Enabling Affordable, Predictable, Reliable Wireless Data Services through Adaptive Content Shaping  
PI: Sujit Dey  
Next-generation wireless data networks are starting to offer new data services. Additionally, wireless data devices (wirelessly-connected laptops, PDAs and cell phones) are becoming more popular and affordable. But delivery of wireless data to, as well as general Internet surfing on, these devices is hampered due to limited bandwidth, unpredictable error levels, and handheld constraints. Dey and his team have developed techniques for shaping data dynamically as a function of network and device conditions and constraints, resulting in a rich wireless surfing experience. Wireless network operators as well as content providers and aggregators already have expressed interest in this technology. This grant will enable Dey and his team to make this software more commercial-ready and add several advanced features.

Overcoming Information Overload by Measuring Message Quality Automatically  
PI: Charles Elkan  
Professor Elkan is developing software to measure the quality of messages and documents automatically, and other software to enable a web server to give faster responses to high-priority users. The first software can assess documents in milliseconds, and developers say the technology "scales easily to millions of documents and millions of users." The von Liebig funding will help Elkan commercialize the first application based on the technology - to financial message boards. Elkan, an expert in data mining, expects that the software will benefit major service providers, such as MSN, AOL, and Yahoo. He also sees great potential for the technology benefiting many other companies in a wide variety of market segments.

HAP: A Software Tool for Identifying the Genetic Basis for Human Disease  
PI: Eleazar Eskin  
With the explosion of genomic sequence data and the completion of the human genome project, much of the progress in understanding the genetic basis of disease relies on computational analysis of the genomic data, including data on the variation in genes associated with a disease for a population of individuals. Understanding the genetic basis of disease involves two steps: determining the functional variants in each gene locus that is linked to the disease and the effect of functional variants on the regulation and gene products of the gene; and understanding how these intermediate phenotypes affect disease outcomes. Using this information, researchers can identify subtypes of the disease which are candidates for different drug response. Eskin's group has developed a powerful piece of software for performing this analysis - inputting genotypes and outputting haplotypes for each individual. The two-year-old HAP Webserver (http://www.calit2.net/compbio/hap) has already processed over 4,000 datasets from researchers around the world. In early 2005, a new version will be released, and articles in several high-profile publications will highlight the project. Eskin sees strong commercial potential among pharmaceutical and biotech companies on top of the public-domain availability of the HAP Webserver for non-commercial and research purposes. The von Liebig Center funding will allow the group to work on potential commercial uses of the software.
**ActiveCity - Location-based, Advertising-supported Services via Mobile Phones**

**PI: William Griswold**

Griswold is developing a mobile phone application called ActiveCity. Based on the location, time, day, and the personal profile of a phone user, ActiveCity will keep the user apprised of nearby relevant opportunities. The application would provide reminders and suggestions for shopping opportunities, coupled with online coupons and multimedia advertising. Additionally, the application could advise of friends and family members who are nearby. Griswold's group has developed technologies for PDAs and mobile phones for performing low-cost location-based computing that has the potential to be highly portable and robust.

The group also has developed market models with von Liebig Center students, and Griswold is developing an operational demonstration of an ActiveCity mobile phone application based on the market analysis developed by the students.

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**High-level Synthesis Using Aggressive Parallelization of System C Code**

**PI: Rajesh K. Gupta**

There have been numerous attempts in the past at creating an effective high-level synthesis tool for designing integrated circuits directly from a behavioral language. While each of them has its own merits, Gupta and his team (in collaboration with Alex Nicolau and Nikil Dutt at UC Irvine) have taken a novel approach to this challenge by using aggressive code parallelization and motion techniques to discover circuit optimizations beyond what is possible with traditional approaches. They have developed a number of speculative code motion techniques and dynamic compiler transformations that optimize the circuit quality in terms of cycle time, circuit size, and interconnect costs. This grant will enable his team to productize the tool by enabling it to interface to common industry formats, linking it to simulation tools, and filing for appropriate intellectual property rights.
**FX: Easy, Effective, Online Photo Enhancement**  
**PI: David Kriegman**

The goal of this project is to create FaceFX, a Web 2.0 solution to putting your "best face forward" in the new digital world. FaceFX is pushing the frontiers in ease of use, and redefining digital image enhancement from a user's perspective. FaceFX exploits a confluence of technologies in computer vision, computer graphics, and machine learning to provide non-professional digital photographers with the power of professional touch up, without the need to learn complex software. Addressing every person's desire to look good, the team is pioneering new techniques specifically targeted at improving the appearance of people in photographs, with little or no user intervention. The first online release of FaceFX will be built on a platform that supports the development of a breadth of advanced computer vision methods, allowing a scaleable and extensible solution suite that will keep pace with the growth of digital photo and video assets.

