UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

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Tomorrow's Technological Solutions and Approaches for Today's Problems

Session Moderator: Marc Dupuis, Computing and Software Systems

389 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Perceptual Thresholds for Multi-Finger Haptic Interaction

Paul David Lambros (Paul) Bartell, Senior, Electrical Engineering
Mary Gates Scholar
Mentor: Blake Hannaford, Electrical Engineering
Mentor: H. Hawkeye King, Electrical Engineering

Force-feedback (haptic) displays are becoming increasingly common in consumer technology. Perceptual thresholds for haptic interaction are important for determining how much force output is required from a haptic display to provide detectable feedback to the user. In this presentation, I will talk about an experiment measuring force perceptual thresholds for single and multi-finger interaction with haptic targets. Using the UW Multi-Finger Haptic Display, subjects feel two targets on a virtual surface. One target produces center-attractive force when in contact with the subject's finger while the other produces no force. A thresholding algorithm presents the subject a new set of haptic targets with a smaller maximum force after correctly selecting the force-producing target twice. Eventually the subject can no longer detect a target and the max force is adjusted upward. This type of forced-choice algorithm causes the threshold force to converge to where the user successfully detects the stimulus 71% of the time. In this experiment, three new methods of presenting time-correlated haptic feedback to the subject were tested. Statistical analysis shows significantly lower minimum force thresholds for multi-finger methods providing time-correlated feedback (mean thresholds of 22.94, 21.75, 22.13 mN) when compared to the single finger and multi-finger spatially correlated methods (29.24 and 33.37 mN respectively). These results suggest a neural summation effect when haptic targets are arranged to provide time-correlated stimulation to multiple fingers at once.

Concurrent Construction of Patient Panels and Care Provider Teams

Tatiana Alexandra (Tatiana) Epstein, Senior, Industrial Engineering
Mary Gates Scholar
Mentor: Zelda Zabinsky, Industrial & Systems Engineering
Mentor: Joseph Heim, Industrial & Systems Engineering

Patient centered health care requires that individuals be linked to a team of care providers responsible for guiding them through the full range of health and preventive services. This research addresses the considerations and lays the foundation for understanding how to incorporate patient characteristics when creating patient panels to match the needs of patients and the skill sets of their health care providers. We illustrate how a strategic plan can be developed with varying combinations of care provider team composition. This strategic plan enables clinics to hire staff with the appropriate skill set to meet patient demand for health care. By examining a representative data set, patients will be pooled according to a minimal set of attributes, such as age, gender, and medical conditions, in order to model the mix of patient attributes within a panel. Using probabilistic distributions, an estimate of total workload for each care-giving panel is established. Different combinations of preferences and panel mix amongst the medical professionals are analyzed with respect to the objectives of meeting patient demand while matching patient preferences with physician capabilities and preferences.

Improving the Method for Ordering and Paying for Drinks at Bars

Curtis John (Curtis) Howell, Senior, Business Administration (Entrepreneurship), Informatics
Ezra Park, Senior, Informatics, Business Administration
Patrick Stanton Siu, Senior, Informatics (Human-Computer Interaction)
Mentor: Amy Ko, Information School

Our capstone project discusses a redefinition of a social bar experience. Opening and closing tabs at bars is stressful, time consuming and frustrating. Today, the process to order a drink at a bar is tedious: wait in line, order a drink, then hand a bartender a credit card to open a tab. Stand in the same line for each subsequent drink as well as to close the tab. This process is time-consuming and detracting from a customer's bar experience. With the imminent rollout of mobile payments as a ubiquitous brick-and-mortar payment method, we identified an opportunity to utilize mobile payments technology to develop an elegant solution to order drinks at a bar. One of our goals is to eliminate as much friction from the experience as possible, which will allow users to better enjoy their drinks with their friends. The service will handle ordering, paying and tipping for menu items, as well as offer additional value-added features that are only possible when customers order and pay for drinks from a mobile device. While we will focus on the bar scenario, our technology platform will be applicable to several other verticals including restaurants and stadium venues. By employing the user-centered design process supplemented with usability research, we seek to create a solution that redefines the bar experience.

Designing Flight Deck Visualizations through Human-Centered Design Methodology

Erin Margaret Murphy, Senior, Design: Interaction Design
Mary Gates Scholar
Mentor: Axel Roesler, Art

This project examines new visual representations for spatial and temporal work tasks in the commercial flight deck. Utilizing integrated map and timeline views, we are exploring an alternative design concept for programming and replanning flight routes with the flight management system. In the current design of the flight management systems, pilots must manage a set of input devices and paper printed flight plans to program the flight route using numeric way points and time markers. Rerouting due to weather or inflight emergencies requires verbal coordination with air traffic control and the flight company. A new integrated interaction design approach to these interface operations could potentially lower the cognitive overhead required for these workflows and provide pilots with a better contextual understanding of their situation. When provided with clear information on the context of the plane and status of the mission, pilots can make better decisions during replanning and emergency scenarios. The presented research applies a human-centered design approach to the commercial flight deck and flight information displays that supports the interactions between pilots and the aircraft. Extensive video prototyping examines new directions for possible flight plan representations.

