing by the question-answering system. (2) Aligning domain ontologies with a large reference ontology. During Phase I, LCC developed a tool that generates domain ontologies from raw text. During Phase II, the firm will extend this tool so that the domain ontologies are automatically aligned with an overarching domain-independent ontology. This alignment will permit deeper expansion of query concepts, because it will allow domain-independent concepts to be augmented with domain-dependent content. (3) Formal evaluation of semantic relations. The foundation of the question-answering system is semantic relations extracted from queries and documents. These relations will be evaluated to assess the relative contribution of each one to question answering. The result of this evaluation will establish which aspects of semantics are most useful to question- answering.

This project will have a direct impact in the following areas: (1) The system can be deployed in commercial and government settings where the accuracy, coverage, reliability, and usability of the retrieved information are crucial. Ideal applications for the technology include homeland defense, CRM, education, medicine, and the law. (2) The system bridges the gap between domain-independent and domain-specific content. Domain ontologies are constructed automatically, and these ontologies are automatically aligned with a large reference ontology, so that queries can be simultaneously expanded into the terms appropriate to many different domains.

Title: SBIR Phase II: Enabling Pedagogical Choice and Cost-Efficiency in the Development of Web-based Curricula

Award Number: 0450380
Program Manager: Ian M. Bennett

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build a first-release Web-based system for content authoring and delivery that supports multiple approaches to pedagogical practice and provides efficient, easy to use methodologies with which course designers can employ system capabilities. Specifically, this project will continue the work started and demonstrated to be feasible in Phase I to create online authoring and complementary course management systems, which have features and benefits that are immediately available to innovative instructional designers. The goal is to enable the development of technology-mediated instruction through cost-effective means for producing new content and to do so with a focus on supporting instructional design innovation without compromising the capabilities of the technology. The goal is an innovation that will empower content providers to use principled learning theories and pedagogical practices for creating new online curricula that support technology-mediated instruction. The project will produce a new type of authoring and delivery system in which the functionality available to create course structure; manage multimedia content development; translate course specification into reliable production delivery; and access course-related activities for learners and their teachers or mentors, including dynamic learning interactions and real-time behavior tracking and reporting reflects the authors' preferred learning theories and pedagogies.

This project seeks to provide a set of enabling tools that support the development of technology-mediated instruction through cost-effective means for producing content, focused on supporting instructional design innovation without compromising the capabilities of the technology. The commercial applications of the research result are sales and licenses of the created systems, both with and without content, to content developers, publishers, and also middle and high schools, districts, and other local entities for use by individuals and groups who desire to create and to publish content and assessments for communities of practice and who are impeded by cost and time constraints. The resulting systems will address a major problem in education: the consolidation of content development and dissemination in the hands of a small number of publishing conglomerates and the consequent lack of quality and diversity of choice that have been a result of that consolidation. With an extensible authoring system, the company would be positioned to tap into a large market with a business model that supports both new business development and the legacy assets of publishers and eLearning providers, and to create major new opportunities for many other types of content providers.

Title: SBIR Phase II: Use of a Visual Programming Environment to Promote Bioinformatics Education

Award Number: 0450526
Program Manager: Ian M. Bennett

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $500,000

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to provide a tool to improve bioinformatics education. This tool, VIBE-Ed, is a software product designed to augment bioinformatics at the college and university level by creating an interactive, integrated, and comprehensive approach to bioinformatics education using visual programming. During the Phase I project, INCOGEN demonstrated that its existing research tool, VIBE, provides an excellent foundation for an educational tool given its inherent technological attributes. VIBE employs visual programming for bioinformatics, and in this respect, VIBE-Ed will provide a novel approach to bioinformatics classroom instruction. The Phase I work demonstrated the effectiveness of visual programming in the learning process. In addition to visual programming, the architecture of VIBE supports the inclusion of extensive information about the bioinformatics tools contained therein, making VIBE-Ed well suited to host the large and complex amount of resources and documentation required by an educational tool. Finally, VIBE was created to be extensible, allowing it to be naturally extended into VIBE-Ed. As the bioinformatics community discovers and validates new analysis tools, these can easily be incorporated into VIBE-Ed, along with the educational features to support them.

Bioinformatics education is a growing field, driven by the great need for trained bioinformaticists in biological and biomedical research. Recent years have witnessed notable increases in the number of bioinformatics courses and degree programs at colleges and universities worldwide. Textbooks and lectures alone do not expose bioinformatics students to hands-on data analysis and, by themselves, they are insufficient for bioinformatics education. Despite the growing trend in bioinformatics education and the need for educationally focused tools, there is a significant lack of commercially available software tools specifically designed for bioinformatics education. Currently, bioinformatics instructors fill this gap by using either complicated and expensive research tools or collections of web-based tools. Bioinformatics research software is often cost prohibitive for an educational application, and the software itself is geared toward experts in the field rather than toward students. Web-based tools are often free of charge, but they are also frequently dispersed throughout the web, requiring excessive time and sometimes also requiring programming skill to combine the use of several tools. Many of the tools are not accompanied by instruction or related conceptual information, making them less suitable for education. VIBE-Ed successfully addresses these concerns and promises to have immediate impact on bioinformatics education and, ultimately, in knowledge discovery on life science research.

