Proceedings of the Third Annual Virginia Tech Center for Human-Computer Interaction

Research Experience for Undergraduates (REU) Symposium

July 10, 2008
5:00-6:30PM
Torgersen Hall Museum

Virginia Tech's Center for Human-Computer Interaction presents the project abstracts for the REU 2008 symposium. The REU (Research Experience for Undergraduates) program provides undergraduate students from various universities with the opportunity to spend eight weeks at Virginia Tech, working with our faculty and graduate students on research projects using the state-of-the-art technology and laboratories assembled here. The REU program is sponsored by National Science Foundation grant IIS-0552732.

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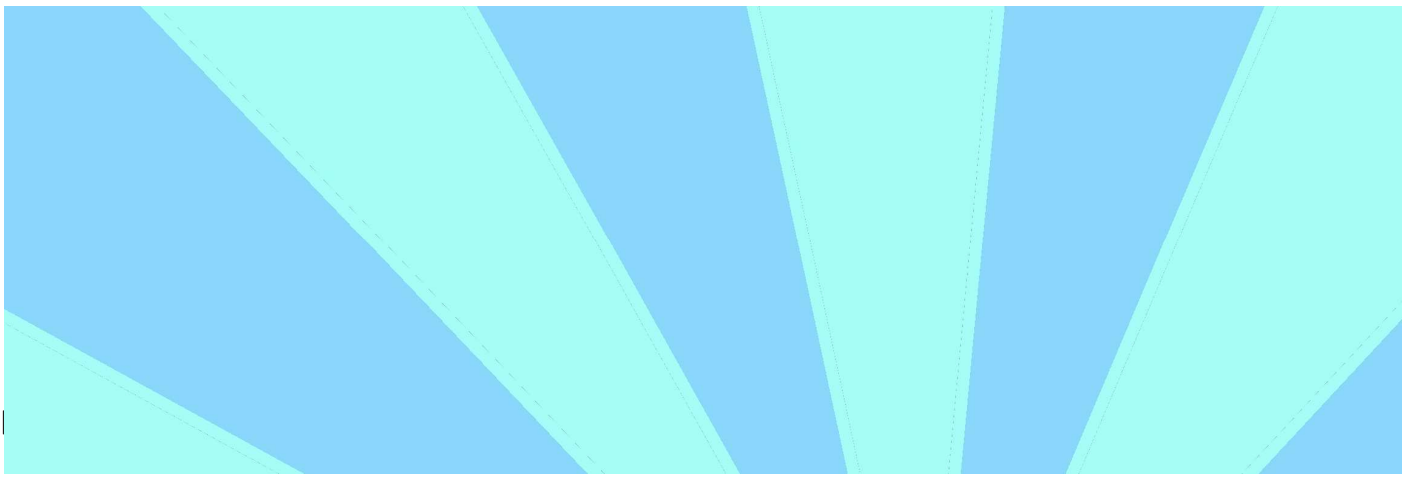

Towards Developing a Universal, Portable, Context-Dependent Input Device

Michael Zlatkovsky
Mentor: Dr. Denis Gracanin

The purpose of our research was to explore the possibility of a universal input device with support for multiple interaction techniques: a "one device to rule them all", that would adapt based on the context, the application, and the desired type of interaction. Despite their vast differences, most input devices rely on combinations of standard components, such as buttons, scroll-wheels, and tilt sensors. We, therefore, created a "universal" input device based on the versatile iPhone: a portable programmable device, equipped with a 3D accelerometer, a multi-touch screen, and Internet/Bluetooth connectivity. Two applications were targeted for the project: a Bomberman-like game and mouse-control. Within each application, we explored the use of various interaction techniques: from utilizing simple touch-screen buttons to using finger-swiping and tilting. Though time and a lack of resources prevented a full-scale usability experiment, a pilot study had shown that most interactions could indeed be mimicked or replicated on the iPhone, and some interactions could even become more intuitive on the iPhone than on the original hardware. To allow for further development of the project, we crafted a framework for deploying new interaction techniques onto the iPhone. To the user, the framework provided a quick way to choose an interaction technique from a list and connect to an application; to the programmer, the framework supplied all of the cumbersome socket-connecting-, database-logging-, and list-inclusion- features for "free". Future work on the project might include extending the list of supported applications, enabling self-discovery of universal-device-enabled applications, and performing further measurements on the effectiveness of a single universal device.

