Zombie Fit!: User Study One Report

Jose Franco Baquera
NMSU
Las Cruces, USA
jose5913@nmsu.edu

Bianca Lujan
NMSU
Las Cruces, USA
bianc19@nmsu.edu

Muhammad Mohsin
NMSU
Las Cruces, USA
zubair@nmsu.edu

Diondra Silva
NMSU
Las Cruces, USA
dsilva40@nmsu.edu

INTRODUCTION / SYSTEM DESCRIPTION

In this report, we will discuss user study one, which is the user study that was conducted to assess the two implemented low-fidelity prototypes. More specifically, the report will summarize the tasks that the participants performed, documentation of the two implemented low-fidelity prototypes, questions formulated prior to evaluation, preparations made prior to evaluation, methods used for evaluation, and lessons learned from our participants. The two implemented low-fidelity prototypes were designed with *Zombie Fit!* in mind, which is a proposed system that would merge virtual reality, video games, and exercise. It is important to note that a total of seven participants used our low-fidelity prototypes and that feedback was recorded for each participant. The report will conclude by discussing which of our low-fidelity prototypes we chose to be the basis for our future functional prototype.

TASKS THAT PARTICIPANTS WILL PERFORM

We have four tasks that are implemented in either one or both alternative designs. These tasks will be performed by participants and will be used to assess which alternative design is better to implement into a fully functional prototype. More specifically, each task will be evaluated both individually and integrated to see what configuration participants are most comfortable in using and what can be done to maximize the experience of our game. The tasks include grabbing a virtual object, punching, running in place, and squatting. Ultimately, we want our system to be able to facilitate exercise motivation. The following table summarizes essential use cases that are needed to support the accomplishment of user intentions:

User Goal: Complete an Effective Workout Routine	
User Intention	*System Responsibility*
Run to burn calories	Prompt the user to run in place for a certain number of time in order to escape from a zombie herd
Squat to do leg exercise	Prompt the user to squat a set number of times in order for them to avoid getting bitten
Air box to exercise	Prompt the user to punch virtual zombies
Touch stretch to warmup for workout	Prompt the user to pick virtual items from the floor

Table 1. Essential use cases used to develop the details of accomplishing the four user tasks.

DOCUMENTATION OF LOW-FIDELITY PROTOTYPES

For this user study, the following two low-fidelity prototypes were used by participants: the American College of Sports Medicine (ACSM) Model prototype and the Constant Exercise Model prototype. Both models will use physical mockups of a virtual reality (VR) headset and controllers, as well as a storyboard to simulate what the participant will "see" through their headset. We note, however, that the storyline for each storyboard will be different and will change how the participant accomplishes assigned tasks. While a participant is using our low-fidelity prototypes, he or she will hold both controllers and will put on the VR headset mockup on their head. Then, a single team member from our group will narrate the game's storyline and will instruct participants on what to do. More detailed information about the documentation of our low-fidelity protypes and tasks descriptions can be found in the following sections.

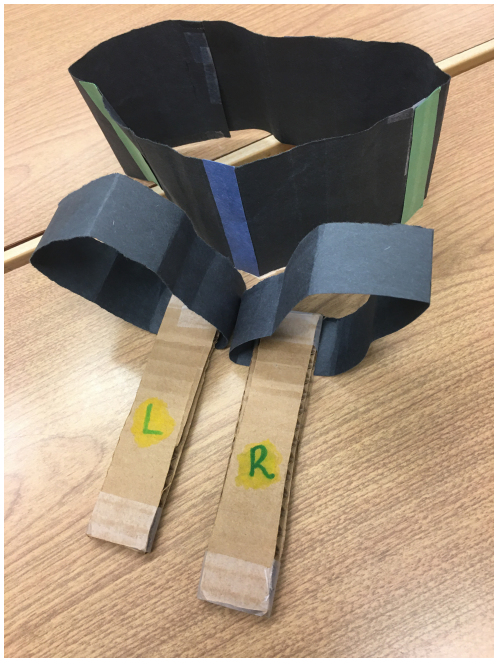

Figure 1. Physical cardboard mockups of a VR headset and controllers used by participants for both prototypes.

