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Introducing Middle School Girls to IT Careers

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Motivation for Research

In the era of independent women and breaking glass ceilings, we tell our daughters that the sky is the limit and they can be anything that they want. Yet, female professionals are still underrepresented in information technology. Women in IT fields have been decreasing since 1985. In 2006 only 26.7% of computer and mathematics professionals were women and by 2008 it continued to drop to 24.8% [1, 2]. Some of the factors contributing to the decline are due to limited interest as well as family influence. Other contributing factors are limited access to and inexperience with using computers and perception of information technology occupations [4]. In fact, during the 1980's 37% of computer and information science degrees were awarded to women. However, in 2006, the number of women receiving computer science degrees was as low as 18% [1]. This is surprising in today's technology filled world. In addition, we see that while 55% of Advanced Placement testing is done by girls, only 15% of the AP Computer Science test takers are girls [3]. For AP Calculus, girls maintain their standing with boys with 48% taking this test; therefore, we know there are gifted girls studying right alongside the boys.

In an attempt to change this situation we want to engage girls at a younger age. Some studies have shown the importance of reaching girls in middle school [4]. Therefore, at Georgia Gwinnett College we have established a summer program, GGC Tech Camp, focusing on middle school girls. The specific purpose of GGC Tech Camp is to provide students not necessarily adept at computing with hands-on computing experience and to engage them in the exciting ways computing is used as a problem solving tool in a variety of career fields.

GGC Tech Camp Background

Georgia Gwinnett College (GGC) School of Science and Technology (SST) sponsored summer enrichment camps for students entering 7th through 10th grades. The first camp debuted summer 2009. Students experienced a five-day schedule full of demonstrations, laboratory exercises, discussion groups, and presentations on the Georgia Gwinnett College campus. Students were supervised by Georgia Gwinnett College faculty and staff. Courses were taught by Georgia Gwinnett College faculty and staff. Each summer the interest has grown tremendously in terms of attendance, variety of programming, and camper satisfaction with the program. Each session is described in more detail below.

In **2009** there were two sessions for middle school students. There were **14** middle school girls in session one and **23** boys and **1** girl in session two. Students reported more interest in a career in computing by week's end, even though an explicit career support was not provided. The students used Scratch to develop games and used Pico Cricket kits used to create musical sculptures, dancing creatures, and other playful inventions.

In **2010** there were three sessions. The first session had **11** campers for middle school girls, session two had **17** middle school boys and session three had **13** boys and **3** girls. Campers were involved in a variety of activities. They built and programmed robots with LEGO MINDSTORMS ®. They learned how to create movies and developed computer games using Scratch. In order to expose students to computing careers, an IT professor presented two 45 minute discussions about IT career opportunities.

In **2011** there were three sessions. The first session had **33** coed High school students. The second session had **25** middle school boys and the third session had **17** middle school girls. The camper's learned how to build and program robots with LEGO MINDSTORMS ®, create movies, design mobile apps using App Inventor, and developed computer games using Scratch. They also attended lunch and learn sessions that were very informative. The sessions were conducted by GGC students and covered the following topics; Pathways in computing, the development of a strategy game, and the evolution of gaming.

Research Objective and Methodology

In order to provide our campers with the optimal summer experience, we need to analyze what worked and what needs improvement. There are many different things that we could look at, but we chose to look at exposing middle school girls to technology career choices to help them start on the path. Each year pre and post surveys were done to evaluate camper's opinions on the activities performed, and how the camp may have changed their attitudes about a career in computing. Below are survey questions given to each camper pre and post that was career related.

Looking at our most successful camp in 2011, a preliminary analysis illustrates that the campers' confidence in computing and programming grew as well as their interest in IT careers. Eighty-eight percent of the campers declared that they knew more about "computing as a job because of this camp."

What we hope to find is what is effective and what changes we can make to improve their overall experience. We can achieve this by; taking a look at other tech camps at other colleges just to see what curriculum they are offering, provide a career day option where campers can see what options are available in Information Technology, expand on popular activities and improve or eliminate unpopular activities.