Title: SBIR Phase II: Sketchpad for Young Learners of Mathematics - Dynamic Visualization Software in Grades 3-8

Award Number: 0521981
Program Manager: Ian M. Bennett

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $499,808

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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to overcome barriers to the effective use of The Geometer's Sketchpad software in elementary and middle school math classes, and to deliver on the software's potential for transforming education at these levels. This research-based educational technology tool and its "Dynamic Geometry" interaction paradigm are well known at the secondary and higher level for their ability to foster visualization and exploration in mathematics and to enhance student learning. This project responds to clear calls for the software's application and adaptation to younger grades coming from teachers, from curriculum development and research communities, and from standards bodies such as the National Council of Teachers of Mathematics (NCTM). The proposed research, led by the team that created and maintains Sketchpad, first identifies and prototypes modifications to the software to add scope and age-relevant functionality and to remove barriers to access for young learners; and second pioneers new classroom activities-structures, materials, and vehicles-for supporting and extending standards-based curricula in grades 3-8 through the agency of Dynamic Geometry technology. The intellectual merit of the proposed activity reflects (a) the degree to which the activity responds to perceived pedagogic need (as cited, e. g., in the NCTM Principles and Standards 2000) for Dynamic Geometry technology at the elementary and middle school level; (b) the opportunity to extend the broad base and literature of research that exists on Dynamic Geometry at the secondary level to significantly earlier grade levels (particularly with respect to effective Dynamic Geometry activity design and Dynamic Geometry impact on student affect and cognition in the early grades); and (c) the resources this proposal brings to the question of how best to integrate effective, standards-based curriculum (in this case, the Connected Mathematics Project, Everyday Mathematics, and Math Workshop curricular programs) with effective, standards-based technology. The project brings together research experience in both curricular and software design; project staff includes Sketchpad's authors and project consultants include the author teams of each of the named curricula.

The broader impact of this project reaching its objectives will be the creation and availability, in primary and middle grades, of age-appropriate Dynamic Geometry mathematics education technologies and supporting curriculum similar to those which define Sketchpad at the secondary level, where the software is considered the "most valuable software for students" (Becker, 1999) by mathematics teachers across the country; and of research-driven solutions to the challenge of supporting standards-based curricula effectively with educational technology.

Title: SBIR Phase II: Digital Microscopy with Collaborative Learning

Award Number: 0450650
Program Manager: Ian M. Bennett

Start Date: April 15, 2005
Expires: March 31, 2007
Total Amount: $500,000

Investigator: Timothy Hall, tim@prime-ent.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to provide a model for integrating digital microscopy and web-based on-line collaborative learning in order to improve science education. In Phase I, Digital Blue developed a collaborative worksite, www.planetmicro.com and enrolled +400 students. In Phase II Digital Blue proposes to further this inquiry by building, in conjunction with the Concord Consortium, a state-of-the-art website where students use common digital microscopes and engage in a true collaborative educational experience. Digital Blue will undertake this work by scaffolding the website to improve interaction between members; improving the work flow in which users "tag" their digital images thus optimizing search engine productivity; developing common curriculum modules; developing an online professional development utility to empower teachers to use this technology in their coursework; and adding thousands of members to foster an innovative and successful collaborative community.

Digital Blue proffers an innovative product and service for the education market, namely Planetmicro.net, a collaborative workspace that is fully integrated with a proprietary digital microscope. The site would be the first collaborative workspace that interacts seamlessly with affordable digital laboratory equipment in each classroom. Other collaborative learning environments offer common methods and processes but fail to integrate uniform tools, creating a gap between the hands-on activity of the lab and the virtual activity. In contrast, Planetmicro.net would make it easy to integrate collaborative learning with traditional science pedagogy.

Title: SBIR Phase II: A Model for Virtual Dialogues with Master Teachers

Award Number: 0450567
Program Manager: Ian M. Bennett

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $500,000

Investigator: William Harless, wgharless@idrama.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project describes software that combines speech recognition, digital video, and personal computer technologies to allow PC users to have "face-to-face" dialogues with video characters that are real people. This software, called Conversim (Registered Trademark), incorporates an independent speaker recognition engine so that any English-speaking user can spontaneously say the words and phrases known to the system and be understood. All Conversim (RT) programs include a non-directive, intelligent prompting algorithm. Each time the virtual character responds to the user, the system dynamically selects statements and questions that are specifically relevant to the character's last response and then displays three choices in a rhythmic scroll. Between questions, the character's active image remains on the monitor as if waiting for the next question. The Conversim (RT) dialogue model is unique since it enables the user to have a virtual conversation with a real person whose intellect, personality, and personae are intact and available. This very personal model opens the door to numerous innovative applications in education. Scientific research has shown that most users enjoy the virtual dialogue experience; many have significant, often accelerated, learning gains; and almost all feel as though they have met the person with whom they have been "talking." These findings strongly indicate the method merits further research in conventional educational settings.

