

Designing an Obstacle Game to Motivate Physical
Activity among Teens

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Abstract

In this research we present an obstacle course game for the iPhone OS platform called Jungle Course. The goal of this game is to motivate and encourage teens to become and/or remain physically active in a fun and challenging way. Increasing and maintaining high levels of physical activity in teenagers are some elements suggested to maintain an energy balance and thus maintain healthy weights. Over the years, obesity has become a main health concern for adolescents and teenagers with many health risks associated with it. Combating obesity is essential to improve the healthy outlook of teenagers as adults and to reduce the expected pressures on our health care systems. To increase teenagers' physical activity, Jungle Course requires that the teenager physically walk in order to complete timed obstacles and gain points. Each level requires that the user walks more steps to complete the level and the obstacle becomes more challenging. Higher scores are given for completing the level in shorter amounts of time, and thus are associated with more vigorous physical activity. To explore the usability and entertainment value of the game, we conducted a focus group for Jungle Course. From this focus group we found that the subjects enjoyed Jungle Course and felt it was best suited to play with other friends. They all expressed they would like to continue to use the game and felt it made walking fun.

Introduction

Maintaining a healthy and physically active lifestyle among adolescence has become a prevailing problem over the last decade. According to studies performed in 2006, over a third of adolescences are considered obese [3]. Unfortunately, obesity is a factor in many health conditions such as high blood pressure, diabetes, stroke, and cancer [3]. The widespread of these conditions also contribute to the rising cost of medical expenses in the United States alone. In 2000 an estimate 100 billion dollars in costs were related to obesity in America [3]. A major factor in the prevalence of obesity among adolescence is the decrease amount of physical activity performed. This may be due to leisurely time restrictions and an increase interest in sedentary pastimes such as watching TV and playing video and computer games [2]. From these measures it can be inferred that adolescences seek entertainment through technology.

Incorporating mobile technology with physical activity is a method used in this project to address the factors that contribute to the low levels of physical activity among teens. Still other issues have to be considered when attempting to motivate teens to become or remain physically active such as motivating forces. Before implementing a system to encourage physical activity, it is crucial to acknowledge a few behavioral theories on motivators. Theory of Meaning Behavior, Theory of Planned Behavior, and the 5 Factor Model of Personality are three significant theories considered in this project. Briefly, Theory of Meaning Behavior explains personal internal and external motivators such as rewards attributed to a behavior [1]. Theory of Planned Behavior considers social norms and perceived outcomes that influence behavior [1]. Lastly, the 5 Factor Model of Personality suggests customized interventions and persuasion techniques based on

individual personality traits [1]. After understanding the motivating factors required by the targeted audience then developing a catered system can commence.

In this project, an obstacle course game, Jungle Course, was developed on the iPhone OS in an attempt to encourage physical activity among teens using a mobile device. Jungle Course requires physical activity to gain high scores and complete levels. After implementation, a field study and a focus group were conducted to obtain feedback for possible improvements and to analyze the effectiveness of the game application.

Jungle Course



Figure 1 Jungle Course Screenshot

Jungle Course is an obstacle course based game in which users virtually travel through a jungle and overcome jungle-type obstacles. The game is divided into two modes: Walking and Obstacle. In the Walking Mode users complete a determined amount of steps before entering the Obstacle Mode in which they have to overcome jungle-type obstacles. The main goal of this game application is to advance levels and obtain high scores by completing each level in the shortest amount of time.