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Egoless Programming in Middle School Summer Camps

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Two major issues the computing world is currently focused on are diversity in the workplace, and programming in teams effectively. The main issue with programming in teams is that individual programmers have to admit that someone else is capable of doing a part better than them, or that they have made a mistake. This is difficult because studies have shown that many programmers develop an attachment to their creations and treat it as though it is their own project progeny. Any criticism of their work is a criticism of him or herself.[1] Egoless Programming is a concept that advocates a lack of personal attachment and ego to a project, and hopes to replace it with project loyalty. The programmer should be willing to put aside personal feelings in order to protect the success of the project, including admitting that he or she has made a mistake that needs to be corrected, or that the programmer does not know enough to complete the project. The other issue is the lack of diversity in programming,[2] and our survey data from GGC Tech Camp indicates that more women in computing could solve both.

A lot of research has focused on how to attract women to programming, simply in order to increase diversity and increase the supply of IT professionals in the U.S. In 2008, only 17.4% of all Bachelor's Degrees in Computer Science went to women.[3] Worse still, from 1997-2004 27% of graduate students pursuing Computer Science degree were women, in 2005, it dropped to 25%.[2] Come 2008, only 22.9% of C.S. PhDs went to women.[3] The trend carries even to high school girls. Even though girls complete 55% of all AP tests, women only finished 15% of the AP Computer Science tests.[4] This early shortage of girls interested in computing leads to the general shortage of IT professionals.[2]

One of the attempted solutions is Summer Camps that focus on a series of projects in order to teach middle school girls how to program solutions. One example of a proven summer camp is Animal Tlatoque. This camp targets middle school girls of Latin American descent.[5] They use one major unifying theme over the week: an endangered animal from Mexico. This camp has met major success as shown by their data. When asked if they thought of CS as a possible career choice before camp, 22% said yes, and afterwards, 65% agreed.[5] The success of camps like these has lead to the creation of more camps, such as GGC Tech Camp.

GGC Tech Camp has been offered for three years, Summer 2009 -Summer 2011. There are three sessions, each lasting a week. The first, for high school students, currently focuses on Python, and App Inventor. The second is for middle school boys, which teaches LEGO Mindstorms and Scratch. The third week is only for middle school girls, and has exactly the same curriculum as the middle school boys' week. At the beginning of each session of camp, a pre-camp survey is distributed that analyzes the perspectives of the students. This was accomplished by asking the students to agree or disagree with a series of statements using a scale from 1-5 where 1 is strongly disagree, 5 is strongly agree, and 3 is "in between". Examples of statements the campers were asked to rate include "Programming is hard," "I can become good at computing." "I am good at computing," and "I know more than my friends about computers." The survey also asked about age, ethnicity, hours spent online, and peer and familial support. A significant difference between the pre-camp, and post-camp values were determined using a one-tailed, paired t-test; any student that did not complete the post-camp survey was scrubbed from the data. It was here that a tiny, yet significant, difference between girls and boys became apparent.

After the camp, in 2009, 2010, and 2011, the t-tests showed that boys rated the statement "I know more than my friends about computers" significantly higher due to Tech Camp. In 2010, the average rose from 3.3 to 3.9, which sounds small, but an analysis of the pivot charts generated for their individual results shows that every boy's score increased or stayed the same; the same happened in 2011, with an increase from 3.3 to 3.6, and in 2009, average 3.4 grew to 3.9. Meanwhile, during the exact same time frame, girls were registering no significant change for this statement. Their average in 2010 started at 3.2, and ended at 3.3, and in 2011, actually dropped from 3.5 to 3.3, and this theme still holds true for 2009, with an average of 3.1 that rose to 3.4. However they did show a significant change for the statements "I am good at computing" and "Programming is hard." In 2010, their scores for "I am good at computing" rose from 3.45 to 4.09, and agreement with the statement "Programming is hard" dropped from an average of 3.18 to 2.45. The changes in 2011 were almost identical, "I am good at computing" rose from 3.40 to 4.06, and "Programming is hard" dropped from 3.0 to 2.65. This means that the girls improved at programming, and believed in their improvement, but did not gain an ego about their superiority to their peers. They believed they were just as smart as the other girls, which is exactly what egoless programming requires. These girls could not only fix the rising demand for programmers, they could be the solution for the demand in egoless programmers.

