

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



hci-reu 2009

Research Experience for Undergraduates (REU) Symposium

July 16, 2009

5:00-7:00PM

106 McBryde Hall

Virginia Tech's Center for Human-Computer Interaction presents the project abstracts for the REU 2009 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 primarily by the National Science Foundation (IIS-0851774, IIS-0552732). Additional support was provided by the NSF (CNS-0540509), the VT CS Department CSRC, and IBM Research.

Table of Contents

Stages: Hyper-Drama Storytelling Authoring Tool	3
Field Study of In-Use Information Security and Interfaces within Childcare	4
Sonification as a Tool for Optimizing Software Configuration.....	5
GPU Accelerated Isosurface Volume Rendering	6
Creating a Visual Survey Application for a Non-profit Agency with Agile Usability & Concept Maps	7
AlgoViz.org : An Online Educational Community for Algorithm Visualizations	8
Evaluation of A Concept Mapping Approach used to Improve Team Interaction in Agile Usability	9
The Making of L2ork: The Virginia Tech Linux Laptop Orchestra.....	10
Visualizing Temporary Objects in Java Applications	11
Understanding Perceived Color In Dynamic Outdoor Augmented Reality Environments	12
LumenCon: An Approach to Monitor and Control LumenHaus using iPhone.....	13
LumenWæther: Weather Information Service for LumenHaus	14
Universal Design of a Computer Interface.....	15
Science In RAP (Recording and Audio Production): Leveraging Interest in Music Production Arts for Teaching STEM	16
VizBlog: From Java to Flash Deployment.....	17
Social Network Sites: A Mirror of Society	18
Picking Up Quality: Exploring the Effects of Quality Perception and Aided Processes on Reuse and Contribution in Storyboarding.....	19
Evaluating Dynamic Program Representations For Blended Analysis	20



Stages: Hyper–Drama Storytelling Authoring Tool

Fabrice Marcelin

Mentor(s): Ashley Robinson, Chao Pen, Francis Quek, Yong Cao

In many cases, the intellectual and social development of a child leads to a steep decline of creative activity. It is at this time, the child is now aware that his/her work has cultural sense and often view as unsubstantial. Therefore, the child does not feel knowledgeable enough to maintain his/her creative activity. We are investigating the development of creativity in children by providing an authoring tool for media creation through hyper–dramatic storytelling, in which children can relate. With the STAGES authoring system, we hope to enhance and nurture creative imagination across these trough years. We want to be able to provide enough substance to the children before social awareness occurs.

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Field Study of In-Use Information Security and Interfaces within Childcare

Tom DeHart

Mentor(s): Laurian Vega, Steve Harrison, Dennis Kafura

How is information accessed, exchanged, and stored in a childcare environment?

Who really owns your child's file? In this pilot study, twelve childcare centers in Southern Virginia were interviewed with these types of questions in mind. Coding and analysis of the interviews provided support for an information hierarchy model as well as the identification of several major themes. More importantly the data gathered continues to unravel information practices in a setting where medical information is exchanged between multiple parties – data that is crucial to the furthering of ubiquitous electronic health records.

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Sonification as a Tool for Optimizing Software Configuration

Andy Wood

Mentor(s): Ico Bukvic, Eli Tilevich

To provide the expected benefits to end-users, software systems must be properly configured to use operating system resources most productively. Configuring complex software systems, however, is one of the most daunting tasks with which the modern software developer can be charged. Determining the inter-relationships between different configuration parameters and how they should be tweaked to achieve optimal performance is more of an art than a science. This research explores a novel software configuration approach that sonifies program execution, so that the programmer could tweak the configuration parameters of a program as guided by the sound of its execution. This research determines the utility of sound as a cognitive aid to assist program configuration by designing custom sonifications and evaluating them via a web-based questionnaire. Specifically, we have constructed a taxonomy of sound properties and program execution parameters as well as a relationship between them. We then selected the most appropriate sound properties and prepared a survey with the goal of evaluating their effectiveness to assist the average programmer in hearing fine grained differences in program execution. The survey is being implemented as a rich internet application that will be accessible to a wide range of programmers, in terms of their level of expertise, expert domains, and music backgrounds. Based on the results of the questionnaire, we plan to construct a next generation program configuration tool that will leverage the power of sonification to guide the programmer in configuring complex computer systems.

