Team Let's Get Weird

PSYCH/CS 6750 Human Computer Interaction
Professor Bruce Walker
P3 Report: System Prototype and Evaluation Plan

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Introduction

After the completion of Part 2 of the project, we carefully analyzed the feedbacks we received during the poster session. We listed out the pros and cons of each design based on the feedbacks. We also carefully examined the constraints and came up with design improvements for each of the three designs. After weighing the pros and cons of each design, we decided to choose “Kinect Kayaking” as our final design solution for the user group.

“Kinect Kayaking” is an exercise-game that requires the user to use their upper body in an interactive kayaking game on the Kinect console at their own pace and experience level. The game encourages the users to stay active through a fun game with small learning curve and minimal to no physical exhaustion. The game involves the users to move their upper bodies and arms in the same fashion as if they were really paddling in order to control the avatar to move forward, accelerate, decelerate, and turn from side to side.

To build a functional prototype, we researched several possible alternatives including Flash ActionScript, Processing, Kinect SDK, and Unity. We decided to use Unity to develop the game prototype as it enables us to create the most realistic video game experience. Based on feedbacks we received previously, the team defined several game attributes we would like to incorporate into the game mockup. These attributes have 3 tiers of priority: “must-have” features, secondary features, and “nice-to-have” features. Must-have features include a moving river, miscellaneous objects in the water, landscape within frame of view (trees, rocks, bushes), skyline, lighting, 3D boat model, start/finish line, a timer, and pause and stop function. Secondary features include coins/points/obstacles, performance summary, leaderboard, and a moving avatar. “Nice-to-have” features include multi-player mode, pop-up survey of user’s physical capabilities, and coaching instruction for first-time users.

Usability Justification

Since our user group is comprised of senior citizens who have limited exposure to technology, we felt it was important to design a simple, user-friendly game. We kept the following usability criteria in mind while developing the game:

I. Task Extensibility

The task of the game is to motivate users to exercise. There is a timer on display in the game that shows how fast the users reach the finish line at the end of the game. Users would be motivated to define new tasks by wanting to try the game again and improve their current time.

II. Low Learning Curve

Many users in our user group have had limited or no previous experience with video games. Also, since this game is designed for senior citizens, a low learning curve is crucial. Users should be able to easily realize that they can control the movements of the rower and the boat by moving their arms and hands. Instructions at the beginning of the game will guide the user on how to play the game. Learning the game should not require users to physically or mentally exhaust themselves. Having too many features, options and a complex interface in the game can overwhelm new users. We will be using limited number of commands, gestures and a simple interface for the game to keep it straightforward, clean and unchallenging.

III. Recovery from Errors

The game should allow users to recover from errors easily. For many, it will be the first time they playing a Kinect game. In case of users making the wrong gestures or selecting the wrong options, the game will not create fatal errors. Keeping our user group in mind, our system will allow for minor errors and mistakes. For example, if the user runs the boat into the riverbank, he/she can recover from this easily by moving the boat back and then proceed with the game.

IV. Accessibility

The game should also be accessible for senior citizens of varying age groups and physical conditions. Some users are in good physical state, while others are wheelchair-bound. Many also have hearing and visual impairments. The game will not include extensive details and complex graphics. The audio in the game is not a crucial element, but augments the overall environment of the game. Since the game does not rely on audio

for instruction or crucial cues, it is accessible to users with hearing impairment. Therefore, the game only requires users to move their arms while kayaking down the river.

V. Engaging Gameplay

Engaging users and increasing retention rate are the major goals of this project. We tried to make the game as realistic as possible so users can relate the game world to the real world. The graphics of the game has vivid colors and realistic features. An engaging gameplay can better capture users' attention to stay focused.

VI. Reduce Memory Requirements

The game should not rely heavily on the users' recall of previous interactions with the game. Since the elderly's memory might not be as sharp as younger adults, it should be simple enough for users to play without having to recall too many details. Once the user starts the playing the game, he has to continue with the same arm movements until he reaches the finish line. Users can easily pick up the game even if they forgot how to play it.

VII. Safety

Safety is a major concern for senior residents. A majority of the users have a variety of health complications. Thus, we have restricted the amount of exertion required by residents to play this game. Users can also pause the game at any time if they need to, and resume the game again later on. Users are only required to move their arms, and can play the game while seated.

VIII. Consistency

The game should be consistent while playing so users are able to pick up the game quickly. The gestures required to control the boat are the same throughout the game. This will allow users to get the hang of playing the game fast and encourage improvement as the game progresses. The type of graphics such a flow of the river and landscape also remain the same throughout the game.