In addition to bringing conventional digital photo editing capabilities to the web, the team will use UCSD patent pending gloss-removal technology for images and videos, and develop methods for automatic flash correction, automatic red eye reduction, automatic shadow softening, blemish removal, wrinkle removal, and other automated face effects. This technological edge differentiates FaceFX from other photo sharing, photo printing, and image processing services.

**Interactive Game-based Music Annotation for Musical Retrieval and Recommendation**  
**PI: Gert Lanckriet**

Interactive Game-based Music Annotation is a technology that uses interactive Web-based games to create a database of high-quality, consistent song annotations (pairs of songs and descriptive words). The annotated database is used to drive both a "musical search engine" and a "musical recommendation system." This technology provides a valuable service and significant competitive edge to music recommendation companies, such as Apple iTunes, Pandora, Amazon, and Yahoo! Music, that require quality annotations for effective navigation through large commercial databases of music. Funding will be used for commercialization and additional technology development.
Low-Cost De-Interlacing Technique for Progressive-Scan Video Player
PI: Truong Nguyen
Professor Nguyen's research team has invented a very efficient, low-cost algorithm for motion estimation that produces much improved video quality in today's interlaced television reception--especially on large screens, where the artifacts due to interlacing are more pronounced. This invention would be a clear improvement on the very simple de-interlacing techniques now built into all commercial DVD players which do not produce high-quality video on big-screen TV sets. The choice of the present interlaced television system arose from numerous compromises between the visual quality of the displayed image, the bandwidth required for the transmission, the technical feasibility of the fundamental components, the cost price of the receiving set and other economic considerations. Unfortunately, interlacing produces some disturbing visual artifacts like interline flicker, line crawling and pairing. In the recent few years with the advent of big screen televisions and DVD technology, the dream to realize the movie viewing experience at home has become a reality. The artifacts due to interlacing are more pronounced when viewed on large screens. The development of the line doublers and finally the progressive scan DVD player is a direct consequence of this quest for much improved quality video. Nguyen's project will further optimize the technique to minimize the computational cost and implement the algorithm on Texas Instruments and VHDL chipsets to accurately measure its computational cost and the chip size needed for hardware implementation. This technique could eventually improve all DVD players, a market of 25 million sold in the United States alone in 2002--and growing at 50% a year.

Video Walkie-Talkie Appliance
PI: Truong Nguyen
The combination of new mobile communication standards (3G) and advances in wireless, PDA and networking technologies is creating opportunities for wireless multimedia access. But current multimedia standards such as MPEG-4, H.264 and H.324 are not designed for mobile devices, and the current default codec for image transmission - JPEG - is not ideal for wireless because it does not take advantage of temporal redundancy using motion estimation and prediction. The result: the decoded image is degraded significantly. As part of this project, Professor Nguyen will develop the prototype of an efficient video codec for wireless multimedia that uses the latest models of mobile phones and PDA with built-in cameras, color screens, etc. This Walkie-Talkie appliance will incorporate Dr. Nguyen's latest research on real-time video coding algorithms as well as decoding enhancement algorithms. He expects that the prototype will attract sponsors including service providers, consumer electronics companies, chip manufacturers, mobile phone and PDA manufacturers.
**Video Instant Messaging System**

**PI: Truong Nguyen**

This is the von Liebig Center's third award to Professor Nguyen, and will build on work he did as part of a 2003 grant to develop a "Video Walkie-Talkie." Nguyen's group is now developing a video instant-messaging system that would work over wireless 802.11 (Wi-Fi) or cellular networks. Users with PDAs could easily videoconference with anyone on their "video buddy list" - with the video streams delivered automatically at the best level of quality available for the specific device. Nguyen sees a pressing need for video instant messaging in the homeland security arena, where emergency first responders and law enforcement would benefit from situational awareness to observe activity at other parts of a disaster scene. Video could also be "pushed" to phones to provide alerts and instructional video information such as news reports.