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2009

GPU Accelerated Isosurface Volume Rendering

Colin Braley

Mentor(s): Yong Cao, Denis Gracanin

Isosurface rendering of volume data is very useful to both medical and scientific professionals. As medical and scientific datasets inevitably get larger and larger, visualization tools have trouble maintaining interactivity. We present a novel GPU based system that allows users to visualize isosurfaces in large volume data sets in real time. In particular, we present a modified depth buffer to speed up the operation of rotating around a volume data set. As the user rotates the camera around the 3D volume data, there will be much similarity between the depth buffers of two sequential renderings. We utilize this coherence in our prediction buffer to achieve a large speedup of the rendering process.

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Creating a Visual Survey Application for a Non-profit Agency with Agile Usability & Concept Maps

Mario Calixte, Benoit Bernadel, Jennifer Francois, Sherley Codio
Mentor(s): Jeremy Barksdale, Scott McCrickard

Agile usability allows software project teams to incorporate usability practices into software engineering by integrating an agile process, such as extreme programming, and a usability process, such as scenario based design. Today many project teams find it very effective when merging the usability engineering and the agile principles, because it takes into account the needs for a product from the users' perspective. This poster focuses on the development of a software application for a non-profit service agency, Better Agreement. It starts with a brief introduction that gives an overview of what the application is all about. And then it describes the method that we followed to build the application. And finally, a screen shot of the different views of the application.

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AlgoViz.org : An Online Educational Community for Algorithm Visualizations

Jonathan Park

Mentor(s): Cliff Shaffer

Algorithm Visualizations (AVs) are helpful and effective resources for students to understand basic and advanced Computer Science topics. While there are many such resources available, they're rarely used in the classroom. To address this issue, we created AlgoViz.org, which is a Drupal-powered online community where professors and developers can discuss the implementation and use of AVs. This will help professors find good AVs to incorporate into lectures and it will help developers create better AVs on those topics most needed. To help increase traffic to the website, we implemented an "AV of the Day" feature which showcases high-quality AVs on the front page of the website and automatically posts Twitter updates. In addition, we integrated an RPX Sign-in to lower the barriers on community participation. Future work includes migrating of all the content on the AlgoViz Wiki (wiki.algoviz.org) to AlgoViz.org, as well as a Single-Sign On implementation, either through the use of a custom Drupal module or incorporation of a CAS server.

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2009

Evaluation of A Concept Mapping Approach used to Improve Team Interaction in Agile Usability

Sherley Codio, Jennifer Francois, Benoit Bernadel, Mario Calixte
Mentor(s): Jeremy Barksdale, Scott McCrickard

Agile usability processes facilitate the integration of software engineering and usability engineering practices. However, this merging of processes is a technical one, and superficially considers how teams may align their interaction with the combined technical process. The goal of this study was to qualitatively evaluate, in a practical context, the implementation of a concept mapping approach used to improve team interaction.

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The Making of L2ork: The Virginia Tech Linux Laptop Orchestra

Michael Matthews, Maya Renfro, Andy Wood
Mentor(s): Ico Bukvic

As the use of laptop computing in music performance and composition has become more common, it would be natural that computer music expand to include an ensemble structure. Both Princeton and Stanford have realized this need for an ensemble of this nature by creating their own respective laptop orchestras.

Princeton Laptop Orchestra (PLOrk) and Stanford Laptop Orchestra (SLOrk) are forerunners in this field, and have created a solid foundation for others to follow and expand upon. The Virginia Tech Linux Laptop Orchestra (L2Ork) has done so.

The creation of L2Ork required the assembly of the hemispherical speakers, website, and software patches. Creating the speakers began with identifying and testing the necessary building materials, which includes amplifiers, speakers, cables, and amp housing, and then assembling the speaker enclosures. Building the website entailed designing the appropriate layout, logo, and methodology for user input. Using the open source program Pure Data, software patches were created to facilitate the interactivity of and provide feedback for each orchestra member, a.k.a. the l2orkists. With this foundation in place, L2Ork has the potential to be a catalyst for future research opportunities in collaboration with other areas of study, such as the Center for Human Computer Interaction at Virginia Tech.