Encouraging Design Reuse and Contribution in Storyboarding

Lauren Cairco
Mentor: Dr. Scott McCrickard

Novice student designers in HCI have ideas for products they would like to design, but often lack the domain knowledge and supporting tools to aid their work. Although a previous study demonstrated that reusing claims, knowledge units encapsulating design features, can aid students during storyboarding, it also showed paper-based prototyping is not a long-term solution for this problem. The lack of a centralized library of claims prevents designers from building on the work of others and disseminating their work to their community, and also makes finding, sorting, and maintaining the set of claims difficult. To encourage claim reuse and contribution, we developed a software storyboarding environment that provides access to claims in a library in the form of "cards". Apart from extracting and creating reusable cards, designers can also leverage the environment by exploring relationships among cards, editing cards, and constructing storyboard narratives. To further investigate how users found cards and created new cards, six participants evaluated the tool in a pilot study. The participants were asked to use our tool to create a storyboard for a notification system and answer a questionnaire about their experience. We found that users tended to rate finding existing cards as more difficult than creating their own cards. Users ranked both tasks as at or below medium difficulty. For future work, we would like to deploy this tool for student projects in HCI classes with the goals of encouraging reuse of previous work and making it easier for students to make their own contributions.

Exploring the Efficacy of Sonification in Program Understanding

Soo Been Kim
Mentor: Dr. Ivica Bukvic, Dr. Eli Tilevich

One of the most demanding intellectual challenges facing professional software engineers and computer scientists is understanding a computer program's source code. The ability to understand the semantics (i.e., meaning) of a program is a prerequisite for all the essential enhancement or maintenance tasks, including adding new features, fixing bugs, or adapting software for new requirements. A wealth of existing research has gone into facilitating program understanding. Most of these efforts have focused on using visual cues. This work, by contrast, explores the use of the programmer's auditory senses as a cognitive tool for code comprehension. We have built an Eclipse IDE plug-in that renders sonic cues using MAX/MSP in support of program comprehension. Then we conducted a controlled two-phase experiment that measured the participants' reaction, comprehension, and preference. The first phase used a sonification tool that provided the participants with limited information about a portion of an unknown code base. The second phase used a visual tool that provided the same information. The reaction, comprehension, and preference of the two groups of participants interacting with sonification and visualization tools, respectively, were assessed through a set of questionnaires. The collected data shows that all the participants were able to understand a given portion of an unfamiliar code base correctly, using either sonification or visualization. These results confirm our hypothesis that sonification can be an effective tool for program comprehension, and motivate future exploration as to how sonification should be combined with visualization to achieve maximum benefit.

A Pervasive Location Aware Infrastructure for Tangible Information Exchange Using Mobile Devices

Sterling Woods
Mentor: Dr. Denis Gracanin, Dr. Chris North

The advent of new mobile devices like the iPhone and PDA opens many new and stimulating opportunities. The portability, "tangibility" and other characteristics of these devices make them perfect candidates to serve as information carriers. Although there are other devices that can transfer information (USB memory stick), most of them require a physical connectivity with the computer. We propose to create a pervasive, location aware framework that will support the use of new mobile devices as information carriers. For example, if working on one computer, we can use an iPhone, to seamlessly "carry" information to another computer. The infrastructure leverages use Bluetooth technology to provide location awareness. Computers periodically scan for present Bluetooth devices and identify them based on major and minor class of devices. The filtered Bluetooth addresses are paired with the computer IP address and that information is stored in the repository. A mobile device can then query the repository for IP addresses of all the computers within Bluetooth range. This provides a lightweight location service infrastructure that can be used to provide a variety of location (computer) based services like distributed copy/paste clipboard, information exchange, location services, etc. We performed usability study for a gigapixel-based multi-user game and plan to use that to identify additional location services to include in the framework. The infrastructure has a Web service based interface that allows integration with other Web services. This work is within a scope of an ongoing project "Live Spaces" between Virginia Tech and National University of Singapore.