This model represents a new paradigm in education, one that allows the student to learn through a one-on-one interview of the master teacher. The paradigm involves non-directive, independent learning by conducting face-to-face dialogues with master teachers in cyberspace, who are always present, always available, and always willing to converse with people who wish to engage them. Multimedia presentations can be used in concert with the dialogue to clarify concepts and complex topics. Also, the power of the computer for tracking and innovative, dynamic evaluation strategies are inherent in this model. The broad objective is to make this model and this new paradigm available in all educational institutions that would benefit from its use. It has potential to provide a means for students everywhere to gain access to and learn by engaging in dialogue with some of the best minds in the country; to be used to educate a broad range of students, from high school to the post-graduate level; to help students whose education is restricted by geographic location or economics; to enhance learning for all students by making them active participants in the learning process; and to provide high-quality education while significantly reducing per student costs.

Title: SBIR Phase II: Cheminformatics Teaching Tools for the Cheminformatics Virtual Classroom

Award Number: 0450457
Program Manager: Ian M. Bennett

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $519,956

Investigator: Norah MacCuish, norah.maccuish@mesaac.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the development of virtual classroom software tools for cheminformatics training in academia and industry. Mesa Analytics & Computing, LLC provides a commercial, integrated suite of the leading-edge cheminformatics software tools for the pharmaceutical and biotech industry. However, these tools, incorporating the most recent research in cheminformatics by Mesa, and integrated with other leading cheminformatics vendors` software (OpenEye, eduSoft, ChemAxon, and AccuSoft), are for use in large-scale research and industrial applications, where the users already have experience in cheminformatics software, most often obtained through on-the-job training. The research goals of this project are to develop an easy to use, comprehensive, and competitively priced cheminformatics virtual classroom. This project will further the advanced research and development of software tools for interactive distance learning in cheminformatics topics, such as finding compound substructure commonalities, generation and use of structural and property compound descriptors, similarity searching, cluster analysis, compound library design, 3D drug design, compound databases, and Quantitative Structure Activity Relationship (QSAR). The project will produce a beta version of the cheminformatics virtual classroom ready for testing and marketing to the academic and industry markets.

There are a growing number of university departments worldwide offering courses and degrees in cheminformatics, across a range of life science disciplines. However, there is no comprehensive cheminformatics virtual classroom product. Software products used in the pharmaceutical and biotech industry are expensive, difficult to install, and of limited utility for introductory training. Converting Mesa`s tools and other vendors` software into a coherent set of Web-based training tools for concept learning, with the help of six diverse academic testing sites, will provide the necessary training tools for academia and industry. Web delivered training software is a cost effective means to provide distance learning for rural and urban academic institutions and industry sites here and abroad. The virtual classroom will help to lower the cost of on-the-job training for early phase drug discovery research efforts found in the pharmaceutical and biotech industries. The long term goal is to increase the quality and quantity of new researchers, with the potential benefit of increasing the number of drug leads, thereby improving the chances of finding more effective drugs for a wider range of serious diseases, and possibly lowering the cost to consumers.

Title: SBIR Phase II: Personal-Knowledge-Management eLearning System

Award Number: 0423443
Program Manager: Sara B. Nerlove

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $491,956

Investigator: Robert London, blondon@taxonomize.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project improves access to knowledge by auto-organizing unstructured data to respond to specific individuals, groups, and their activities. Taxonomize Resource Aid (TRA) uses syntactic, semiotic, semantic and statistical techniques to generate and update resource taxonomies, which are multi-level indices into the information corpus (documents, web sites, etc.) specific to users' activities. These active taxonomies are practice-relevant and personalized, and they provide applications of enhanced search, auto-produced portals, personalized content management, and knowledge discovery. For example, TRA's coordinated knowledge directories produce discovery of trends in time-based documents (such as discussion groups); extraction of information from unstructured data (such as distributed themes); and notifications from monitoring multiple information sources for patterns of confluences (e.g., news relevant to collaborating partners) or discrepancies (e.g., knowledge missing in one area that can be filled from another). Phase II development will take the successful prototype that was tested in educational settings, and create a commercial product (initially as a SOAP/WSDL web service) that will be licensed to firms selling software solutions in the areas of e-learning, search, and knowledge management. Taxonomize Resource Aid (TRA) will provide knowledge tailored for individuals, groups, and activities, and thus will provide people who have been limited by accessibility, resources, or background ready access to resources of knowledge, instruction, and collaboration. The TRA prototype has already been shown to provide significant benefits to some university students who were learning how to do primary research. Those who have difficulty with the culture, language, or technology gain the greatest benefits from TRA, because it gives them accelerated access to knowledge that is automatically selected for relevance to their activities, based on Taxonomize's powerful auto-categorization capabilities. TRA can help in any field where people need to organize, manage, access and use large amounts of information and resources.

TRA can help improve education, healthcare, defense, and government organizations process information quickly, especially when dealing with immediate and critical situations. It can also help disadvantaged people find necessary resources, and keep updated with changes that would otherwise be infeasible to monitor. TRA improves knowledge accessibility, flexibility and adaptability and affordability of general learning capabilities, and so may benefit formal and informal learning in every area.