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Visualizing Temporary Objects in Java Applications

Luke Marrs

Mentor(s): Mark Fisher II, Barbara Ryder

During the execution of a typical Java application, objects are created that are used only for a short time, and then never referenced again. These are known as temporary objects. The use of temporary objects is common, but the cost of creating and storing them can start to build up in large applications, especially in framework-intensive programs. The developer may not know the cost of calling a method in a library, or the performance loss caused by passing objects between frameworks. The excessive use of temporaries is object churn, and it can cause a significant increase in running time and memory use. We have developed a tool that allows us to navigate trees that have nodes corresponding to method calls and view the objects that are used in every method in the tree. The trees and corresponding graphs of the objects used are the result of a progression through three other tools that analyze and process the data from source code. Our tool reads in the file containing the calling context tree, which has a node for every method in the call trace of the execution, and the files containing the connection graphs, which have a node for every object. The nodes in the calling context tree are matched up with the corresponding connection graphs so the user can explore what objects were created and where they were used. In future research, we plan to add a feature that allows the user to investigate the creation point for an object and where it is last referenced (captured). We also intend to find out how a developer can best use our tool to find performance issues caused by object churn, and add additional features like tracking of long-lived objects and the type of data they hold.

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Understanding Perceived Color In Dynamic Outdoor Augmented Reality Environments

Jason Zedlitz

Mentor(s): Joe Gabbard, Woodrow Winchester

Augmented reality (AR) is beginning to emerge in niche applications from text overlays in automobiles, to location-aware games on mobile phones. In many cases, AR user interfaces are designed and developed without a clear understanding of perceptual and cognitive unpinnings inherent in novel and emerging technologies—specifically those that fundamentally alter the way humans perceive the world (e.g., VR, AR). Color perception is one of many important, yet traditionally understudied, perceptual factors in creating effective AR user interfaces. In outdoor AR using optical-see through displays, mobile users encounter dynamic real-world backgrounds and lighting conditions resulting in unpredictable perceived color of user interface elements (e.g., virtual objects and text). Previous research has shown that real-world backgrounds and natural lighting conditions affect user performance on text legibility tasks. As such, it is critical that we understand color perception through these AR displays as a precursor to effective user interface design. This research creates an experimental testbed for systematically measuring the effect of real world colored backgrounds on the color of virtual objects under natural lighting conditions. We describe the testbed, as well as, our approach to simulating real-world backgrounds in a lab setting. We also describe our initial measurements overlaying blue and green virtual colors onto a sidewalk background.

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LumenCon: An Approach to Monitor and Control LumenHaus using iPhone

Arthur Billingsley, Roosevelt Cooper, Felicia Osborne
Mentor(s): Denis Gracanic

One major impact on society is the way that we live: large homes that take massive amounts of energy to power them. Virginia Tech researchers are working to solve that problem without giving up the standard of living that we have become accustomed to. The project, LumenHaus, is a solar-powered, off-the-grid smart house. The house's controls will be implemented using the controller developed by Siemens specifically for the LumenHaus. Is it possible to use mobile devices, such as iPhone, to control LumenHaus? Our research was focused on the development of an application, called LumenCon, that would allow an iPhone to connect, send, and receive data from the controller. First, we needed to figure out how to use the iPhone as an interface to the Siemens Controller. Second, there are many different devices and data points in the LumenHaus and they all have different characteristics, so finding a uniform way to connect with them could prove difficult.

Another issue is security. The program needs to be able to make sure only the authorized users are able to monitor and control the house. Our approach was based on the following three concepts. First, we provided a controller interface hiding the controller proprietary characteristics and providing an abstraction of control systems. Second, we used those abstractions to define the high level commands used by iPhone. Finally, we provided a mapping between the high level and low level commands. The first version of LumenCon communicated directly with the server using sockets. The second version of LumenCon uses a P2P connection between iPhones and a bluetooth capable device. The contributions/results of the research include a developed iPhone application user interface and the corresponding controller interface and implementation of a Bluetooth bridge. We tested data exchange and protocols used for communication.