This leaves the question, what can we do to attract these egoless programmers that diversify programming? Now that we know girls are naturally more inclined towards egoless programming, a good idea for future camps is to implement paired programming that would permit girls to communicate, and share ideas. Another concept GGC Tech Camp and other camps can borrow from the Animal Tlatoque camp is to focus on one over-arching theme that girls enjoy.[5] One untested hypothesis is to create one main project that can be easily sub-divided into small parts that promote a daily sense of accomplishment and can be shared easily between a team. This project-oriented focus would not only help train these future programmers to be better egoless programmers; it would also be more interesting and fun for them, and possibly lure them to become CS or IT majors.

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App Inventor In-A-Box: Engaging Teen Girls in Computing

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The demand of IT jobs is currently outstripping the supply of IT workers, and this gap will continue widening [2]. Women make up 55% of those studying bachelor's or master's degrees, but women only comprise 21% of the CS majors [4]. Promoting women to pursue an IT major is an important step to help meet the ever growing demand and also address the need for diversity among IT workers. A key barrier to women entering the IT field are misconceptions about the computer sciences, which can be prevented best by early intervention [3]. Early intervention comes in the form of camps, workshops, or extracurricular activities that engage young women in computing activities, we are developing self-contained curriculum modelled after NCWIT's program-in-a-box series [1].

Since, girls are "more socially oriented, more interested in context, and making a difference in the world..."[5] we will leverage that in our curriculum. Mobile application development would address the social orientation that is missing from most other computing activities. App Inventor is a relatively new, visual blocks programming language designed to create mobile applications on Android operating system smart phones [6]. Visual blocks programming languages are well-suited to introduce programming concepts, since there are no syntax errors. Thus the novice can focus on the logic and flow associated with the context or the application, such as a text messaging reply application. Not much research has been conducted on App Inventor in regards to its effectiveness in attracting women to the field of IT. However, Scratch, a visual blocks programming language similar to App Inventor, has convincing results as a powerful tool in teaching basic programming concepts to youths [p367 Maloney] and increasing the appeal of computer science to female college students [a17 utting]. This makes App Inventor a great fit for increasing interest in computer science amongst young females because it offers socially oriented functions seen only on phones, more tangible results, and has the potential to produce applications that impact the real world. During the Georgia Gwinnett College Technology Camp of 2011, we developed tutorials based upon App Inventor to teach basic programming concepts to high school students. These tutorials covered manipulating App Inventor's component layout, conditional statements, variables, and lists. Students were given creative freedom for two class periods after running through the tutorials to work on a final project. Generally, students initiated extensions of the tutorial exercises or created games. To assess the results of App Inventor, we recorded personal experience, observed levels of success, and gathered feedback from students.

The success of App Inventor in summer sessions, led us to select it as the basis for self-contained "programming in-a-box" activities to interest more teenage students in computing. A three hour IT workshop will be offered on October 8, 2011 for middle school girls utilizing App Inventor. We are designing a completely new curriculum based upon our assessment from the GGC summer technology camp and studies of college students [6]. Wolber showcased compelling examples of texting functions' appeal to his students and its relevancy to the real world. We will feature the texting functions of App Inventor in our curriculum. Texting meets the key points of interest for girls like being socially oriented,

having context, and has the ability to make meaningful differences in the world. A balance will be placed on making the new tutorials engaging and teaching the basic program concepts of variables, conditional statements, and lists. The attendees will be utilizing Galaxy Tablet computers, with cell phone capability to test their apps after each tutorial. These tests on a new, “cool” tablet/cell phone provides a real-world impact of an app they will have just programmed. Our App Inventor programming “in-abox” curriculum will leverage girls interest in text messaging using a visual language and will demonstrate its use on cell phones and tablet computers.

To evaluate the effectiveness of App Inventor and text messaging applications to interest teen-age girls in computing, we are designing a survey to be used along with the programming “in-a-box” curriculum. This survey will be administered at the beginning and the end of the workshop to gauge the girls’ perceptions of technology, comfort level with computing, and how likely they are to consider a career within IT. We will also gauge the success of the App Inventor curriculum via questions on engagement. These questions will be numbered ratings associated with appropriate word descriptions. A follow-up workshop with advanced tutorials may later be offered to the same girls on a later date to evaluate the long term influence of the first workshop and appeal of App Inventor to middle school girls.