Tite: SBIR Phase II: Modular Online Simulations for Math and Science with Integrated Assessment of Complex, Standards-Aligned Learning Objectives

Award Number: 0422116
Program Manager: Sara B. Nerlove

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,246

Investigator: Paul Cholmsky, pcholmsky@explorelearning.com
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P.O. Box 2185
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Phone: (434)293-7043

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will produce a commercial version of PathfinderPlus, an online system that integrates assessment of complex, standards-based instructional objectives within interactive simulations and makes the resultant data available in a timely and efficient manner to students, teachers and administrators. In order to effectively implement curriculum standards-based educational reforms (e.g., as mandated by the No Child Left Behind Act), teachers need guidance in linking students' day-to-day learning to these standards and in adapting subsequent instruction based on students' progress against the standards. Existing educational technology products, however, are explicitly correlated only to the macro-level terminal objectives in each state's curriculum standards. As a result, these products do not provide diagnostic information regarding component knowledge and skills, and they thereby fail to support teachers in understanding more precisely where students are having difficulties within a given terminal objective. PathfinderPlus provides a comprehensive online library of highly interactive learning objects that track student' actions as they use them. The system analyzes the generated data to create assessment probes which yield results that are indexed against a hierarchy of component knowledge and skills related to each state's terminal objectives. This analysis provides students, teachers and other educational stakeholders with a roadmap to success in meeting their state's curriculum standards. In terms of broader impacts, the successful production of a fully functional, commercial PathfinderPlus product will break significant technical ground in the field of large online repositories of interactive learning objects. The deployment of ExploreLearning's XML specification HILO ML (Highly-Interactive Learning Object Markup Language) separates the pedagogical logic of a learning object's adaptive behavior from its technical instantiation. This separation enables the efficient development of the volume of scripts required by a system that covers entire courses (e.g., Algebra). The use of a four-tiered architecture to link fine-grained pedagogical events (i.e., pedagogically-meaningful interactions between students and the online simulations) to macro-level terminal objectives provides a flexible, modular foundation for the system.

In terms of impacts on K-12 education, PathfinderPlus will foster alignment with standards-based curricula, support teachers in integrating technology effectively and efficiently into their classrooms, and provide a new approach for measuring the impact of educational technology on student learning. In addition, the system's use of interactive simulations as the medium for assessment enables a broader range of more complex, higher-order instructional objectives to be assessed (e.g., problem solving strategies and skills), as compared to traditional probes used in computer-based applications such as multiple-choice questions.

Title: SBIR Phase II: Interactive Earth: Tools for Earth Systems Science

Award Number: 0349784
Program Manager: Sara B. Nerlove

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $531,998

Investigator: Kirk Bergstrom, worldlnk@well.com
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San Francisco, CA 94115
Phone: (141)593-1695

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to research and develop ways to increase accessibility and utilization of Earth systems science data and visualizations for secondary school teachers and students. The commercial product will consist of a DVDROM, curriculum, and web site. Building on WorldLink Media, Inc.'s previously published CD product, Interactive Earth, the firm will develop an integrated tool set for data display and image interpretation that will enable students to inquire, hypothesize, analyze, discover, and communicate with peers-replicating the work of real scientists. Much more than a static software program, the Interactive Earth DVD-ROM will be part of a "learning platform" that includes an in-depth curriculum package, access to a rich archive of global data via the web, and professional development opportunities. Partnerships with NASA's Earth Observatory web site and the World Resources Institute's EarthTrends project will enable classroom access to extensive global data sets and visualizations. TERC, a research and education organization, will develop a curriculum that aligns with the National Science Education Standards. This SBIR project recognizes the vital interplay between a curriculum developer (TERC), data providers (NASA and World Resources Institute), and a media designer and tool-builder (WorldLink) in creating exemplary learning materials. Earth science is of national strategic importance as a field of research and innovation.

The potential contribution to our schools and students is not just in Earth systems science, but in the broader applicability of the skills developed by students to related domains of science, math, geography, and other fields. These thinking skills include inquiry, visual literacy, understanding systems and models, and the ability to apply knowledge and problem solving to a range of real-world issues.

Universal Access

Title: SBIR Phase II: (IT-B5) Feasibility to run novel voice interface on a low-power microcontroller

Award Number: 0822743
Program Manager: Ian M. Bennett

Start Date: August 15, 2008
Expires: July 31, 2010
Total Amount: $500,000

Investigator: Seth Cameron, seth@cameronsound.com
Company: CameronSound, LLC
2004 Centennial Dr.
Great Falls, MT 59404
Phone: (801) 474-0134

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will implement a miniature information management system that is suitable to the access requirements for visually impaired users. Current information technologies for the visually impaired are slow and difficult to operate while holding a white cane or guide dog. Visually impaired people will benefit greatly from a hands-free/eyes-free information system that is much faster to operate and easier to access. The project will develop a voice-operated personal digital assistant (PDA), called Vivian, which performs 10 times faster than Braille PDAs. The outcome of the Phase I study demonstrated the feasibility of real-time speech processing algorithms on integrated microcontrollers without hardware floating-point arithmetic. The outcome of this Phase II project is anticipated to result in a wearable device similar to a state of the art media player with 10X faster processing and 10X smaller in size. With more than 160 million visually impaired people worldwide, 10 million in the US alone, the proposed research is a critical step towards a device that will address their mobile information management needs significantly better than current alternatives. Moreover, this device should impact mobile information management for sighted people. The results of usability trials with sighted users speaking multiple languages conducted during the Phase I project, indicate that the outcomes of a powerful and fast alternative human computer interface to graphical user interfaces for sighted and visually impaired users. Additionally, this voice technology is suitable for integration into mobile appliances such as mobile phones for which over 300 million were sold in 2007.