Future work will include a support for a network of Bluetooth beacons and integration with other similar applications. Another improvement would be to provide access control (ex: username and password, voice and facial recognition).

We also need to conduct usability studies.

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LumenWæther: Weather Information Service for LumenHaus

Erik Irvin-Williams, Tavon Gatling
Mentor(s): Denis Gracanic

Smart houses and smart house technologies are designed to enhance the overall living experience. Interaction with a smart house should be intuitive, ubiquitous and efficient. We present the research that marks the start of a development effort that will significantly change the way we design smart houses and change the way users interact with them. The research is a part of a much larger scale project which takes advantage of the smart phones and related mobile devices, the efficiency of green technology, and the novelty of the solar house itself. We describe the proof-of-the-concept application LumenWæther which addresses one of the most important issues in solar house design and control, i.e. weather conditions. The knowledge of current and future weather conditions is required to maintain the solar house at comfortable and enjoyable levels while still running smoothly and efficiently. In order to properly, efficiently, and effectively develop applications to be used for the Virginia Tech Solar House project (LumenHaus), we researched the architecture of iPhone application development. We conducted usability studies and made changes based on the received feedback in order to improve the user interface and make it easier to use. This can also provide some guidelines for the development of similar applications. This application was developed with the hope that in future iterations it will be integrated into the LumenHaus control system, APOGEE GO by Siemens, and the concept of its development will be expanded to the applications which control elements such as in-house temperature, the automated doors, security systems, among other things, within the LumenHaus. The goal is to make iPhone the “master device” for the LumenHaus, while at the same time still using it as a phone.

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Universal Design of a Computer Interface

Kathleen Hudgins

Mentor(s): Sara Lu and Kimberly Ellis

Approximately 54.4 million people in the U.S. have some type of disability, representing 19% of the population. Many companies have implemented computer interfaces designed for people with typical needs, which creates obstacles for people with special needs in obtaining or retaining employment. The objective of this project was to design a computer interface based on the principles of universal design to accommodate all people. The research team redesigned a computer interface for a workstation at a Walgreens distribution center in Anderson, South Carolina, where 38% of the employees have some level of disability. In collaboration with the employees at Walgreens, the team established the requirements for the interface, surveyed potential users of the interface, prepared a task analysis flowchart, generated alternative designs, and consulted with users to establish the final design. The interface incorporates key features, such as a structured flow and visual cues, to accommodate people with autism and physical disabilities as they learn and operate the redesigned system. In the future, the interface will be linked to existing databases at Walgreens. The results of this project include a redesigned computer interface to accommodate employees at a distribution center, including those with special needs. In addition, the outcomes of the project have the potential to increase the understanding and prominence of universal design in distribution centers around the globe.

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Science In RAP (Recording and Audio Production): Leveraging Interest in Music Production Arts for Teaching STEM

Phoebe Bakanas

Mentor(s): Dan Dunlap, Andrea Kavanaugh

The United States is missing from the list of top-10 science and math education countries. One reason for Americans' inability to perform academically and for the overall attrition of learning in STEM (Science, Technology, Engineering, Math) is a loss of interest and enthusiasm in math and science. We believe that the best way to re-ignite enthusiasm in science is through a subject that youths are passionate about, such as music production. The hypothesis is that youths with interest in the art of creating and recording music, will be interested in the science surrounding the art, and thus the artistic endeavor can become an effective vehicle for teaching science. This summer I researched different modes of transaction that can be used to teach the science behind recording studios. I explored how those modes can work together to create the connections needed for deeper levels of learning. My methods of research were: interviews, qualitative research, scenario-based design, user-centered design, field study and participant observation. Through this research we designed a project titled "Science in RAP (Recording and Audio Production): Leveraging Interest in Music Production Arts for Teaching STEM". This project will promote lifelong learning of STEM in a wide variety of informal settings, from museums to after-school programs. We are applying for a NSF Pathways Grant, which will give us funding to research, develop, and implement proof-of-concept models that build on the relationship between music and science.