Description of Prototype

I. Diagram of the Proposed System

The Kinect Kayaking game is played on a computer that is interfaced with Microsoft Kinect. The graphics are shown the computer's display, and the player controls the game by performing paddling actions in a seated position. Kinect gives the feedback about the user's actions to the computer, the computer analyses these actions and the boat moves forward. The following diagram illustrates these steps in further detail.

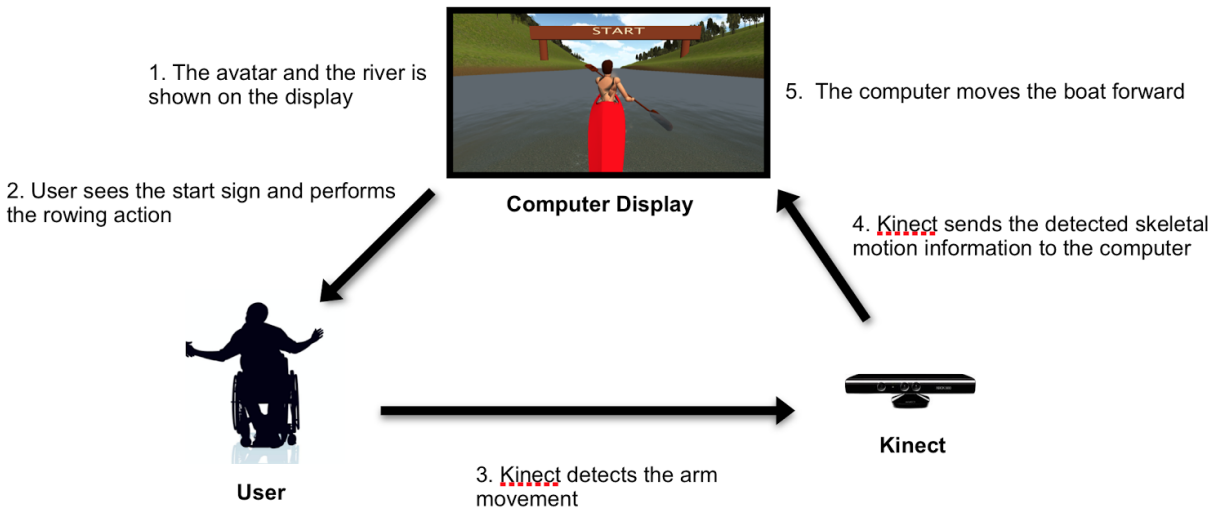

Figure 1 Diagram of the proposed system

II. Implementation and Challenges

We started the prototyping phase by evaluating various tools that would help us rapidly prototype the game interface. We evaluated tools such as Flash, Processing, Kinect SDK and the Unity Game Engine. Unity seemed to be the most suitable option as it supported scripting in multiple languages such as Javascript, C# and Boo and it also has a vast 3D model asset library. In addition, we found that we could use the Zigfu development kit to interface the Kinect system with the Unity 3D game engine. We decided to leverage these factors to quickly prototype this 3D kayaking video game in Unity.

Later on, we evaluated two approaches for prototyping using Unity. First approach was embedding a kayaking video from a rower's first-person perspective. By controlling

speed of the video play according to the speed of user's movements, it would create an illusion that the speed of the boat depends on how fast the player rows. However, it was not possible to embed long high definition video files into the Unity game. Hence, we decided to adopt the second approach of constructing the entire game world using 3D models. We downloaded a few of the 3D models from online 3D asset stores. The models were modified in third party software such as Google Sketchup, Autodesk 3D Max, Maya, and then imported into Unity.

As all the team members were working on the source code we decided to use Git for managing the code base. We also used Trello for keeping track of the various implementation tasks and for development coordination.

Ideally, we would have Kinect control the game using Kinect's motion detection. However, we were unable to include this interfacing due to time constraints. We decided to use a "Wizard of Oz" technique to evaluate the prototype instead. We will ask the player to play the game by perform paddling movements. In reality, one of our team members will be controlling the game using keyboard keys. The team member will pay attention to the arm movements of the player, and control the game accordingly using keyboard keys. Thus, we will create an illusion for the player that their arm movements control the game. Taking time constraints into consideration, we discarded the multiplayer option and different game levels.