Title: SBIR Phase II: Electronic Orientation and Navigation System for People with Visual Impairments

Award Number: 0822972
Program Manager: Muralidharan S. Nair

Start Date: July 1, 2008
Expires: June 30, 2010
Total Amount: $500,000

Investigator: Michael Manning, michael@manningrf.com
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2718 Winningham Rd.
chapel hill, nc 27516
Phone: (919) 967-5438

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will design, build and test a new type of orientation and navigation (O&N) system for people with visual impairments. While GPS-based solutions show promise in outdoor environments, there are currently no widespread O&N devices that are designed for use in indoor environments. This makes it difficult for people with visual impairments to navigate through indoor public spaces. The purpose of this research will be to complete development of a new type of radio frequency identification (RFID) system, in which intelligent, variable-range active RFID beacons are programmed with information about their locations and placed through indoor environments like schools, shopping malls and museums. This information will be accessible to people with visual impairments via a small RFID receiver worn on the user?s belt. Information will be conveyed to the user via a text-to-speech interface. Results from field testing have demonstrated that the device helps people with visual impairments to navigate through an unfamiliar environment. Phase II research will complete development of the communications protocols and interface techniques that give the system its unique capabilities for delivering speech-based information to people with visual impairments. There are 10.4 million people with visual impairments in the U.S., and this research will lead to an inexpensive commercial product that will greatly enhance their ability to navigate in unfamiliar surroundings. The market for this technology includes those who will purchase the RFID receivers and the RFID beacons. This includes people with visual impairments, as well as the owners and tenants of public spaces, such as office buildings, schools, malls, museums and government facilities. Also, because of the simplicity of the interface, the system will be useful to Orientation and Mobility educators working with young children to develop spatial concepts.

Title: STTR Phase II: Developing a Mixed Reality Rehabilitation System

Award Number: 0750551
Program Manager: Ian M. Bennett

Start Date: April 15, 2008
Expires: March 31, 2010
Total Amount: $500,000

Investigator: Mark Wiederhold, mwiederhold@vrphobia.com
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San Diego, CA 92121
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Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project investigates further development of a mixed reality (MR) haptics-based virtual reality system in preparation for commercialization. This MR system will aid the physical rehabilitation of stroke patients with upper extremity disabilities. This MR system includes hardware and software designed to induce neuroplastic changes and increase mobility through mental practice, video capture body movement, and engaging mixed reality scenarios. The goals of this project will be to file the appropriate paperwork for regulatory approval of the system in preparation of use on the market, improve the system in scenarios, add mental practice and video capture scenarios, program metrics into the system, develop sensor tracking interface and telerehabilitation capabilities, and conduct clinical trial to determine system safety and efficacy. Headed by a collaborative team of qualified investigators from The Virtual Reality Medical Center, the University of Central Florida's Institute for Simulation and Training, and Kindred Hospital (consultant), this project will increase the understanding of state-of-the-art adjuncts to traditional stroke rehabilitation therapy. To date, no MR rehabilitation tool that facilitates mental practice, includes video capturing, and aids physical therapy, has ever been commercialized. The resulting marketable product will be sold to rehabilitation facilities. This STTR Phase II project will lead to the commercialization of new software and hardware that can be used for further technological developments in mixed reality systems, including those for other applications such as prosthetic limb rehabilitation for amputees. The success of this project will also add to the scientific knowledge base on what is known about mental practice in rehabilitation. With over twelve million families in the U.S. alone that have members with a physical development, success in this project will therefore pave the development and commercialization of future rehabilitation systems to help this broad and underserved population. By increasing stroke patients' upper extremity mobility and rate of recovery, this system will also increase their activities of daily, enable at-home physical therapy, relieve some of the burden of caregivers, and decrease costs in lost productivity and hospital length of stay. The commercial spin-out company resulting from success of this project will be located near the University of Central Florida's College of Medicine where future joint projects will include recruiting and training students (including those from underserved populations) in research. The commercial spin-out company will also create new jobs, taxable revenue, and income within the Florida High Tech Corridor.

Title: STTR Phase II: Low-Cost Portable Telerehabilitation System for Intelligent Stretching and Remote Assessment of Hypertonic Arm Joints

Award Number: 0750515
Program Manager: Muralidharan S. Nair

Start Date: March 1, 2008
Expires: February 28, 2010
Total Amount: $485,564

Investigator: Yupeng Ren, yupeng.r@gmail.com
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2510 Wilmette Ave.
Wilmette, IL 60091
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Abstract:

This Small Business Technology Transfer Research (STTR) Phase II research project seeks to develop technologies needed for rehabilitation of post-stroke patients with neurological impairment. For those patients, physical therapy followed by timely examination is the cornerstone of the rehabilitation. However, not all patients receive sufficient therapy due to limited access to expert healthcare services. There is a need for a tele-rehabilitation system that can stretch the spastic/contractured joints under accurate control at a remote location and provide remote access to expert healthcare services. This Phase II research will focus on improving the technology and making it suitable for the market by improving the design of the tele-rehabilitation system for multi-purpose applications to treat/evaluate multiple joints in the arm. It will make the portable device stand-alone with built-in capabilities of passive stretching, voluntary movement exercise, and tele-assessment of joint range of motion, stiffness, spasticity, and catch displayed in an intuitive way. Finally, a clinical test of the tele-rehabilitation system on stroke survivors will be conducted. This portable and low-cost stretching device is suitable for home use, making frequent and convenient treatment accessible to a large number of patients. It can potentially have broad impact on rehabilitation of stroke and other neurological impairments. The intelligent stretching concept was developed to insure safe and effective treatment and it will also be useful in other applications dealing with human-machine interface.

