Gender and Technology
A Mobile Application for Women in Computing

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Abstract--Mobile applications frequently serve to provide users with similar services or experiences to those accessed on personal computers. This paper describes CS4G (Computer Science for Girls), a mobile application developed to provide reliable and accurate information for guiding high school girls in making decisions towards Computer Science careers. The application provides information on Computer Science Education, Female Role Models, Scholarships for Women, and Networking Events for Women in Computer Science.

Index Terms --mobile application, computer science education, women in computing

INTRODUCTION

Retention of women once they enter the Computer Science major is important, but it is secondary to getting women into the major initially. This suggests that the most effective solutions will be those that concentrate not on retention but on recruitment [1].

This presentation describes the development of a mobile application, which provides information necessary for decision making towards Computer Science careers. By integrating mobile app technology specially designed for women and girls, into Computer Science Education, this project envisions a strategy for recruiting and retaining women in computing.

MOTIVATION

Mobile applications allow for information to be stored within the application, hence there is no need to wait on loading information over slow internet connections. Slow internet connections are a common occurrence mainly in developing countries, therefore, this app would be ideal.

Mobile applications are great for storing large amounts of information, such as videos. Since the information is stored within the app, the user's experience will be greatly enhanced.

Through this mobile application, information needed to guide high school girls in computing careers decision making will be easily accessible 24/7. This is a challenge which has been expressed by high school girls, to whose schools I have done outreach to, in the recent past.

The users will be able to access centralized information much faster than if they were browsing the internet. CS4G will also allow girls to access up-to-date information on Computer Science trends, events, scholarships, etc.

Users will be able to provide feedback through the application, this will allow for continuous knowledge of requirements which ideally would not be met in other spaces.

1 COMPUTER SCIENCE EDUCATION

Computing is the foundation of modern society. A proficient computing workforce is essential for maintaining the country's leadership and competitiveness in the global economy [2]. In a constantly evolving and highly competitive laissez-faire economy, the failure of the multi-billion dollar IT industry to address gender diversity is akin to Social Darwinism. Women represent 45% of the entire workforce in the United States but only comprise a scant 26% of the high tech industry; a huge gender gap [4]. In Africa, women remain largely unaccounted for in the technology sector and this gap is wider than the world average. More than 20 years after gender bias studies began in earnest there has been no noticeable increase in female participation in the computing fields. Such career paths are still generally viewed as male arenas of expertise [5]. The number of women earning undergraduate degrees in computer science

declined from 36% to 21% between the years of 1983 and 2006 [6]. For these reasons, the recent decline in enrolments across Computer Science departments and the decrease in gender diversity pose significant challenges to the continuation of nations' prominent positions in the global high technology arena.

2 DISCUSSION

This discussion describes the development of an Android mobile application using Android Studio. The application steps take the user through a demonstration of the various features of CS4G mobile application.

The objectives of the application are: 1.) to avail information on computer science that is accurate and relatively easy accessible to women and girls. 2.) to provide practical and interactive interfaces that can assist in building spatial skills of women and girls, a skill that is key in the field of computer science. 3.) to improve gender perceptions of computer science by exposing women and girls to female role models. 4.) to enhance communication and interaction among women and girls in the field of computing by providing. 5.) to provide a feedback mechanism on user experience in the field of computing through a simple rating system. 6.) to demonstrate the usefulness of mobile application technology in Computer Science Education.

2.1 FACTORS INFLUENCING CAREER CHOICE IN COMPUTER SCIENCE

The CS4G mobile application sought to address the following factors that influence career choice in Computer Science.

2.1.1 Stereotypes
Negative stereotypes about girls' and women's abilities in science persist despite girls' and women's considerable gains in participation and performance in these areas during the last few decades. Two stereotypes are prevalent: girls are not as good as boys in science and scientific work is better suited to boys and men [7]. The solutions to these problems range from encouraging students to have a more flexible or growth mind-set about intelligence, exposing girls to successful female role models in computer science to teaching students and teachers about stereotype threats. Where have these solutions fallen short? For the most part, stereotyping remains a gray area as people are not consciously trying to discourage women from computer science. Instead, people's behavior is often subconsciously influenced by stereotypes that they may not even realize they have. That some women feel uncomfortable in mostly male environments is not primarily a result of men's trying to make them feel unwelcome but of dynamics resulting directly from the male majority and societal sex-based differences in behavior [8].