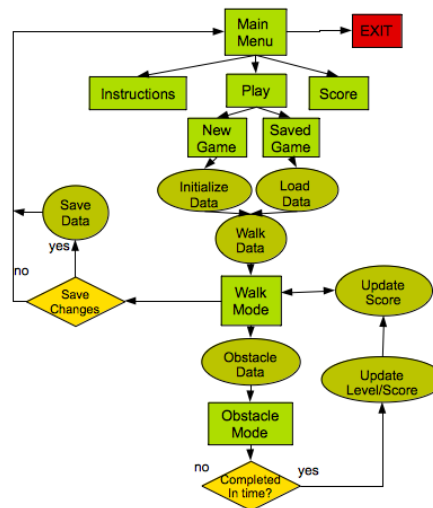


Figure 2 Complete Diagram of Jungle Course

Walking Mode



Figure 3 Walking Mode Screenshot

Users begin each level in the Walking Mode where they have to complete a designated amount of steps in order to advance to the Obstacle Mode. The Walking Mode includes a jungle-type path as the graphic to simulate walking through a jungle. Included in the display are the amount of steps left to complete the mode and a timer. Each level has a determined amount of steps that is proportional to the level with increments of multiples of ten. For example with the amount of steps required to complete level one is ten steps, the amount of steps for level two is $10+(10 \times 1)$ or 20 steps, and the amount of steps required for level three is $10+(10 \times 1)+(10 \times 2)$ or 40 steps. A step is intended to be recognized while the users are walking with the device in their pocket, but due to the inaccurate activity recognition of the device, a step can be

recorded while users are walking, running, jumping or stair climbing with the device in hand. In order to make this mode more engaging to its users, the Walking Mode includes a timer which keeps track of the amount of time it takes for users to complete the required amount of steps. The timer displays the elapsed time in seconds on the bottom right hand corner of the screen. The purpose of including the timer is to motivate users to complete the Walking Mode as fast as possible in order to gain high scores.

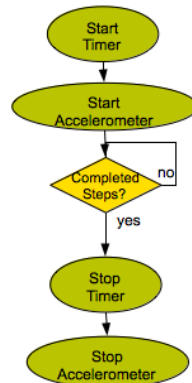


Figure 4 Walking Mode Diagram

Obstacle Mode



Figure 5 Obstacle Mode

After successfully completing the Walking Mode, users enter the Obstacle Mode in which they must complete a number of obstacles in a timely manner in order to advance levels. Obstacles are similar to those in which one might overcome while walking through a jungle. Such obstacles include pushing branches out of the way, swatting mosquitoes, and swinging on vines. Each obstacle has instructions at the top of the screen informing the users how to conquer the obstacle. For example, in Figure 5 users are required to “Push Hard” which entails that the user must push the device with some acceleration in order to complete the obstacle. In order to make the Obstacle Mode challenging, users may have to complete more than one obstacle. The number of obstacles the user has to complete is directly proportional to the level. For instance, level one has one obstacle and level ten has ten obstacles. Similar to the Walking Mode, a timer is included to make the game more fun and challenging. The time to complete obstacles is less than five seconds and will gradually decrease as users advance into higher levels. Users have to successfully complete all required obstacles before the time expires in order to advance levels. For each level, all obstacles have to be completed in one attempt. If users do not complete the obstacle(s) in time, they may have another chance to complete the obstacle(s). Users in the first ten levels have an extra attempt at completing the obstacles. Users in the last ten levels have two extra attempts at completing the obstacles. These chances are incorporate to help users adjust to and figure out the correct motions to overcome the different obstacles. However, if users do not complete all the required obstacle(s) in time and have used all their chances, then the users have to repeat the level again starting in the Walking Mode. At the end of each successfully completed Obstacle Mode a motivating message such as “Great Work!” or “You rule this jungle!” which will inform and congratulate users of their accomplishments before advancing a level.