Title: SBIR Phase II: Tactile Graphic Array

Award Number: 0450169
Program Manager: Ian M. Bennett

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000

Investigator: Oleg Tretiakoff, oleg@catechnology.net
Company: C. A. Technology, Inc.
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Jensen Beach FL, 34957

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will conduct research leading to the development of working prototypes of new low cost and compact Tactile Graphic Displays and Braille Displays. The dominant technology today, displays driven by piezo-electric actuators, has two major deficiencies. It is very expensive, about $12 to $16 per tactile dot, and the actuator shape, a 50 to 70 mm long reed, significantly increases the volume of feasible displays, essentially limiting their use to single line Braille displays for desktop or portable devices. During the Phase I of the project, C.A.Technology performed extensive research on the design of a new Shape Memory Alloy single dot actuator and has demonstrated the feasibility of tactile displays based on this technology. This actuator uses a short and very thin Titanium-Nickel alloy wire, which will bring the cost per dot down to about $3 to $4, and will considerably reduce the display volume, allowing its use in hand-held devices. The Phase II effort will include the following: 1) detailed design, construction and user testing of the new tactile arrays; 2) development of software to interface these displays with various portable and hand-held devices, such as C.A.Technology's own Portable Print Reading Device; and 3) preliminary design of manufacturing tools and facilities.

In the mid-seventies, the appearance of the first electronic Braille displays changed the lives of blind individuals. Today, many have immediate and selective tactile access to textual information through refreshable electronic Braille displays. However, the high cost of these devices still severely limits their diffusion. By reducing their cost, their size and their weight, this new technology will increase the market penetration of Braille displays, making them accessible to many more blind and deaf-blind individuals and significantly improve their employment opportunities. Access to graphic symbols widely used for example in mathematics, chemistry and access to plain graphics is still only possible through slow, bulky and very costly graphic embossers. If a picture is "worth a thousand words", then a compact, low cost refreshable graphic tactile display proffers a significant new opportunity for the lives of blind students, blind engineers, blind physicists and blind people involved in almost any intellectual activity. In addition, it will also be important to those with low vision.

Title: SBIR Phase II: Individualized Guidance for the Blind (IGB)

Award Number: 0620511
Program Manager: Ian Bennett

Start Date: September 13, 2006
Expires: August 31, 2008
Total Amount: $467,488

Investigator: Gary Livshin, glivshin@talking-lights.com
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Phone: (617)242-0050

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an Individualized Guidance for the Blind system which is an accurate, affordable, easy-to-use indoor/outdoor assistive navigation system to aid people who are blind in wayfinding and traveling. In a separate effort, a wayfinding system for the blind using GPS for outdoor location is now being designed and built. For indoor use, however, this system requires a complex inertial guidance system for location and guidance. In this project, inexpensive optical locators will be used to improve indoor wayfinding and supply GPS-like location indoors.

Software developed will allow Individualized Guidance for the Blind locators to provide GPS-like locator information indoors and permit the input of location to the personal data assistants (PDA), updating of location and elimination of errors. As a commerical product, application areas will include hospitals, care facilities, museums, malls, schools, retail stores, trade shows, transportation facilities and otherplaces where blind and people with limited vision require navigation assistance.

Title: SBIR Phase II: Folding Power Wheelchair with Modular Battery System

Award Number: 0548759
Program Manager: F.C. Thomas Allnutt

Start Date: February 16, 2006
Expires: February 29, 2008
Total Amount: $488,309

Investigator: Bart Kylstra, kylstra@gmail.com
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20 Scot Alley
San Francisco, CA 94107
Phone: (415)385-4508

Abstract:

This Small Business Innovative Research (SBIR) Phase II project aims to develop a lightweight modular wheelchair that can be easily lifted and handled by either the user or a companion. This wheelchair can be loaded into any vehicle, thus dramatically improving the mobility of the user. The research project focuses on designing the frame, drivetrain, motor and battery system to allow more of synergistic effect and lightweight to aid the user in his/her mobility.

The commercial and societal benefits from this project will result in not only greater mobility but also drastic increase in the quality of life for the user, improved family mobility.