2.1.2 Self-Efficacy
Fewer girls than boys say they are interested in science careers. The work of Shelley Correll, a sociologist at Stanford University, sheds light on how girls' and women's seemingly voluntary decisions to avoid STEM careers are influenced by the cultural belief that science and math are male domains. In response to this, schools, departments, and workplaces can cultivate a culture of respect. When institutions (including K–12 schools, universities, and workplaces) and individuals send the message that girls and boys are equally capable of achieving in math and science, girls are more likely to assess their abilities more accurately. In addition, the need for affirmative action has been proposed in the past as a solution; this includes lowering of entry grades into computer science programs so that more women can be absorbed [8]. However, research shows that while there is a need for affirmative action programs, they have large negative effects that must be considered. Even if a program does not entail lower standards for women, doubts are cast on a woman's qualifications in a society that already mistrusts them. Programs with lower qualifications may be a tactical mistake (in addition to being unjust) because people may be put in situations for which they are not qualified, giving them less overall success and self-confidence that they would have had otherwise. To immediately dispose of a red herring, let us state emphatically that none of us believe a less qualified (scientist)

should be hired, just because she is female [9].

2.1.3 College Student Experience

Many young women graduate from high school with the skills needed to succeed in majors in science, yet college-bound women are less likely than men to pursue majors in these fields [10]. The culture of academic departments in colleges and universities has been identified as a critical issue for women's success in earning college degrees in computer science. Various solutions have been applied including but not limited to; sending inclusive messages about who makes a good computer science student. Carnegie Mellon changed the admissions policy that gave preference to applicants with a lot of previous programming experience once the university realized that this was not key to student success. This change sent a more inclusive message about who could be a successful computer science student and helped Carnegie Mellon recruit more women with no change in the quality of the applicant pool. Addressing peer culture within a department has a tremendous effect on students' experiences and is determined primarily by how students treat and relate to one another. Faculty should, therefore, pay attention to peer culture to ensure that no student clique (for example, hackers) dominates or becomes the ideal way of being in the major [11]. Solutions like these, however, have been termed as "Informal Special Treatment". Case in point, in MIT for example, one woman objected to there being a class entitled ``Women and Computers'': I personally consider the class is poorly named, and I for one would not sign up for such a course. It assumes that women have different/special issues with regard to computers than men have, solely because of their gender. This gives exactly the wrong message to both men and the more `traditional' women. What we, as liberated women, should be doing is asserting over and over until we can make it so that, except for a few basic physical differences that we, unfortunately, can't deny (e.g., size and upper body strength), women and men are the same. By naming a course `Women and Computers,' all you are doing is helping to perpetuate the myth that women are somehow `different' and should be treated differently. That's how we got where we are in the first place! [8].

2.1.4 Inadequate Career Guidance

The current education system often means that students sometimes make career choices based on inaccurate information, a fact that has been acknowledged by the Ministry of Education in its guide on careers [12]. This means that students may be eliminating many potential careers that they qualify for because they lack accurate information. Thus the effects of poor career guidance may have lifetime implications.

In order to counter this, colleges perform outreach initiatives to high schools. From 1997 to 1999 Carnegie Mellon University hosted a summer institute for advanced placement computer science teachers to prepare them to teach programming and provide them with gender equity instruction to help increase the number of girls taking high school computer science. Not only did participating teachers report success in recruiting more girls, but an increasing number of talented students, both female and male, from the participating high schools applied to the Carnegie Mellon School of Computer Science, which supported the university's recruitment of a more diverse student population [13].

In as much as outreach programs have significantly contributed towards increasing the number of women in computing, this has its limitations including university costs of planning and execution, inability to reach all women owing to a large number of schools and less follow up done or feedback received on how effective these programs are for the recipients.

2.1.5 Physiological brain differences

That men and women are different is common knowledge, especially owing to external anatomy as well as primary and secondary sexual differences. Furthermore, subtle observable differences exist between male and female brains; however, such gender variations in the brain are often exaggerated and misappropriated, not only by the mass media but also by scientists, to reinforce stereotypes and perpetuate myths [14].

Male brains utilize nearly seven times more gray matter for activity while female brains utilize nearly ten times more white matter. Gray matter areas of the brain are localized. They are information- and action-processing centers in specific splotches in a specific area of the brain. Once they are deeply engaged in a task or game, they may not demonstrate much sensitivity to other people or their surroundings. On the other hand, white matter is the networking grid that connects the brain's gray matter and other processing centers with one another. This profound brain-processing difference is probably one reason you may have noticed that girls tend to more quickly transition between tasks than boys do. The gray-white matter difference may explain why, in adulthood, females are great multi-taskers, while men excel in highly task-focused projects.

Men, on average, perform better than women on certain spatial tasks. In particular, men have an advantage in tests that require the subject to imagine rotating an object or manipulating it in some other way. They outperform women in mathematical reasoning tests and in navigating their way through a route. This may account, scientists say, for the fact that there are many more male mathematicians (often associated with computer science), airplane pilots, bush guides, mechanical engineers, architects and race car drivers than females. Furthermore, men are more accurate in tests of target-directed motor skills – that is, in guiding or intercepting projectiles. Women tend to be better than men at rapidly identifying matching items, a skill called perceptual speed. They have greater verbal fluency, including the ability to find words that begin with a specific letter or fulfil some other constraint. Women also outperform men in arithmetic calculations and in recalling landmarks from a route. Moreover, women are faster at certain precision manual tasks, such as placing pegs in designated holes on a board [15].