AMERICAN COLLEGE OF SPORTS MEDICINE MODEL LOW-FIDELITY PROTOTYPE

One of our designs is based on an exercise configuration suggested by the ACSM. This configuration states that an exercise routine must have a 5 to 10-minute period of warmup, a minimum of 20 minutes of stimulus (i.e. maximum heart rate), and a 5-minute cooldown period of low intensity exercise in order to return the heart rate to resting levels [1]. For our ACSM prototype, we will use this configuration to make our tasks more modular and independent from one another. For example, a participant will not be instructed to punch and run in place at the same time. As previously mentioned, this prototype will use physical mockups of a virtual reality (VR) headset and controllers, as well as a storyboard to simulate what the participant will "see" through their headset. We will use the Science Hall building located at New Mexico State University (NMSU) as the virtual environment for our game.

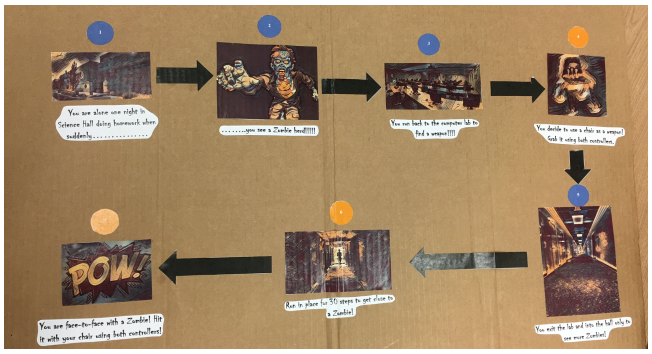

Figure 2. Storyboard used for the implementation of the ACSM Model low-fidelity prototype. We note that the orange circles are stages of the game in which the participant will have to accomplish a specific task.

The storyline of this prototype can be found in the following table:

Storyline Stage Number	*Corresponding Prompt*
1	"You are alone one night in Science Hall doing homework when suddenly……..."
2	"……you see a zombie herd!!!!"
3	"You run back to the computer lab to find a weapon!!!!"
4	"You decide to use a chair as a weapon! Grab it using both controllers."
5	"You exit the lab and into the hall, only to find more zombies!"
6	"Run in place for 30 steps to get close to a zombie!"
7	"You are face-to-face with a zombie! Hit it with your chair using both controllers!"

Table 2. Prompt given to users at several different stages of the game.

ACSM MODEL PROCESS / TASKS DESCRIPTION

The ACSM model prototype's process is described in this section. This prototype will simulate the user exiting the Science Hall building after a long night of doing homework alone. After exiting the building, the user will notice that there are zombies in the area. After seeing the zombies, the user will then enter the computer lab and will grab a chair using both system controllers. We note that the computer lab will serve as a "safe zone" where no zombies can enter, and the user can retreat to it when needed. The tasks performed so far will fulfill the "warmup" stage in the ACSM configuration. For the "stimulus" stage, the user will have to exit the computer lab and run in place for 30 steps to get close to a zombie. Lastly, the "cooldown" stage will consist of the user hitting a zombie multiple times with the chair. Throughout this process, we will verbally provide more detailed instructions to participants and will also play suspenseful music to immerse them more in the system.

CONSTANT EXERCISE MODEL LOW-FIDELITY PROTOTYPE

The second alternative design will not be based on any configuration models but will instead aim to have the user doing moderate exercise for extended periods of time. More specifically, the user might be instructed to do two or more tasks at a time, such as running in place and air punching. Even though this prototype will also consist of physical mockups and a storyboard, it will differ on when tasks are presented to users.