Title: SBIR Phase II: Accessible Electronic Mathematical Content

Award Number: 0522308
Program Manager: Ian M. Bennett

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $499,959

Investigator: Neil Soiffer, neils@dessci.com
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Long Beach CA, 90802
Phone: (562)432-2920

Abstract:

This Small Business Innovation Research (SBIR) Phase II project makes mathematical expressions in common electronic formats seamlessly accessible to people with print disabilities. Print disabilities include blindness, low vision, dyslexia and other learning disabilities. While others have explored aspects of accessibility in stand-alone applications, none have integrated access to mathematical content for those with print disabilities into users' existing screen readers or other assistive technology. The advantage of this project's approach to math accessibility is that it allows documents containing math to be read with standard browsers and document viewers. The electronic formats supported by this project are web pages that encode math using MathML, Microsoft Word documents, and PDF. Accessibility is achieved by providing software add-ons to Internet Explorer, Word, and Adobe Reader, and modifications to the industry leading authoring and publishing workflow tools to embed MathML into these formats. The project brings together work on various aspects of making mathematical content accessible. It pushes forward the state-of-the-art in audio rendering of mathematical expressions, navigation of mathematical expressions with audio feedback, and audio rendering synchronized with highlighting of the sub expression being spoken. The project provides a platform that allows other NSF-funded research projects to convert MathML to Braille math codes and other formats.

Accessibility of electronic content is a requirement of the Rehabilitation Act Amendments of 1998, Section 508. Many states have adopted similar requirements for state-funded entities. The Individuals with Disabilities Education Act (IDEA) mandates accessibility of school materials. Accessibility laws apply to all forms of content, not just textual content. Current solutions for math accessibility are so costly and time consuming that access to materials in a timely manner is not always provided to those that need the access despite legal mandates. The results of this project will present a fast and inexpensive route for publishers of textbooks with mathematical content to satisfy these laws. It will also provide a simple and painless way for people who author documents with math in them to make the document accessible to people with print disabilities. The availability of books and other material coupled with accessible authoring of mathematical content has the potential to dramatically enhance the way students with print disabilities are taught and learn mathematics, science, engineering and other technical fields.

Title: SBIR Phase II: Commercial Combustion Synthesis of Homogeneous Lots of Carbon Nanotubes

Award Number: 0522093
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $499,482

Investigator: Henning Richter, hrichter@nano-c.com
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33 Southwest Park
Westwood MA, 02090
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project is designed to achieve a pilot-plant demonstration of the technical and commercial feasibility of cost- and energy-efficient large-scale conversion of natural gas to single-walled carbon nanotubes (SWCNT). The research will include: (1) exothermic and selective synthesis of SWCNT by premixed combustion of natural gas after introduction of catalyst precursors with the cold gas mixture; (2) continuous collection of material by means of a bag-house filter; and, (3) detailed understanding of the correlations between operating conditions (pressure, type of catalyst, fuel-oxygen ratio, dilution with inert gas, cold gas velocity) and characteristics of the carbon nanotubes (single-, double-, or multi-walled, diameter, length, conductivity).

Results of this project are expected to have a significant impact on the development of the US nanotechnology sector and to strengthen its international competitiveness. Projected sales price of not more than $50/g will lead to a pronounced increase of the number of economically viable SWCNT applications.

Title: SBIR Phase II: Accessible Scalable Vector Graphic Authoring and Editing Applications

Award Number: 0422218
Program Manager: Sara B. Nerlove

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $493,942

Investigator: Vladimir Bulatov, bulatov@viewplustech.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will support development and testing of Windows applications for creating and making available highly accessible SVG files. Scalable Vector Graphics (SVG) is a graphics markup language supporting features critical to accessibility by individuals with print disabilities. One application permits authors easily to create and/or edit mainstream graphical information as SVG files fully usable by individuals with print disabilities. Full accessibility requires only that authors supply names of important graphics objects, a task easily done with the SVG Editor. Most individuals with print disabilities can comprehend graphical information better by moving the mouse over text or graphics objects displayed in the ViewPlus SVG Reader, whereupon they hear the text or names of graphics objects spoken aloud. Blind users and those unable to use a normal mouse can also comprehend such information by creating a tactile copy on a ViewPlus Tiger embosser which can then be read with their fingers after placing it on a ViewPlus Touchpad. Sighted users can obtain an embossed color image with the new Color Embosser. Availability of an appropriate embosser and Touchpad means that even individuals with severe print disabilities can access mainstream graphical information without assistance by another human being. Computer users with severe print disabilities currently have good access to words but very poor access to graphical information. Lack of good access to graphs, charts, and diagrams severely affects quality of life and educational and professional opportunities, particularly in the STEM fields, i.e., science, technology, engineering, and mathematics.

Graphical information today is "made accessible" largely by written or verbal description. There is currently no practical way to make most graphical information available in a form usable by individuals who are severely dyslexic or for blind people, who may or may not read Braille. These new SVG applications will provide a user-friendly technology that fills that need. Graphical information can simply be created and displayed on the web or in electronic documents as SVG files that are usable by everybody. The hardware technologies needed by blind or severely dyslexic people should cost no more than a present-day Braille embosser, so it should be affordable for libraries and institutions to provide this capability thus to serve these clientele. The largest user base for the SVG Reader will probably be individuals with less severe print disabilities who can improve their comprehension by supplementing visual with audio information.