III. Prototype

We prototyped the kayaking game using Unity's game development ecosystem. The video game scene consists of the river, kayak, avatar with a paddle, hills, skyline, start and finish lines along with ambient sound of the splashing water which is played in the background. Below is the description of the scenes from the game and the required user interactions.

Scene 1: Start of the game

The game landscape consists of a river that is surrounded by hills on both the sides and an avatar seated in a kayak holding a paddle. The start line is displayed. Sound of water splashing is played in the background.

Figure 2 Starting scene of the game

Scene 2 : During the game

The user performs the paddling action to move the boat ahead. During prototype evaluation, one of the team members will press the up arrow key on the keyboard, to move the boat ahead. As the boat crosses the start line, the game timer is triggered and shown on the bottom right corner.

Figure 3 Game scene during play

Scene 3: Pausing and resuming the game

The player raises his hand in order to pause and then resume the game. During the prototype evaluation, one of the team members will press the 'P' and 'R' keys to pause and resume the game respectively.

Figure 4 Pause and Resume the game using "P" and "R" keys

Scene 4: Approaching the finish line

Once the boat reaches closer to the destination, a finish line will appear at the destination. The player continues to perform the paddling action and one of the team members continues to press the up arrow key of the keyboard.

Figure 5 Game scene approaching the finish line

Scene 5: Game Over

As the player crosses the finish line, the game ends. A congratulation message showing the total time take to reach the finish line is shown.

Figure 6 Congratulation Message

Benchmark Tasks

We identified the following benchmark tasks as necessary to produce a functional prototype:

I. Understanding the two-dimensional game world as a replication of three-dimensional real life.

Since our user group does not frequently play video games or interact with a digital interface, it might be hard for them to comprehend the idea that the video game world is an approximate replica of the real world. To navigate in virtual game world, they have to control the avatar in the same orientation if the user were to navigate himself in the game world.

II. Game control using body gestures

The purpose of this benchmark task is to examine whether users understand the concept that they can interact with their console/computer without the need for a game controller; Kinect can track the movements of the individuals in three dimensions. We will execute this function using "Wizard of Oz" experiment techniques while the team members manipulating the games while the users carry out body movements.

III. Clarity of the background sound

We added ambient sound such as water splashing sound to the video game. We want to evaluate whether these sounds will cause any confusion among the users.

IV. Pause and resume the game

Instead of letting user to pause and resume the game on their own, the design team is controlling the pause and resume in the focus group study. Therefore, we want to test whether the users are able to carry out the action (raising hand up in front of Kinect to pause, raise hand again to resume) to pause/resume the game, and whether that action is the best alternative to bear the "pause" and "resume" functions. This benchmark task has two purposes: we want to inspect if the pre-determined actions will cause any confusion among the users.

V. Time to Complete

This benchmark task tests whether length of the kayaking track in the game is appropriate for the users. We want to see how long on average it takes average users to cover the entire track, or whether they can finish the track at all.

Evaluation Plan

Our evaluation plan includes hosting a usability session with the retirement community that we have been working with, Campbell Stone Retirement Home in Sandy Springs, GA. We have been working with this community in the past, as we attended Bingo sessions and other social events with the residents.

The Wellness Coordinator will invite members of that community. The Wellness Coordinator will help us to screen any participants that may not be physically capable of completing the designed physical activities. During the evaluation, we will refrain from using notepads to remain unobtrusive. We have also conducted unstructured interviews with them to learn more about their goals, habits, capabilities and beliefs when it comes to physical activity. Our past visitations have provided us with the necessary user requirements and insights, and have helped us build a rapport with the user community.

Evaluation Goals

The evaluation aims to obtain feedback on our design as a possible alternative to existing physical activities. Our design is predicated around the following usability and design concepts:

1. *Accessible to users*
2. *Enjoyable and entertaining*
3. *Acceptance as a physical exercise alternative*
4. *Encourage user engagement*

We will be evaluating these concepts and the subjective interests of the users during our user sessions. It is important that we note that we will not be evaluating the physical exertion or timing the participants' completion time. This element has been purposely excluded for IRB concerns. In addition, our design goal is to develop a system that motivates and engages the users to exercise in an enjoyable way, instead of testing their fitness level.

Evaluation Techniques

We will be evaluating the system per the previously stated usability needs and design concepts. Given the qualitative nature of our data, we will be evaluating the user's experience using observation of the desired tasks and surveys to gather information about the subjective experiences of the user.

