Android Application Development to Promote Physical Activity in Adolescents

Darryl Clark[1], Clarence Edmonds[1], Antonio Moore[1], Julee Harlow[2], Kacie Allen[2], Woodrow W. Winchester, III[2], D. Scott McCrickard[2], Paul Estabrooks[2]

[1]Department of Computer Science
Norfolk State University
Norfolk VA 23504 USA

[2]Center for Human Computer Interaction
Virginia Tech
Blacksburg VA 24060 USA

Abstract- **Adolescents in today's society are becoming increasingly less active, contributing to a rising obesity rate. With this epidemic as motivation, and the use of smart phones by youth as opportunity, a suite of Android Applications was developed to promote physical activity among this population.**

Keywords- human-computer interaction; mobile computing; mobile interfaces; usability engineering

I. INTRODUCTION

Adolescents in today's society are becoming less active, contributing to the rising obesity rate. With this epidemic as motivation, and the growing accessibility of smart phones to teenagers as opportunity, this paper describes our development of a suite of collaborative Android games to promote physical activity among this population. Informed by interactions with youth groups, application development occurred through the scenario-based design usability engineering method.

A suite of three applications using various mobile hardware components were developed and evaluated at the Roanoke Boys and Girls Club. The first application, Apple Tree Shaker is an application that uses the accelerometer to ask players to shake the device to knock down as many apples off the tree within a given time period. Color Scavenger Hunt is an application that prompts the player to choose a color between red, green, and blue (the three primary colors). Once a color is chosen the player is asked to take pictures of objects of the same color, and throughout the game the player is given hints to find that color in different locations so that physical activity is involved. Speed of Light (SOL) is an application that uses the GPS and involves a race where the players plot their finishing line and the starting point. The players receive points based on the speed and distance they traveled.

With emerging numbers and types of mobile devices, multiple hardware components could be combined to make one fun, challenging, and competitive game for adolescents to increase exercise and interaction between players. Improved graphics has promise to improve the games to make them more interactive.

The remainder of this paper presents the background and motivation for this work, the usability process for the Android application creation, with visual depictions for each design stage, and directions for future work in this area.

II. Background

There are a growing number of life-threatening diseases and conditions that can be prevented or lessened with a healthy diet and exercise, including heart disease, cancer, and diabetes (e.g., [1]). This work seeks to create an engaging interface to address health and wellness concerns. In particular, there have been recent increases in childhood obesity in recent years, (e.g, [2]) leading to a focus in the childhood obesity area by First Lady Michelle Obama.

Prior work suggests that mobile devices are a good match for our work. Many young people, notably African Americans, use mobile devices from a young age as a primary means to connect to the internet. Mobile device interfaces are showing strong potential as enablers of behavioral change, particularly in the health and wellness areas (e.g., UbiFit Garden fosters physical activity through the use of mobile displays [3]). In particular, games provide an experience for users that is both engaging and informative. Games have been leveraged previously to reach out to both adults and children [4]. Moreover, findings suggest that computer games could be effective in promoting healthier food and beverage consumption [5]; hence our continuing research focus on developing and evaluating mobile games for young people [6].

II. Application Development

This work used a scenario-based development approach to creating the mobile applications [7]. The first step was to develop scenarios that reflect the target usage, as reflected in the example below and in figure 1:

978-1-4673-1382-7/12/$31.00 ©2012 IEEE

Scenario: A group of kids at a cookout are looking for a means of entertaining themselves after eating when a kid mentions he has a new app and challenges someone to beat his high score. He demos the game, shakes off 20 apples off the tree then passes it to his challenger

Figure. 1. Sample pictorial usage scenario for this project

Each of the full scenarios shows how the key actors approach a situation and temporally walk through it to reach a resolution. We worked toward the creation of scenarios that would encourage activity among young people.

As a next step, we created wireframes to capture the key stages in the application. They could then be compared to the scenarios to ensure that there was a match between the important parts of the scenarios and the stages of the application. Two wireframes are shown in figures 2 and 3, reflecting that wireframes could be either computer-generated or paper-based.

The wireframes then provided for us a basis for our application creation. We ensured that each frame in the wireframe (and hence each element in the scenarios) matched with something that would be visible to the people using the applications. This allowed us to conduct cognitive walkthroughs with expert reviewers throughout the design process, thus simplifying the application design toward the creation of better applications.

It is through these usability engineering steps that we connected researchers in multiple disciplines, toward contributing to the discipline. While other applications seek to encourage healthy behavior (e.g., [3,4]) , this work presents an approach for designing these applications (see [5] for details).

Figure. 2. Computer-generated wireframe for the "Apple Shaker" application.

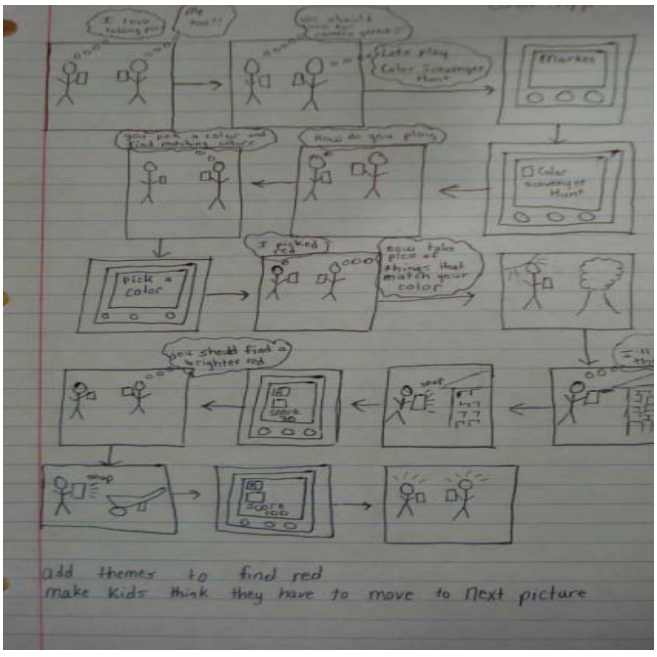

Figure. 3. Hand-drawn wireframe for the "Color Hunt" application.