Title: SBIR Phase II: Creating Accessible Science Museums for Blind and Visually Impaired Visitors with User-Activated Audio Beacons

Award Number: 0421973
Program Manager: Sara B. Nerlove

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,710

Investigator: Steven Landau, sl@touchgraphics.com
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330 West 38 Street
New York, NY 10018
Phone: (646)515-3492

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will demonstrate the effectiveness of a new system for guiding visitors in science museums and other public spaces. Touch Graphics will design, implement, and evaluate an apparatus that will allow any museum visitor to dial in to, and then interact with, a computerized attendant, using the visitor's own cell phone or one lent to him/her. A special feature will allow blind and visually impaired users to navigate independently by following sounds from environmental audio beacons that they will control by pressing keys on their phones. Once a visitor arrives at the requested exhibit component, his or her phone will serve as an audio explainer and control interface. While the development of this concept has been motivated by the desire to accommodate the needs of visually impaired museum-goers; in Phase II, the small business will configure the system as a mainstream audio guide product that includes optional accessibility features. The small business will create an experimental installation of the envisioned system in a large science museum in New York City, where it will undergo two rounds of human subject testing. As part of this installation, an interactive touch model of rockets that are part of the museum's collection will be designed, fabricated and tested to study the effectiveness of users' cell phones as an accessible control interface for individual exhibit components. The project will also be complemented by a parallel study in which user-activated audio beacon technology is deployed in a different context; a phone-based navigation tool will be implemented and tested as a travel aid for blind and visually impaired bus riders in Austin, Texas who need to find public access information.

This user-activitated audio-beacon technology has the potential to improve access to important public resources, particularly science museums for individuals who have been excluded due to disabilities. It seeks to provide opportunities for the blind and visually impaired to experience the enrichment and entertainment offered at hundreds of facilities around the country. These institutions offer opportunities for informal science education that can inspire people to pursue careers in science and technology, and the Nation as a whole stands to benefit when more qualified young people are encouraged to enter these crucial fields. Improved science literacy for all citizens, young or old, is an important goal that this project seeks to promote.

Title: SBIR Phase II: Mobility Agents for Persons with Cognitive Disabilities

Award Number: 0349663
Program Manager: Sara B. Nerlove

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $500,000

Investigator: Alexander Repenning, alexander@agentsheets.com
Company: Agentsheets, Inc.
6560 Gunpark Drive, Suite D
Boulder, CO 80301
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Abstract:

This Smal Business Innovation Research (SBIR) Phase II project will develop Mobility Agents that help persons with cognitive disabilities use public transportation systems. The realization of an operational system that wirelessly connects users to real-time bus information through Mobility Agents depends on the fact that public transportation systems are increasingly equipped with GPS (Global Positioning System) systems connected to control centers through dedicated wireless networks. Controllers use this infrastructure to schedule and optimize operations and avoid organizational problems such as bunching. Agentsheets proposes to use this existing infrastructure to compute highly personalized information and deliver it on PDAs or cell phones to persons with cognitive disabilities. Wireless devices with location aware Mobility Agent services that help travelers use public transportation systems, permit caregivers to customize these agents, and monitor the progress of travelers by means of utilizing The Pragmatic Web, a framework for highly customizable Web information; and Deductive Tracking, a combination of sensor fusion and minimalist common sense AI that creates more reliable tracking information. Agentsheets will explore design and implementation issues for agent-based real-time user interfaces on handheld devices; build the system, and test it in a real-world setting using the Boulder bus system as a public transportation test bed.

The Mobility Agents technology turns general GPS-based information into personalized, practical information. Customization mechanisms range from simple preferences to rule definition, and are relevant to the fields of End-User Development/Programming, Visual Languages, and Human Computer Interaction. Deductive Tracking contributes to Sensor Fusion and Artificial Intelligence. Parts of a Phase I 3D engine, used in the real-time transportation visualization, have been made available to other research organizations and are already in use. This technology proffers assistance to persons with cognitive disabilities. The elderly and other groups will also benefit from the same technological developments. This technology creates new service organizations. It reduces the need for human escorts, increases the autonomy of persons with cognitive disabilities, and decreases the need for federal support.

Title: SBIR Phase II: The Accessible Semantic Web

Award Number: 0349718
Program Manager: Sara B. Nerlove

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $532,208

Investigator: Edward Sims, eds@vcom3d.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to develop an Accessibility Markup Language (AML) that annotates digital representations of English text with linguistic information needed for proper translation into other modalities, as required by persons with physical or cognitive disabilities. As an exemplar of the technology, VCom3D will develop, demonstrate, and evaluate the application of AML to making Web content accessible in American Sign Language (ASL). This development will entail the implementation of an Encoder to create AML from English text, and a Decoder to generate grammatical ASL from AML. Multinational corporations and institutions have recognized the economic and social need to make information and instruction accessible to persons around the world for whom English is, at best, a second language. To address this issue, international organizations, including the World Wide Web Consortium (W3C) are defining methodologies for using Controlled Languages, systems of annotation and, in the future, the Semantic Web to increase accessibility in other languages. These same emerging technologies and infrastructure can provide an unprecedented opportunity to make information available to underserved Americans with sensory, cognitive, and cultural differences. This project will demonstrate the application of emerging information technology to make information accessible to Deaf persons, and will provide resources for further research into ASL linguistics.

The initial commercial product based on this technology will be a translation and authoring tool that substantially automates the creation of grammatical, animated ASL from English text. This product will be used to increase access by Deaf and Hard of Hearing children and adults to digital information and to promote inclusive education and employment in accordance with the New Freedom Initiative, recent amendments to Section 508 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA), and Section 255 of the Telecommunications Act.