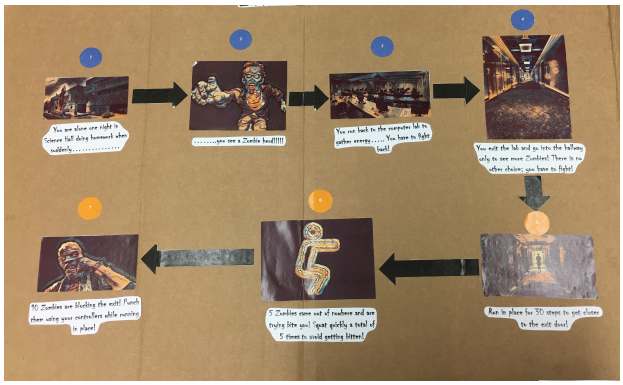

Figure 3. Storyboard used for the implementation of the Constant Exercise Model low-fidelity prototype. We note that the orange circles are stages of the game in which the participant will have to accomplish a specific task.

The storyline of this prototype can be found in the following table:

Storyline Stage Number	*Corresponding Prompt*
1	"You are alone one night in Science Hall doing homework when suddenly……..."
2	"……you see a zombie herd!!!!"
3	"You run back to the computer lab to gather energy."

4	"You exit the lab and go into the hallway only to see more zombies! You want to exit the building but there are several zombies next to the exit door. There is no other choice; you have to fight!"
5	"Run in place for 30 steps to get closer to the exit door!"
6	"5 zombies came out of nowhere and are trying to bite you! Squat quickly a total of 5 times to avoid getting bitten!"
7	"10 zombies are blocking the exit! Punch them using your controllers while running in place!"

Table 3. Prompt given to users at several different stages of the game.

CONSTANT EXERCISE MODEL PROCESS / TASKS DESCRIPTION

The constant model prototype's process is described in this section. This prototype will also simulate the user exiting the Science Hall building after a long night of doing homework alone. However, the user will be instructed to run back to the computer lab (after he or she notices the zombie herd) to gather energy rather than to grab a weapon. After resting for a bit, the user will then go back out into the hallway only to notice more zombies. The user will be instructed to run (in place) towards a zombie in order to fight back. However, the zombie will attempt to attack the user, so he or she will be instructed to squat in order to dodge these attacks. To defeat the zombie, the user will be instructed to punch it a set number of times. They will achieve this by moving the controllers as if they are punching something in the physical world. As previously mentioned, the user may have to do two or more of these tasks at once in order to facilitate constant moderate exercise. This process might be more fun and realistic (i.e. in the real world, we usually do more than one task at a time) than the first process. However, implementing clear instructions on how to multitask might be difficult and might lead to confusion if not done correctly.

QUESTIONS FORMULATED PRIOR TO EVALUATION

The following list of questions was formulated prior to our evaluation:

- What goes right when performing the tasks?
- What goes wrong when performing the tasks?
- Which design is more effective in motivating exercise?
- Which design is more error-prone?
- Which design is more fun?
- Which design is more physically challenging?
- Which design has clearer instructions?
- Which design is more realistic?
- Which design is more practical?
- Are more modular tasks easier to instruct?
- Which combination of tasks are awkward or out of place?

These formulated questions were used to guide us on deciding which is the better design choice going forward.

PREPARATIONS MADE PRIOR TO EVALUATION

Several preparations were made prior to meeting with our participants. The first preparation we made was creating an open-ended, unstructured interview script containing the following list of questions:

- Which design do you prefer, if any? Why?
- Is either design fun? Why?
- Do you feel like you are exercising?
- Would you use a system like this to exercise? Why?
- Any other suggestions or comments?

The second preparation we made was to familiarize ourselves with the questions formulated in the previous section in order to look for specifics during evaluation. That is, our group also conducted an observational study while our participants used both our prototypes. Notes were taken by a specific group member while the evaluation was taking place. It is important to note that any formulated questions that do not overlap with any questions found in the interview script will be answered through these observational study notes. The last preparation that we made was to make sure that a variety of participants were actually recruited. In our case, we recruited the following seven participants:

Participant Number	*Special Attributes*
1	male; teacher; middle-aged adult; video game player
2	male; undergraduate student; early 20's; video game player
3	male; undergraduate student; early 20's; wants to exercise more
4	female; graduate student; middle-aged adult
5	graduate student; late 20's; video game player
6	female; high school student; 18-years of age; exercise enthusiast
7	female; undergraduate student; 28 years old; desires to get fit

Table 4. General description of the seven participants used in this user study.