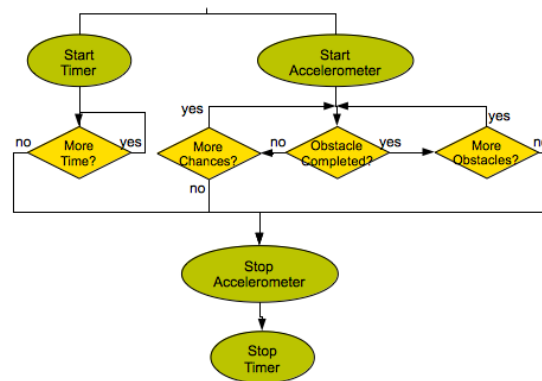


Figure 6 Obstacle Mode Diagram

Points and Scoring



Figure 7 Scores Screenshot

An important feature for motivating the targeted audience is including a scoring system in which users are rewarded based on their performance. Incorporating timed activities was a method used in this project. As mentioned earlier, the timer implemented in the Walking Mode is used to help motivate users to complete the mode as fast as possible in order to gain high scores. In the Walking Mode points are rewarded based on the amount of steps and the time it took to complete the steps. The formula for this system can be explained by: $P = \text{steps} * 100/\text{time}$. Where P represents the amount of points and time represents the elapsed time to complete the required amount of steps. Since the Obstacle Mode includes timed activities that have to be completed in a single attempt, users are rewarded 100 points for each obstacle successfully completed in a single session of the Obstacle Mode. This scoring system permits users to have different scores at the end of the game which provides users with the ability and encouragement to replay the game and attempt to beat their own high scores.

User Interaction

Another feature incorporated into Jungle Course was the ability for users to resume the game in the same state when returning after exiting the application. When users press PLAY in the main menu of the game application, they have the option to “Continue Game” or “Start a New Game”. When users select “Start a New Game”, the score is restored to zero and the level is restored to one. However, if users select, “Continue Game”, the user resumes in the Walking Mode of the level they were at last before exiting the application. When users exit play by pressing the “Main Menu” button located in the navigation bar at the top of the screen during play, they have the option of saving their level and scores. Saved scores and levels can be view when the user presses “Scores” in the main menu. If users are in the Obstacle Mode when they exit play, when they resume they will resume in the Walking Mode. If users are in the Walking Mode when they exit play, when they resume they will resume in the Walking Mode and the steps required to complete will not be restored from where they last left off. However, in the Walking Mode, there are “GO” and “STOP” buttons that allow users to pause and resume the timer and motions detected by the device. It is suggested that users use this feature and let the application run in the background when leaving the Walking Mode. The aim of including such features will help enhance the users experience with Jungle Course and encourage usage.

The Experiment

Adhering to goal of developing game applications to encourage physical activity among teens, a field study and focus group were conducted to analyze participant usage of Jungle Course. The purpose of these procedures was to examine the impact the game application had on the participants' motivating factors to become or remain physically active and to collect ideas for possible improvements. The field study was conducted on August 9, 2010 on the campus of University of California, Santa Cruz. The field study consisted of three high school females between the ages of 15-17. Only two of the females were heavily involved in sports and extracurricular activities in high school. The field study began with two participants playing Jungle Course alongside and one participant played alone for 10-15 minutes. Participant usage was observed and video recorded. After the completion of the field study, the focus group was conducted to analyze participant usage. The focus group began by questioning the participants' background and their thoughts about being physically active. Next the participants were asked specific questions about Jungle Course. Some of the questions asked included:

- Would you play this game again?
- Would you play with other people? Whom?
- Where would you like to play this game?
- How long would you play this game?
- How often would you play this game?
- Do you think you would be motivated to do the more difficult levels?
- What are your likes and dislikes?
- How would this game be improved?

Most importantly these questions gave insights to possible improvements to the effectiveness of Jungle Course in motivating teens to become or remain physically active.

The Results

Overall the participants found Jungle Course a fun, challenging, and possible method to motivate them to exercise when they have free time. They enjoyed the challenging aspect of the game which would most likely motivate them to play along with friends and family. It was observed that the participants enjoyed the game more when played with a companion. Playing alongside with a companion allowed the participants to walk, converse, and compete amongst themselves. It was also mentioned that if participants were playing alone, the game application would most likely supplement activities such as walking the dog or walking to school. In addition, the participants favored the timed element in the game because they have control over the scores they obtain. This was said to be a great motivating factor to complete the more difficult levels and beat their own high scores. The inaccuracy of the motion of walking detected by the game

application was a general dislike among the participants. However, it did cause them to walk more vigorously and use other activities such as running up stairs or skipping in place. Suggestions for improvements to Jungle Course can be summed up in the thematic network included below that outlines a general consensus from this focus group of a game application that would most likely motivate teens from ages 10-17 to become or remain physically active.