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The Usability Studies in Human Mobile Computer Interaction

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Introduction

We created a mobile app to be used by the Career Center at our university. The main purpose of the app is to serve as a college progress track to assist the students with their college life accomplishment as well as to keep them on track of their graduation progress. “Progress Track” displays different tracking items that are categorized in groups. The checkboxes locating at the beginning of each item allow the user to check the items that they have accomplished. Clicking “Learn more” button, the user will be able to see the detail of the specific item that they need to do. Besides the checker, the users are also able to view the articles and events posted by the career center. The mobile app is available on both Apple and Android app store.

The purpose of the research is to study the usability of the Career Center app. The usability is as important as the functionality and the user experience can have enormous effect on not only the app itself but also the image of the career center. We need to conduct the research to find out what part of the app may cause unpleasant user experience and if the effectiveness of the app can help the students with their college accomplishment. In order to make sure that the app is useful for the students of all classification, a group of students, including freshman, sophomore, junior and senior, are going to be selected as participants for the research and they are going to be studied by the methods below.

Methods

Two methods are going to be conducted in studying the usability of the mobile app. The first one is objective and the second one is subjective. Both approaches have their own advantages and disadvantages and they can complement each other by using both methods correctly. The objective method involves data collection and analysis and the subjective method includes questionnaires.

Objective method

The ultimate goal of the mobile human computer interaction is to enable the users to perform specific task in the most efficient way where any wrong or unnecessary steps should be minimized. In order to improve the usability, we first need to find out what exactly the unnecessary steps the user did when interacting with the app. Therefore, it is a critical task to record, sort and analyze the data that is related to the user mobile interaction. A logging system that is injected underneath the app is going to be implemented in the research. The logging works completely hidden so that no interference will be caused to distract the user from normal performance. The logging system is activated and started to monitor the mobile computer user interaction as soon as the app is launched. The specific button the user clicked along with the timestamp of the event is going to be recorded.

All the interaction data above will be sent to the remote server database via AJAX for the further study and analysis. The data collected is used to reproduce the sequence the users took to finish different tasks. By reviewing the logs, we will be able to evaluate the user's interaction with the app comparing to the ideal interaction to accomplish the tasks. We should be able to identify the extra unnecessary steps that the users took to finish the tasks. The list of these steps will enable us to draw conclusion about the parts of the design that causes the problem.

In addition to the usability data collection and analysis, we are also interested in finding out whether the app is helpful for the college students. Therefore, another monitor system is going to be embedded into the production version of the app. The monitor system is going to monitor how many times each unique user uses the app in certain time period and which questions the users stay at for the longest time. The data automatically collected from the user device will be sent to the remote server database whenever the device has internet connection.

Subjective method

Though the objective method is precise and effective in data analysis, it doesn't take user's personal experience into account. Some users may get the tasks done correctly but are not quite happy with user interface. For example, they may feel awkward about the position of a button even though they hit it correctly. Such personal experience will not be captured by the data collected in objective method. Therefore, subjective method is used to collect these subjective data. Questionnaire is the most effective way to capture these problems caused by human factor. However, unlike objective method, the data from questionnaire sometimes can be distorted and is affected by several factors. Some of problems can be avoided and some are out of our control. First of all, the questionnaire should be carefully worded otherwise it may lead to biased answers. Secondly, the participants should be tested under neutral condition. The mood of the users can have great impact on their answers. Though we cannot control the emotion of people, we can try our best to minimize the impact of the emotion on the testing result.

Conclusion

The combination of objective method of subjective method should complement each other's advantages and disadvantages and produce the list of defects that the app has regarding to the user mobile interaction. After obtaining and analyzing the data from both research methods, we will be able to find solutions to solve the problems.

Data Assimilation

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Abstract

The goal of data assimilation is to obtain optimal predictions of a system state based on a combination of model outputs and observational data while carefully minding their respective error and uncertainty. Lagrangian data assimilation (e.g., the incorporation of data collected by devices that move with the fluid flow) is practically relevant because many ocean data collecting devices (so called floaters, gliders, and drifters) are Lagrangian in nature. Furthermore, the dynamics of these devices can be highly nonlinear posing many challenges to traditional data assimilation schemes. We are developing sequential Monte Carlo (SMC) methods for Lagrangian data assimilation. SMC methods use an ensemble of model runs and partial state observations to produce a weighted average of full state estimates. We chose to test these methods on a two layer point-vortex system, i.e. a column of fluid made up of two distinct layers of fluid where vorticity is equal to zero everywhere but a specific points called vortices. Specifically, we are interested in inferring the vortices' dynamics based on observations of Lagrangian drifter paths.