Use of Avatars as an Educational Tool for Psychological Disorders

Rykiell Rhea-Turner
Mentor: Dr. Tonya Smith-Jackson

Understanding psychological disorders is important to the public because these disorders are dealt with daily through personal experiences with friends, relatives, or by someone living with a disorder. Unfortunately, not everyone is granted an opportunity to gain mental health literacy from professionals. Lack of understanding of psychological disorders may lead to miscommunication, stereotyping, lack of compliance, and ineffective treatment. This project explored an innovative approach to educate the public on psychological disorders by integrating computer technology and psychology. A pre and post-test control group design was used to determine whether the use of an avatar or a human reader would facilitate knowledge transfer related to bipolar disorder. Fourteen graduate and undergraduate students ages 18 and older volunteered to participate. Seven of the participants were assigned to the control group (human-human interaction) and seven were assigned to the experimental group (human-avatar interaction). People Putty ® by Haptek software was used to create the avatar. The ANOVA results revealed no significant difference between the two groups on knowledge transfer. Although not significant, the results indicated a trend toward improvement in post-test scores. Significant differences in knowledge transfer were found among participants' academic majors, $F(1, 10) = 5.25$, $p < .10$. Mechanical Engineering majors showed significantly lower knowledge transfer scores from pre to post-test compared to Industrial and Systems Engineering majors. Results also showed that avatars may be an effective way to educate the public, because of the relative similarities between human computer interaction and human-human interaction. Understanding this brings us closer to realizing the efficiency of avatars as a public education tool.

Low-Cost Motion Tracking System Based on Sensor Networks and Arrays of 3D Accelerometers

Wayne Wu
Mentor: Dr. Denis Gracanin, Dr. Yong Cao

Motion tracking technology has been widely used in film and gaming industries. However, the traditional motion tracking equipment is very expensive and not readily available. The next generation devices (iPhones, Wii controllers) include 3D accelerometers that can be used to implement the motion tracking technology in a cost-efficient way. The devices are attached to the body and 3D acceleration measurements are used for motion tracking. However, a whole set of Wii controllers attached to the body is not feasible. Instead, a collection of sensors (sensor network) may provide a solution. Attaching a sensor node to joints and extremities allow us to measure acceleration for motion tracking. However, sensor nodes may not have necessary power and communication bandwidth. Instead, we can use a single, scalable sensor node connected by wire (I2S) to a set of 3D acceleration sensors. The sensor node controls the accelerometers and periodically samples the sensors. Due to the hardware limitations, some measured values are out of range, causing errors in motion tracking model. These values need to be filtered out in order to proceed to the next step. We can use a buffer to pre-process the data in order to get smoother data ready for modeling. Based on the data and the position of different body parts, we may be able to restore the 3D model. Using this approach we can provide low cost affordable motion tracking system.

Community Participation through Mobile Augmented Reality

Hector Raphael Mojica
Mentor: Joe Gabbard

The lack of community involvement, particularly from young adults, is potentially detrimental to the cultural and physical development of towns and cities. To address this, we propose a new location-aware augmented reality (AR) notification system that notifies users of community events (e.g. proposed construction) and encourages participation via online discussion and visualization. The main goal is to bring young adults to the community forum through a series of new technologies, such as Web 2.0 and mobile devices, which the target audience is already comfortable with. The features that will be presented in such an application includes an image-driven presentation and direct augmentation feature, which will empower the user to annotate still AR images for collaborative purposes, and an information overlay interface which will not only recognize famous landmarks in the vicinity with text, but also provide forum interactivity relevant to the current location. This work presents a working prototype of a mobile AR interface with support for the above-mentioned features. By using a digital compass for tracking and keeping registration of synthetic objects static, we developed a working AR interface that provides links to Facebook forum threads for an object of interest. Furthermore, the annotation feature allows the user to make visual suggestions, potentially providing a new way for community feedback. Future work lies in developing a "hotspot" data infrastructure as well as putting the AR interface and annotation feature under rigorous user testing.