The Needle in the Haystack: Automatic Idiom Identification

Felix (Grace) Muzny, Senior, Computer Science, English
Mary Gates Scholar
Mentor: Luke Zettlemoyer, Computer Science & Engineering

Natural Language Processing is a subfield of Computer Science that inspects the intersection of computation and human language. Idiomatic language is in turn ubiquitous in human language—when someone is a "diamond in the rough", they are not literally an uncut diamond, rather, they are a person whose goodness is hidden by their surface appearance. However, a "diamond in the rough" is a phrase that can literally mean an uncut diamond—this is to say, it has two different senses, one that is idiomatic and one that is literal. Given a dictionary entry, a human can easily distinguish between idiomatic and literal definitions, however, doing this in an automatic fashion is difficult because it requires asking whether the meaning represented in the definition corresponds with the literal meaning of the phrase. This research leverages Wiktionary, an extremely large, collaboratively authored dictionary, to perform idiom identification in a scalable manner through machine learning algorithms. To do this identification, we are developing two sets of features—traits that we describe a definition-phrase pair with—selectional preference features and graph-based features. Selectional preference features describe traits of language that are used in a way that violates its literal meaning while graph-based features describe where the entry occurs in relation to the other pages within Wiktionary (what links does this page contain?). We are using two kinds of machine learning algorithms for idiom identification—supervised methods and semi-supervised methods. Supervised methods allow us to verify the validity of the features that we develop, and semi-supervised methods allow us to use these features for knowledge discovery because they are ideal for discovering definitions that are not yet marked as idiomatic but that ought to be.

UW Mobile Payments Battleground

Ezra Park, Senior, Informatics, Business Administration
Brian Fu, Senior, Informatics (Human-Computer Interaction)
Curtis John (Curtis) Howell, Senior, Business Administration (Entrepreneurship), Informatics
Mentor: Katie Davis, Information School

This research discusses the investigations of a research project regarding the likelihood of adoption of particular mobile payment platforms by University of Washington students. Mobile payments have been around for several years now, but users have been slow to adopt the technology. Recently, companies are beginning to invest in this technology despite its previously slow growth. College students are also usually at the forefront of technology adoption, but this has not been the case with mobile payments. This research

project details our investigational study of determining which type of mobile payments platforms UW students are most likely to adopt and will continue as follows: First, we discuss background information to define some key terms, concepts and technologies. Next, we detail the methods that we used to find the answer to our research question. These methods included research methods often used for usability research including focus groups and surveys. We report on the findings from our investigation at the end of our research paper. Given the data and analysis of our research, our findings have the potential to inform both consumers but most importantly mobile payment providers.

Real Time Health Monitoring System (RTHMS)
Henry Joseph (Hank) Robinson, Senior, Information Technology (Tacoma)
Robert Sanchez, Senior, Information Technology (Tacoma)
Mentor: Marc Dupuis, Computing and Software Systems, UW Bothell

Everist Genomics reports, "If ˜20% of Americans currently diagnosed with hypertension reduced their systolic blood pressure by 12.5 points it would reduce heart disease risk by 21%, stroke risk by 37%, and risk of death from heart disease or stroke by 25%, and generate >$75 billion in annual cost savings for healthcare payers and employers." Current procedure for health monitoring requires that patient be monitored by an in hospital or out-patient basis. Monitoring the daily variations involved with everyday activity can produce a more complete and exacting type of diagnosis and prognosis for health care professionals, as well as providing important information to the health compromised, regular, or health conscience individual. Real Time Health Monitoring System (RTHMS) is a conceptual idea that would benefit people of all ages and health categories. The interface would be worn against the skin and reports encrypted real time health information to a secure on-line database through a cellular data network. The user would have administrative abilities to personal health records and has the only authority to grant access to suitable parties. Depending on the application, monitoring scenarios could include detecting patterns in pre-seizure activity, and monitoring of blood chemistry and distribution of medication. Real time monitoring may give physicians information for earlier diagnoses prior to the onset of illness. Patients suffering from addiction difficulties may be presented with the monitoring option as a way to avoid incarceration and remain productive. The concept is sound, the finance required for implementation is tricky, but could be done creatively through mass markets and stylized design. The benefits that could be achieved by the Real Time Health Monitoring System are obvious and realized through the saving of time and money in the treatment of health issues, and also could provide significant health safeguards and embellishments for the individual as well as an individual's interactions with society.

Analyzing Clinical Laboratories using Object-Oriented Hierarchies and Discrete-Event Simulation
Hao Wang, Senior, Industrial Engineering
Mentor: Joseph Heim, Industrial & Systems Engineering
Mentor: Zelda Zabinsky, Industrial & Systems Engineering

The process flow in clinical laboratories resembles that in a traditional manufacturing setting, but there are distinct differences between the former and the latter which make it difficult to directly reflect the essential functions of a clinical laboratory in a simulation model. Creating a simulation model enables us to analyze and determine the impact on key metrics such as turnaround time and utilization rates when we change the physical configuration of the laboratory and vary the input parameters of the model. We have adapted the object-oriented nature of SIMIO, a program commonly used in a manufacturing setting, to create a discrete-event simulation modeling language for clinical laboratories reflecting the technical knowledge of experts from the clinical laboratory domain. We organized critical aspects of the clinical laboratory into class hierarchies to clearly delineate their functions and relationships. We then developed specific modules using the class hierarchies to represent the unique behavior of instruments, equipment and processes in a clinical laboratory. Using these modules, we created a simulation model of the clinical laboratory. The domain-specific modules we have formulated provide clinical laboratory experts with a customized tool to understand and improve their own system from a modeling perspective.