Resonance Raman Simulations of Carbonmonoxy Myoglobin: A QM/MM Study

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The objective of this research is to obtain simulated resonance Raman spectra of a large protein that are comparable to experimentally obtained spectra by utilizing hybrid Quantum Mechanical/Molecular Mechanical calculations. Raman spectroscopy is a technique that provides "fingerprint" spectra from the inelastic scattering that results from the relaxation of molecules excited to a virtual energy state by monochromatic light. Resonance Raman (RR) is a refined form of Raman spectroscopy that produces higher intensity peaks by using incident light of a certain wavelength associated with the energy transition to an actual excited electronic state of the molecule. RR spectra have been experimentally created, but not computationally simulated, for large molecules. Myoglobin is a large globular protein responsible for oxygen storage in muscle tissue. This study focuses on carbonmonoxy myoglobin rather than oxymyoglobin because myoglobin's active site, an iron II porphyrin, has a much higher bonding affinity to CO than oxygen, hence the danger of carbon monoxide poisoning.

In order to produce the RR spectra using a computer program called TDSPEC, molecules' electronic properties must first be computationally modeled and examined. Modeling CO-myglobin fully quantum mechanically would be very accurate but impossible due to high computational costs. Molecular mechanics have less computational cost but are more inexact. Therefore, the hybrid Quantum Mechanical/Molecular Mechanical (QM/MM) calculation would be used to model the system accurately and efficiently, with the protein's active site as the QM region and the rest as the MM region. An initial study of alanine peptides was conducted to understand how molecules could be separated into QM and MM regions such that their electronic properties remained similar to the more accurate, fully QM representation of the molecules. Proper QM/MM boundaries proved to be those that did not split functional groups in a molecule.

Quantum mechanical computational calculations and RR simulations of CO-myglobin's active site alone were successful, generating spectra that showed some definite correspondence with experimentally obtained spectra of the entire protein. However, partially frozen quantum mechanical calculations of the active site with surrounding amino acids presented difficulties that inhibited spectra from being simulated, such as non-aufbau occupation of orbitals, a positive HOMO energy, and extensive wall clock time for calculations. Without successfully completing the study of this system, which was to be the quantum mechanical region in the QM/MM calculation of the whole protein, analyzing the protein as a whole was not begun.

This research concludes that RR does enhance spectral data over regular Raman spectroscopy. However, quantum mechanically studying systems larger than just the active site proved to greatly increase the complexity and costs of the computational calculations, thus clearly demonstrating the need for hybrid QM/MM calculations to investigate protein-sized molecules. QM/MM calculations, when implemented correctly, do yield efficiently accurate results, as shown in the study of alanine peptides. Therefore, properly applying QM/MM calculations to CO-myoglobin will give reputable spectra as long as errors in analyzing the QM region can be corrected.

Hiding Trajectory on the Fly

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The rapid development in micro-computing has allowed the implementation of complex mobile Wireless Sensor Networks (mWSNs). Privacy invasion is becoming an indispensable issue along with the increasing range of applications of mWSNs. The private trajectory information not only indicates the movements of mobile sensors, but also reveals personal preferences and habits of users. In this paper, we propose the distributed Basic Trajectory Privacy (BTPriv) and Secondary Trajectory Privacy (STPriv) preservation algorithms to hide trajectory of the data source nodes online. The effectiveness of our proposed algorithms is evaluated by the software implementation in our simulation experiments.

The aim of this work was to develop a mechanism that hides the trajectory of data source nodes, denoted as the target nodes, on the fly with considering nodes mobility in WSNs. In this particular paper, “on the fly” is defined as a node hiding its trajectory while undergoing data transmissions. It is a distributed and online method that protects trajectory privacy.

We consider the network under the passive attack. Adversaries deploy eavesdroppers at data aggregation locations. Most existing routing protocols are shortest-path oriented. It creates the possibility for adversaries to obtain the trajectory information. We propose the unique privacy-aware routing phase, where each node selects the next-hop node according to the dynamic trajectory distance to hide its trajectory. To the best of our knowledge, this is one of the first works, if it is not the very first, to provide distributed and online trajectory privacy preservation mechanisms in mWSNs.