Web 2.0: Its Effect on Information Access and Exchange.

Melissa Martinez
Mentor: Dr. Manuel Pérez

In Web 2.0 applications, form is separated from content facilitating data exchange and enabling new application opportunities. Web 2.0 applications are developed using the mashup technique; in which content, gathered from different Web locations, is combined and provided in an appropriate form. The process is as follows. First, some information is obtained from different Web sources. Second, the information is stored in a local database. Third, the information collected is merged to produce new content. Finally, the new content is provided to the user. To provide multi-device access to the new content, only the last step needs to be tailored. Often problematic are instances when information sources do not support Web 2.0 access. One possible approach is the use of web crawler/screen scrapper application to obtain needed content. A web crawler is an automated script that reads a web page and separates content from links on the page. The links are then used to repeat the process recursively. The content is parsed to remove HTML and extract the relevant pieces of information (screen scrapping). To obtain insight into the efficacy of this approach, a crawler and screen scrapper was designed and deployed that 1. Collects the thesis and dissertation information (student name, thesis title, abstract, advisor, committee, etc.) of the Virginia Tech Computer Science department and 2. Stores the collected information to database. With the collected information, two web application where developed: one to complement the CHCI website and another one to provide the information on an iPhone. My project serves as an example that in Web 2.0, we are able to develop applications that facilitate the exchange and multi-device access of information.

On the Use Of Multi-Core-Based Systems in Resource Sharing Environments

Lamar Simpson, Robert Meeks, Timothy Watson, Sir James Harvey
Mentor: Dr. Ali Butt

Modern scientific research increasingly relies on computer systems for investigating complex physical phenomena. The computers are used to handle large-scale simulations that model and emulate scientific principles. Thus improving the performance of computer systems enables pushing the state-of-the-art in research. A challenge is that not everyone has access to the necessary large-scale resources, and for such users Grid computing paradigm offers a mean for economically attaining needed computational power. Grid computing provides a virtual supercomputer, comprised of a large network of computers working together to perform large computations. A common issue in grids is loss of efficiency when multiple users vie for the same resources. The Condor project solves this problem by introducing a mechanism for harvesting unused computation cycles of desktop machines, by efficiently using and managing the available resources. With the advent of new technologies and architectures, there is a need and opportunity for exploring efficient resource management of Condor, especially in combination with modern architectures such as the IBM's multi-core processor – the Cell Broadband Engine commonly found in the Sony Playstation 3 platform. Our first step was to learn about the Condor system. We did this by installing Condor on several virtual machines. Once we became proficient with innards of Condor and its installation procedure, we explored the Cell/BE and its use in conjunction with Condor. In future work we hope to employ a cluster of Sony PS3s in a Condor-based system to achieve better system efficiency.

Influencing Storyboarding Activities Through Artifact Presentation

Ashley Hagmaier
Mentor: Dr. Scott McCrickard

Student designers often need to learn how to design effective systems by considering the consequences of their choices. During storyboarding activities, reusing artifacts such as claims, knowledge units encapsulating the effects of design artifacts, can provide designers with the opportunity to build off of the work of others and consider the associated rationale. However, providing possible design choices is not enough. It is important to encourage the designers to consider the types of artifacts that are important to designing a system. The challenges lie in trying to impact the storyboard through the way claims are presented to the designers. A pilot study aimed at investigating whether the structure of a storyboard could be affected by manipulating the presentation of claims was conducted. Participants underwent design sessions in one of two presentation conditions: categorized claim features or randomized claim features. Participants were asked to create a storyboard which portrayed a notification system. The process was video recorded and qualitatively analyzed. Analysis showed that participants with the categorized condition created more panels and used less features in their storyboard than participants in the randomized condition. The card categories enabled participants to design around scenarios they created as opposed to choosing features to determine the scenario. A lower feature/panel ratio within the categorized groups showed each panel had a more specific role to play. Future work will investigate other ways in which the design process can positively influence student design choices and understanding.

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