A suite of three applications using various mobile hardware components was developed for evaluation at the Roanoke Boys and Girls Club (see the next section for details).

The first application, Apple Tree Shaker, uses the accelerometer and asks players to shake the device to knock down as many apples off the tree within a given time period. Participants each have their own devices and can compete to see who achieves the highest score. Figure 4 shows two stages in the Apple Tree Shaker application.

Figure. 4. Screenshots from the "Apple Tree Shaker" application.

Color Scavenger Hunt is an application that prompts the player to choose a color between red, green, and blue (the three primary colors). Once a color is chosen the player is asked to take pictures of objects of the same color, and throughout the game the player is given hints to find that color in different locations so that physical activity is involved. Competition among participants will encourage them to move around to find highly-rated pictures. Figure 5 shows two screenshots from the Color Scavenger Hunt game.

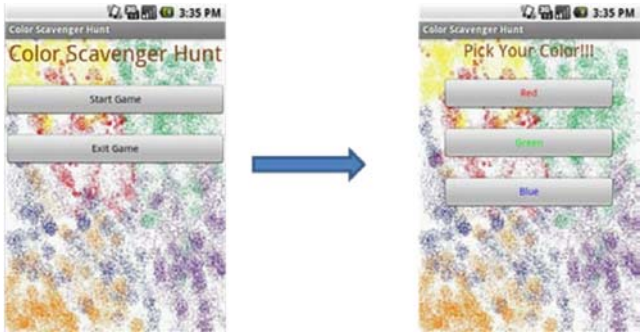

Fig. 5. Screenshots from the "Color Hunt" application.

Speed of Light (SOL) is a final application that we developed to use the GPS and involves a race where the players plot their finishing line and the starting point. The players receive points based on speed and distance traveled.

III. Conclusions and future work

This paper describes three mobile applications for the Android platform that encourage exercise among groups of young people. The applications make use of specialized hardware in today's smartphones, like GPS and accelerometer, with the expectation that these phones will be inexpensive and common among younger populations in the near future.

To assess the viability of these applications among young populations, we are working closely with our local Boys and Girls Club [8]. Our initial results show a high degree of familiarity with mobile phones, particularly for gaming and communication—a great match for the applications that we have developed. Our next steps will be to deploy these and other similarly-targeted games within this youth community for long-term study, seeking to observe usage patterns and to collect user feedback among peer groups (as in [9]). We also plan to release the games within mobile application marketplaces for broader dissemination.

ACKNOWLEDGMENT

Thanks goes to the United States National Science Foundation (NSF) grant IIS-0851774 for their support of this work through the REU Site program at Virginia Tech. Thanks also to George Zhang for his assistance with the application development and to the great many people who commented on the applications.

REFERENCES

[1] K. Kulkarni. "Food culture, and diabetes in the United States," in *Clinical Diabetes,* vol 22, number 4, 2004.

[2] S. Kim and E. Obarzanek. "Childhood obesity: A new pandemic of the new millennium," in *Pediatrics* vol 110, number 5, 2002.

[3] S. Consolvo, D. W. McDonald, and J. A. Landay. "Theory-driven design strategies for technologies that support behavior change in everyday life," in *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI),* 2009.

[4] A. Grimes, V. Kantroo, and R. E. Grinter. "Let's play! Mobile health games for adults," in *Proceedings of the ACM Conference on Ubiquitous Computing (Ubicomp),* 2010.

[5] W. W. Winchester, III, D. S. McCrickard, and F. Doswell. "Towards culturally empowered design: Addressing African-American health disparities through notification interfaces," in *CHI Wellness Informatics Workshop*, 2010.

[6] D. Hill, J. Blunt, T. Pugh, M. Monk, J.-S. Kim, W. W. Winchester III, D. S. McCrickard, P. Estabrooks, and F. Doswell. "Mobile technologies for promoting health and wellness among African American youth," in *Proceedings of HCI International*, 2011.

[7] M. B. Rosson and J. M. Carroll. *Usability Engineering: Scenario-Based Development of Human-Computer Interaction.* Morgan Kaufmann, San Francisco, 2002.

[8] K. Allen, J. Harlow, E. Cook, D. S. McCrickard, W. W. Winchester, III, J. Zoellner, and P. Estabrooks. "Understanding perceptions and experiences of cellular phone usage in low socioeconomic youth," in *Proceedings of the 33rd Annual Meeting and Scientific Sessions of the Society for Behavioral Medicine*, 2012.

[9] G. B. Terrell and D. S. McCrickard. "Enlightening a co-located community with a semi-public notification system," in *Proceedings of the Conference on Computer Supported Cooperative Work (CSCW),* 2006.