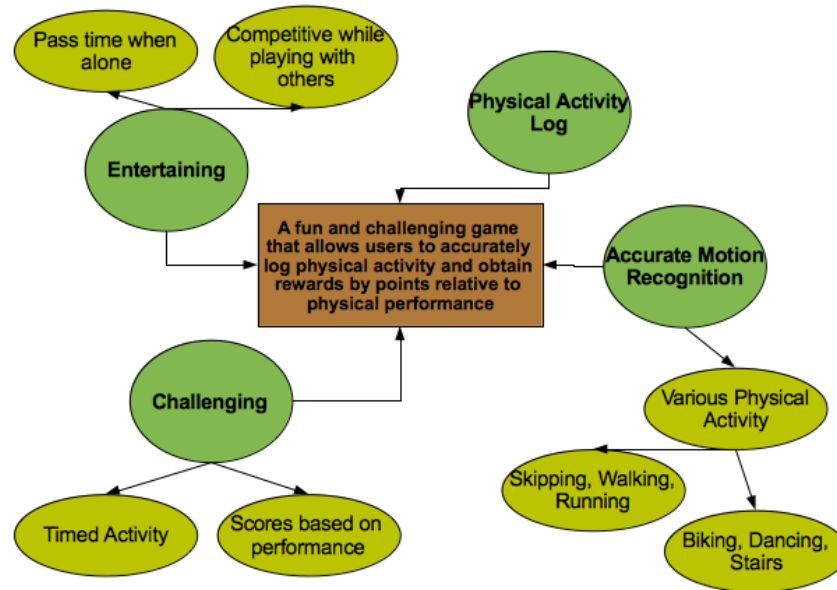


Figure 8 Thematic Network of Results

Conclusion

The main objective of this project was to develop a mobile game application on the iPhone OS that would positively impact the levels of physical activity among teens. After the implementation of this project, it can be deduced that such a mobile game application can be developed. However one major issue is developing an application that users would want to use beyond their free time. In other words, developing an application in which users feel the need to incorporate usage in their schedules as opposed to using it at their own leisurely convenience. Addressing this could possibly mean incorporating a light punishment for not using the application regularly alongside with the rewards of gaining high scores. Based on the focus group conducted, it was noted that the inaccuracy of the activity recognition in the game would possibly deter usage of Jungle Course. This information implies that users need accurate credit for their performance. In this case, Jungle Course scores users based on their performance, so ensuring accuracy is essential in keeping users encouraged and motivates to use the game application. As a result, incorporating a balance between rewards and punishment is a critical factor when developing mobile game applications to encourage physical among teens.

Future Work

The next step for this project is to improve the Jungle Course game application. Improvements include:

- Physical activity log
- Audio notification throughout game play
- Include various themes (jungle, forest, island, etc)
- Increase the accuracy of the activity detector by the accelerometer
- Include various activity motions

References

1. Ajzen, I. The theory of planned behavior. *Organizational Behavior and Human Decision Process*. 50, 1991, 179-211.
2. Consolvo, S., Everitt, K., Smith, I., and Landay, J. A. 2006. Design requirements for technologies that encourage physical activity, in *Proceedings of CHI '06* (Montréal, Canada, 2006). ACM Press, 457-466.
3. Ogden, Cynthia L., Margaret D. Carroll and Katherine M. Flegal. "High Body Mass Index for Age Among US Children and Adolescents, 2003-2006." 2000. JAMA. 18 May 2009 <<http://jama.ama-assn.org/cgi/content/full/299/20/2401>>.