Family and culture are a major force in the way males and females view themselves and the things around them. Therefore with an understanding of these differences, parents can educate and support children from an early age, for example, girls can grow their motor skills through working zippers, building blocks, completing puzzles among other tasks as early as preschool years so that they can easily develop interest in computer science careers at an early age.

2.2 Development
The target platform for the application was chosen to be Android. Android is easier to use, integrate with other platforms and is low cost.

Development began with the creation of the wireframes and later translated into screens using Android Studio. The content was then researched on and integrated into the app. The content data comprised; Computer Science Education, Female Role Models, Networking Events, Computer Science Careers, among other information. This information is stored on the app's database (Realm.io) and some of the screens with dynamic content are updated through a Web API developed using Django and data stored in its MYQSL database.

2.3 User Experience
The application loads a Splash Screen when run, with images of girls and computers. The images selected are meant to give a typical high school girl the feeling of inclusion in the field of computing with no regard to race or gender. The Splash Screen also briefly highlights the intention of the application.

Fig. 1. Splash Screen.

Thereafter, the app defaults to a screen with information highlighting reasons why one should pursue a career in Computer Science.

The application also has a Navigation Bar with which the user can easily navigate the app regardless of which screen they are viewing.
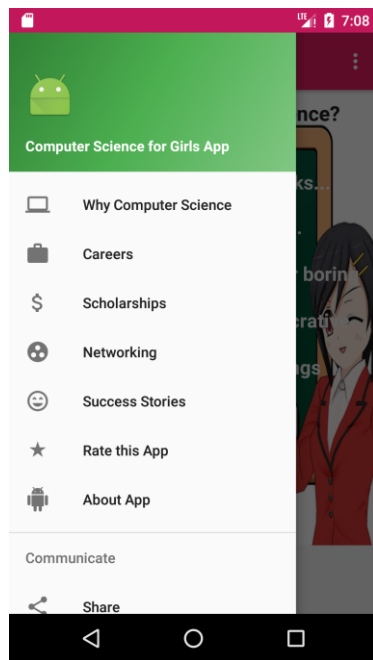

Fig. 2. Navigation Bar.

The remaining screens were designed based on the following functional and non-functional requirements.

Functional Requirements
Below are the high-level requirements.

- **Computer Science Education:** Information on Computer Science Education and reasons why it is the career to pursue. This information will also be updated frequently as Computer Science is a dynamic field.
- **Computer Science Careers**: Information on the career options that exist in the market as well as communications/videos from experts in those areas.
- **Scholarships:** Information on scholarships for women in Computer Science which will be updated as deadlines draw near.
- **Success Stories:** Information on Female Role Models in the field of computing. In addition, movies and documentaries on the same.
- **Networking Events:** Information on events for women in Computer Science, including online talks, career fairs, etc.

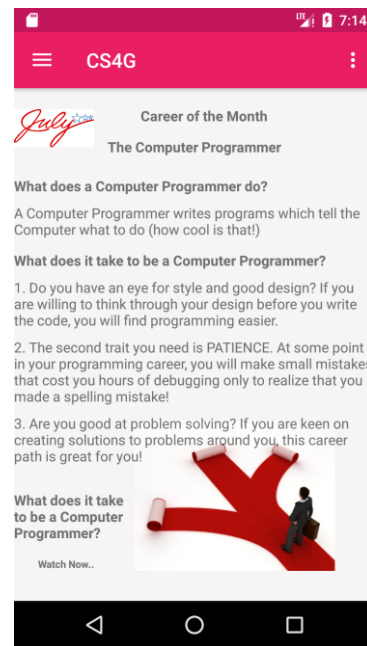Sample screens of the above requirements are shown below.

Fig. 3. Computer Science Careers.

Fig. 4. Female Role Models.

Non-functional Requirements
- Users shall be able to provide feedback about the application and areas of improvement (including information they would like to be added to the application).

Sample screens of the above requirements are shown below.

Fig. 5. Rate this App Screen.

- The application shall be available 24/7
- The application shall allow for its sharing on social media sites.

3 CONCLUSION

The motivation behind the development of this application was to provide accurate and reliable information to high school girls about Computer Science through the use of mobile technology.

Even though the project outcomes to a large extent have been met, there are still future recommendations for an application like this to be successful. In researching on spatial skills that women need to succeed in Computer Science, games like puzzles and board games can be integrated into this application. The application can also be made fully interactive so that girls from all over the world can get information they need to make decisions about Computer Science careers in real time. Women from around the world can also reach out to Female Role Models and network amongst each other about challenges in the field of computing and how they have overcome them; providing a great support structure for them to succeed. Quizzes on Computer Science Education can also be built in the application, with prizes attached, to provide motivation for learning.

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