**Real Time Image Scaler**

**PI: Truong Nguyen**

Image scaling, the process of scaling the size of images and video from low-resolution, is directly beneficial for a wide variety of end-user applications. Constraints, such as legacy hardware systems or limited storage and transmission capacity, often prevent the communication of high-resolution images and video content. However, quoting the title of ProAV magazine's online resource, "resolution reigns supreme", and trend lines for the market in 2007 make HD and telepresence videoconferencing a formidable trend. It is this existing need for high-resolution video sequences in an industry where the video itself does not exist that motivates the development of our proposed technology.

There are many applications for this proposed technology, including but not limited to: large screen television entertainment using low-resolution broadcasts, DVD player conversions of regular or HD content into super HD content, camera phone and iPod image enhancements, cameras for traffic monitoring and closed-circuit surveillance, and online digital maps. The proposed technology is independent of the application, allowing simultaneous development for any foreseeable market in video and image resolution enhancement.
App2you: Customizable Webb Applications for Everyone
PI: Yannis Papakonstantinou
The addressed pain point is that the design, development and deployment of custom Web applications, where members of an Internet or Intranet community can exchange structured data and collaborate, remains the domain of highly skilled professionals. The app2you project solves the problem by bringing Internet users to the drivers' seat: It allows every Internet user to create and own a hosted Web application where his/her community exchanges data and collaborates. The user may draw the Web pages of the application using the JustSketch interface and assign access rights for the users of the application. Then a pp2you inspects the HTML structure of the pages and the hyperlinks connecting the pages and infers a database and web application. In the more typical use case, the user starts from app2you-provided Web application templates and modifies them with JustSketch to fit his needs.

The target audience of app2you is the millions of communities that want web applications where they can exchange data and collaborate but do not have the time or money to hire IT professionals.

The technology of app2you is based on the app2you WebDB framework, which maps page and page components into a database schema. The mapping is enabled by app2you's analysis of the context in which every page and its components are found, where the context includes both the individual structure of each page as well as the hyperlinked structure of the full set of pages and the access rights.

Next-Generation Computational Mass Spectrometry for Proteomics
PI: Pavel Pevzner and Vineet Bafna
The estimated size of the Proteomics market today is $6 Billion, of which around $3 Billion is Mass Spectrometry and is expected to grow at more than 11% per year (GEN: Vol. 26 No. 3 p1, 2006; TCAW: Vol. 10 No.10 p45, 2001). With instrumentation capabilities significantly improved in the last decade, software is proving to be the new bottleneck in making optimal use of the huge amounts of data generated by these very expensive instruments. Although there are companies selling software in this field, there are three major challenges being faced by the industry: (i) Existing software, which usually comes bundled with the instrument, is slow and inefficient. (ii) There are only few limited applications that existing tools in the market offer. (iii) Unlike genomics, computational mass spectrometry is a very hard field to enter in, owing to the inherent complexity in the huge datasets. Our computational mass spectrometry group, the biggest in this field, has developed a set of extremely efficient and vital algorithms for processing mass spectrometry data.
Personal Digital Tele-viewer for Handheld Devices  
**PI: Mohan Trivedi**  
Traditional pan-tilt-zoom video monitoring systems permit only one remote viewer to have a customized view at a time. A digital tele-viewer (DTV) is a software tool that taps into an omnidirectional video feed, and unwarps the video into a customized view. Many users can customize their views simultaneously from the video stream of one 360° camera. Adapting this technology to PDAs and other mobile devices would provide clear benefits for crisis management, traffic monitoring, surveillance, virtual reality, and other purposes.

NetControl: Setting the Internet on AutoPilot  
**PI: George Varghese**  
As the Internet expands, it is taking more and more time to oversee the networking technology that links it all together. Now, Varghese believes that he has settled on new software systems that could effectively remove human beings from the loop in certain key networking functions such as controlling Internet attacks and spam. He is proposing to develop two new software products that, according to one von Liebig reviewer, "represent technology that could solve a real pain."