As the previous table demonstrates, we seem to have recruited a wide range of participants ranging in age, sex, and life experiences.

METHODS USED FOR EVALUATION

Several methods were implemented and used during our evaluation. For example, we evaluated only one participant at a time and one design at a time.

Furthermore, the ordering of which design participants first evaluated was done at random in order to reduce lurking variables within our data. We note that different participants evaluated our designs in different settings, such as in a classroom, in a computer lab, or at the participants' home. During evaluation, one team member from our group narrated the game's storyline and instructed the participant on what to do. Meanwhile, a different team member observed and documented any positive or negative reactions to our designs. In other words, one team member "drove" the evaluation while another one observed and documented. After each participant finished using both designs, he or she was then asked the five previously mentioned open-ended interview questions. It is worth mentioning that the interview process was very unstructured and informal. In fact, we allowed other bystanders (e.g. participants' friends, other classmates, etc.) to converse with our participants during the interview process.

The reason why our interview was unstructured and why we allowed bystanders to get involved in the interview process is because we wanted to be as unobtrusive and unrestrictive as possible. That is, we wanted our participants to express themselves to the fullest and to provide an honest critique. Furthermore, by allowing other people to get involved, we created an open environment in which all participants seemed to enjoy as new ideas were being discussed and interchanged. Because of the methods used during our evaluation, our group managed to gather more qualitative data than quantitative. Nevertheless, our group was more interested in qualitative data since, as of now, we want our participants to suggest new innovating ideas that we have not yet thought about.

WHAT WE LEARNED FROM PARTICIPANTS

In this section, we will summarize what we learned from our participants. As previously mentioned, our evaluation led to mostly qualitative data since this is what we are more interested in at the moment. The following table summarizes the observed data (not the interview results) and lessons learned from participants:

Formulated Question	*Observed Data*	*Lesson(s) Learned from Participants*
What goes right when performing the tasks?	All participants know how to squat, run in place, and air box.	Our system can safely assume that most potential users will know what these simple exercise tasks are and their implications.
What goes wrong when performing the tasks?	A majority of participants had a hard time doing two or more tasks at the same time.	Instructing a user to do two or more tasks at the same time might overcomplicate the system.
Which design is more effective in motivating exercise?	All participants were intrigued by both designs.	Both designs are intriguing and interesting enough to motivate users to exercise.
Which design is more error-prone?	All participants delineated more from what they were told to do while using the Constant Exercise Model prototype.	The Constant Exercise Model design needs better written instructions that are less confusing and clearer.
Which design is more fun?	All participants appeared to have fun while using both designs.	Both designs might be considered as fun by future potential users.
Which design is more physically challenging?	Both designs made participants work up a sweat. More specifically, participants started to get somewhat physically tired when they started running in place.	Running in place for a long period of time is physically challenging.
Which design has clearer instructions?	All participants seemed to understand the instructions given to them while using the ACSM Model design. However, a small majority of participants were confused by the instructions provided to them while using the Constant Exercise Model design.	The Constant Exercise Model design needs better written instructions that are less confusing and clearer.
Which design is more realistic?	A majority of participants agreed that the squatting task found in the Constant Exercise Model design was out of place.	Squatting is awkward while using the system since it does not map well with the storyline.
Which design is more practical?	A majority of participants had an easier time using the ACSM Model design since only one task was assigned to them at a time.	It is not practical to do more than one major physical task at a time while also playing a game.
Are more modular tasks easier to instruct?	All participants had an easier time understanding modular tasks assigned to them.	It is much easier to instruct a user to do a modular task than multiple tasks at the same time.
Which combination of tasks are awkward or out of place?	A majority of participants agreed that squatting was awkward and out of place.	Squatting does not map well to the game's storyline.

Table 5. Summary of the observed data that was collected during the evaluation of our low-fidelity prototypes.