Surveys

We will administer two surveys to each participant: one before the session starts and one after the session. By doing so, we can assess how physically active they currently are and more importantly, any biases they might have towards video games. After the session, we will conduct a second survey verbally. The second survey will assess the users' perception and experience with the game. Survey questions will focus on degree of enjoyment and feasibility of the system for daily usage.

Observation

We will assess the enjoyment and engagement of the user by looking for specific social cues: concentration, smiling, facial expressions, elations, competitiveness, frustration, indifference, boredom, etc. We will have one researcher evaluate each participant during the session.

Analysis Plan

Our analysis plan will focus on the qualitative data that we will collect. We will use this information to address our initial evaluation goals. We will identify any potential trends from the surveys, and compare close-ended responses among different users.

Usability Testing

Preparation and Training

We are adopting the "Wizard of Oz" technique for our prototype evaluation. The study will begin by our team by giving an overview of the game to the participants. As the participants are not used to playing video games based on Kinect, our team will walk the participants through one round of game to explain the instructions.

Once the participant understands how to play the game, he or she will be seated in a chair at a proper distance from the Kinect and the computer/TV display to be ready to start the game. The participant is asked to perform the following tasks:

1. Paddle the kayak forward
2. Pause the game
3. Resume the game
4. Check the time for which the game was played.
5. Stop the game

In the "Wizard of Oz" method, one of the team members controls the game using keyboard arrow keys. The team members carefully observe the participant performing the paddling action. Depending on the player's action, the team member moves the boat forward or pauses/resumes/stops the game. We will be verifying if the player is performing the correct action.

Once the player reaches the finish line, a congratulation message and the total time taken to finish the race is displayed. The game will record how long it takes the player to finish the game. We will then assess the response of the participants with the help of the pre and post-game surveys.

Pre-Game Survey

Before participants are asked to play the game we will conduct a short pre-game survey. This survey will help us understand our users' expectations and current experience with playing video games. Participants will be asked questions about how often they exercise, what they enjoy about it and what they feel about the current exercises they take part in. The survey will also assess their likes and dislikes for video games.

Post-Game Survey

After the user has completed playing the game we will conduct a post-game survey. This will give us feedback on our game. The post-game survey will help assess users' likes and dislikes about our game and the likelihood of users playing our game again. The survey will also ask participants to give feedback on any discomforts they experienced and the difficulty level of the game.

Conclusion

Our prototype of the Kinect Kayaking game provides an exercise alternative to senior residents aged 65 and up. The system includes a TV display, the game, and the users themselves. Instead of using joysticks, players use their body movements to control the movement of the avatar and the boat. Current system also records the time it takes for

a user to row from the start to finish line. In the upcoming iteration stage, we would like to gradually incorporate some secondary and “nice-to-have” features to better the game.

Due to numerous limitations, we are adopting the “Wizard of Oz” methods to evaluate this prototype. In our original design proposal, we wanted to implement a feedback loop into the system and let the system automatically generate obstacle/rewards based on the user’s performance. During game development stage, we had to abandon this function due to limitation and time constraint. Therefore, the effectiveness and fidelity of the evaluation could be hampered if the “wizard” does not manipulate the system seamlessly.

Another important lesson we learned is that there is no “one-size-fit-all” design for our user group. Although the game caters to senior citizens in general, there are numerous physical, cognitive, and perceptual discrepancies and individual preferences within the group. In the next stage, we need to take these considerations into our design improvements.

Appendix 1: Pre-Game Survey

1. How often do you exercise?
2. Do you think the current exercises organized by the coordinator are fun?
3. If not, do you think exercising could be fun?
a. If so, what about it do you think is fun?
b. If not, do you think an interesting form of exercise would increase your interest?
4. Do you play video games?
a. If so, what do you like about it?
b. If not, what about it do you not like about it?

Appendix 2: Post-Game Survey

1. On a scale of 1-4, with 1 being "Not Interested At All" and 4 being "Very Interested", how much did you enjoy playing the game?

1 – Not At All Interested	2 – A Little Interested	3 – Somewhat Interested	4 – Very Interested

2. What did you like about the game?
3. What did you dislike about the game?
4. Will you like to play this game again and for how long?
5. On a scale of 1-4, with 1 being "Very Easy" and 4 being "Very Difficult", how was the game's difficulty level for you?

1 – Very Difficult	2 – Somewhat Difficult	3 – Somewhat easy	4 – Very Easy

6. Did you experience any discomfort while playing the game?

Appendix 3: Link to Unity Project on Git

https://github.com/jrthompson33/kinect-rowing