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VizBlog: From Java to Flash Deployment

Joralis Sánchez Solá

Mentor(s): Manuel Pérez–Quiñones, Andrea Kavanaugh

Web logs have become a popular way to share information between people that have the same interest. They are a good tool to develop social discussion and deliberations about common issues into the society, since the internet has become an essential part in our life style. As a consequence of the web log's attractiveness the amount of web sites dedicated to them is increasing every day. This is the main motivation to develop a tool, VizBlog, to help us manage all this information. Exploring the content in blogs is a time consuming task. VizBlog had been created as a tool to explore different web logs to identify similarity between their content. It will place all the similar web log entries in a cluster making the web logs search easier. This project focused on re-implementing VizBlog using Adobe Flash programmed with ActionScript.

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Social Network Sites: A Mirror of Society

César E. Concepción-Acevedo

Mentor(s): Andrea Kavanaugh, Manuel Pérez-Quiñones

It took a little more than a decade for Social Networks Sites (SNS) to become one of the most popular destinations for internet users. Based on the popularity of these sites, issues of privacy, identity, politics and socialization overall have been raised online and “offline”. Meanwhile, dichotomized perspectives of offline and online behaviors have been nurtured to understand the unique social scenarios created in response to SNS’s. However, with recent research it is becoming more evident that the behaviors shown on these sites are only a mirror of individuals and furthermore, society. These sites are not only influenced by events that occur offline but are also prone to social factors like: institutionalized isomorphism, free market behavior, politics and normative social values. This medium of interaction has allowed people to magnify their social capital since social networks are more visible and more easily accessible. Nevertheless, to completely understand the benefits and drawbacks of this novel way of communication more research is needed.

haci-reu
2009

Picking Up Quality: Exploring the Effects of Quality Perception and Aided Processes on Reuse and Contribution in Storyboarding

Joe DeGol, Lulu Hu

Mentor(s): Shahtab Wahid, Scott McCrickard

We built upon the previously existing storyboarding tool, PIC-UP, that leverages features in the form of cards containing pictures and design rationale (*claims*). Designers can use the tool to facilitate storyboarding by reusing features. The tool includes three portions that allow the users to browse through available cards, edit or create new cards, and structure their storyboard. To improve the tool, we focused on providing ways for designers to be aware of the quality of the cards stored in the system, integrated the notion of card relationships to facilitate reuse, and guidance targeting novice designers. The tool was modified to integrate a color coding scheme based on the popularity of cards within the system, methods to search, contribute, and view the existing relationships among cards, and a guided step-by-step process for storyboarding based on relationships. We conducted an exploratory study of the modified tool. Our findings show that quality was successfully reflected, but not taken into account, card relationships were easily created, but not necessarily used, and the guided process was often ignored. Our future work will focus on making improvements to the tool, populating the tool with more cards and relationships, and conducting a larger study.

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Evaluating Dynamic Program Representations For Blended Analysis

Shrutarshi Basu

Mentor(s): Mark Fisher II, Barbara Ryder

Blended analysis is a program analysis technique that uses a dynamic program trace to inform a static analysis of the program source code. This allows the analysis to be more efficient and precise by analyzing only relevant parts of the source code. The information from the dynamic trace is recorded in the form of a dynamic calling structure. Previous work on blended analysis uses Direct Calling Graphs as the calling structure. Direct calling graphs record the methods being called but do not contain any context-sensitive information. When the analysis is used to collect object lifetime information, this results in imprecision as the actual point of an object's allocation or capture cannot be determined.

Our work looks at a different calling structure: a Context-sensitive Calling Tree which contains context information for each method call. We use these trees for blended analysis for codebases on which analysis has already been performed using direct calling graphs. By comparing the results of the two analyses we hope to see whether the use of calling trees produces a marked improvement in terms of precision of the analysis. Our preliminary analysis on two large code bases shows that while there is an increase in precision, there are considerable performance problems. Solving these problems might require a redesign of the analysis algorithm or a calling structure intermediate to direct calling graphs and context-sensitive calling trees.

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