Both qualitative and quantitative data was collected when participants were interviewed at the end of the evaluation. This data and the associated lessons learned are summarized in the following table:

Interview Question	*Summary of Recorded Qualitative / Quantitative Data*	*Lesson(s) Learned from Participants*
Which design do you prefer, if any? Why?	2 out of the 7 participants preferred the Constant Exercise Model design. They both agreed that this design was more physically challenging. The remaining 5 participants preferred the ACSM Model design since it was more realistic and engaging.	The ACSM Model design is preferred more than the alternative since it is more realistic and engaging.
Is either design fun? Why?	All participants stated that both designs are fun. Furthermore, the majority of participants commented that the design's immersive aspect made the evaluation fun.	Both designs might be considered as fun by future potential users.
Do you feel like you are exercising?	5 out of the 7 participants felt like they were exercising while using either design.	Both designs might allow future potential users to exercise successfully while using the system.
Would you use a system like this to exercise? Why?	5 out of the 7 participants stated that they would use either design to exercise. All 5 participants agreed that both designs made exercising interesting and/or fun.	There exist individuals in the real-world that would use our system to exercise.
Any other suggestions or comments?	Many participants had additional suggestions. A few mentioned that there should be feedback on the number of steps taken by the user. Others commented that, instead of running for a set number of steps, the system should tell the user to run in place for a period of time. A few participants mentioned that the system should incorporate other physical objects such as dumbbells and exercise balls. Lastly, a couple of participants stated that the context of the squatting task did not correlate to the game's storyline. One participant, for example, suggested that it would make more sense to squat to simulate placing a barrier on a door.	We can incorporate other physical objects to our system in order to immerse users more. Furthermore, we have to map user tasks more accurately to the game's storyline.

Table 6. Summary of participants' responses to the interview questions.

CHOSEN DESIGN

We note that, according to our data gathered, both designs share some positive attributes such as being fun, immersive, and physically challenging. Nevertheless, the ACSM Model did outperformed the alternative in other aspects. For example, according to row two from table five, instructing a user to perform two or more tasks at the same time is impractical and overcomplicates our system. The ACSM Model prevents this since it will always instruct a user to perform at most one modular task at a time. Row eleven from table five states that, according to most participants, squatting is awkward and does not map well to the game's storyline. Fortunately, the ACSM Model does not instruct users to squat since such task is not needed for its given storyline. Lastly, row one from table six suggests that the ACSM Model design is preferred more than the Constant Exercise Model design since it is more realistic and engaging. Because of all the information previously mentioned, we conclude that the ACSM Model is a better design to use for the base of our functional prototype. More specifically, it was determined that the ACSM Model has tasks that are better mapped to its storyline and that modular tasks are more practical than combined ones.

ACSM MODEL MODIFICATION

A few modifications will be made to the ACSM Model's design in order to make our system more compelling. For example, instead of counting steps, we will instruct users to run in place for a given amount of time. This will make it much easier for the user to concentrate on the actual game rather than the number of steps taken. Furthermore, more feedback will be introduced into the system. For example, a timer will be displayed to the user while he or she runs in place. We note that such feedback is necessary since it reduces the amount of mental work needed by users (e.g. instructing a user to count to 60 seconds while running in place negatively affects the usability of our product). The last modification that we will make will be to adjust the prompts given to users (see Table 2). Clearer prompts will make the system easier to use and less confusing.

CONCLUSION

Both the Constant Exercise Model and the ACSM Model have advantages and disadvantages. However, participants overwhelmingly agreed that the ACSM Model is the superior design. After carefully analyzing and examining the gathered data, we too agreed with our recruited participants' opinions. We conclude that the ACSM Model low-fidelity prototype will be used as the basis for our future functional prototype.

REFERENCES

[1] Sinclair, J., Hingston, P., & Masek, M. (2007, December). Considerations for the design of exergames. In *Proceedings of the 5th international conference on Computer graphics and interactive techniques in Australia and Southeast Asia* (pp. 289-295). ACM.