Mobile Gaming: It’s In The Gamepad

Comparing Touchscreen Gamepads On Mobile Devices

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CCS CONCEPTS • Mobile gaming design • Human-centered computing →Human computer interaction (HCI) • Digital gamepad design

Additional Keywords and Phrases: User study, Smartphone gamepads, Mobile phone games

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1 INTRODUCTION

Since Apple released the first iPhone, touchscreens have become ubiquitous in our everyday life. As gaming on smartphones has been increasing in popularity, it raises questions about designing responsive touchscreen gamepads that are within an acceptable rate of error and are user-friendly. This research will investigate the accuracy and useability of two smartphone gamepads in a 2D obstacle course. This will be a comparative study between a digital directional pad and a digital joystick. While physical controllers are still preferred for gaming devices, this research will investigate which touchscreen controls are more accurate and precise for mobile gaming. Researchers Lee and Zhai have highlighted the limitations of touchscreen controls noting that “soft controls on touchpads lack the same tactile response as physical game controllers.” [1] The goal of this research is to determine the most responsive and precise touchscreen gamepad, despite these limitations.

I designed a mobile game where participants navigate a UFO throughout a game level and collect materials. Participants will be timed and given an exit survey after they complete the experiment. The user experience is important when considering which gamepad is most accurate in completing the obstacle course. The survey will include qualitative data on which gamepad the participants preferred as well as which gamepad was more precise

This game is designed to be played in landscape mode to allow more surface area for the gamepad graphic. The target size for each gamepad should be sufficiently large for one-handed thumb use while completing the task. This research pertains to this particular UFO game as there is not one game and design model that is most suitable for all mobile phones [2]. Although there is extensive research comparing physical analog controllers to digital controllers, more research can be done on mobile touchscreen gamepads.

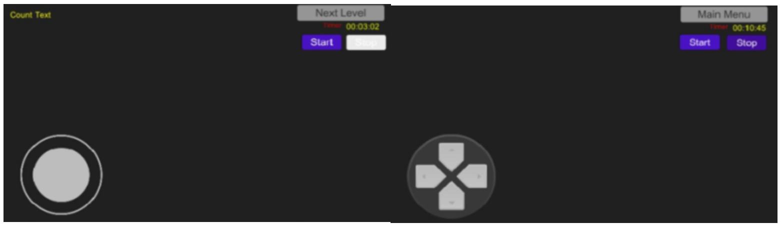


Fig. 1. I compared two different gamepad designs for touchscreen mobile phones: the virtual joystick (left) and virtual directional pad(right).

The first gamepad features a virtual joystick (Figure 1, Left Panel) with a knob that can moved to specify direction. This is very popular for movement in mobiles games such as Among Us. The second gamepad features a virtual direction pad (Figure 1, Right Panel) or d-pad. This d-pad appearance is designed to look like the d-pad on modern video game controllers. The directional pad offers eight directions for movements (i.e. up, down, left, right, and four diagonals).

It will build on previous research on on-screen gamepad design[3]. While diving further into functional designs for touchscreen gamepads.

This study will measure the time that user took to complete the task while taking in account finger stroke estimates on touchscreen devices from previous research[9]. I will consider past research that indicated that specific types or genres of mobile games should be designed for different mobile phone interfaces[2].

2 RELATED WORK

This paper relies on previous work in a variety of disciplines, including research involving the controller preferences of gamers, controller accuracy, and input methods. The following section outlines the research in these areas.

2.1 Controller Preferences

Baldauf, et. al., compared the accuracy of four different types of game controllers: the joystick, tilt control, directional buttons, and a directional pad. The authors hypothesized that the directional pad and buttons would feel most familiar to users. Their results showed that the directional pad controller resulted in the shortest completion times. The authors found a statistically significant effect of the type of game controller on game completion time [4].

2.2 Controller Accuracy

Baldauf, et. al. hypothesized that the joystick would be the most accurate and feel the most comfortable to users because of the familiarity of this type of controller. Consistent with this hypothesis, the authors' results indicated that users self-reported much higher scores on ease of usage for the joystick than for other controllers. The authors found no statistically significant effects between the type of game controller and self-reported scores for accuracy, speed, comfort, and fun [4].

2.3 Input Methods

Much of the research surrounding mobile gaming to-date has focused on the differences between analog game controllers and digital controllers, rather than comparing different types of digital controllers. For example, Ramcharitar and Teather explored the sensitivity of three different game input methods on the Steam Controller which is a game controller for use with both computer-based and mobile gaming. The authors evaluated a thumb-based touchpad, thumbstick, and gyrosensor. and concluded that a touchpad or gyrosensor are good alternatives to traditional game sticks, even though most game developers show a preference for the thumbstick controller [10].

In 2011, Chu and Wong conducted an experiment involving players' experiences based on whether they were using a hard keypad or a soft keypad and concluded that "physical buttons outperform touchscreen controls or are better perceived by the participants" [11]. Similar experiments have shown substantially similar results [12, 13, 14, 15].

3 METHODS

In the following, I describe my research hypothesis and the design of the comparative lab study.

3.1 Participants

I recruited 11 experienced smartphone users were recruited via public announcements. 4 were female and 6 were male with an age between 24 and 61 years old (mean=34.5, median=32.5). 3 participants were left-handed, and 8 participants were right-handed. The participants experience with mobile gaming varied from none at all to 5 or more years of experience.

3.2 Research Hypotheses

I constructed research hypotheses for each gamepad concerning the gampad's suitability for the UFO game.

Direction Pad

HA1. Participants' completion time will be shorting with the directional pad compared to the joystick because people have familiarity with the directional pad, and the diagonal movement allows for increased control.

Joystick

HA2. Participants will find joystick offers more precision than the directional pad because the joystick's controls are more touch sensitive and allow for smaller, more subtle movements.

3.3 Experiment Setup

I conducted the experiment remotely by allowing participants to download the UFO game from the Google Play Store. The participants were allowed to use their own mobile devices which varied widely by make and model. A survey that included instructions on how to play the game was provided to each participant, and participants completed a short tutorial before starting the game.

3.4 Study Design and Tasks

I designed my study as a with-in subject experiment. I had the participants complete a demographic survey about characteristics such as age, gender, and how experienced they were with mobile gaming.

Then, each participant was asked to play the UFO game using each type of navigational control. The participants were asked to complete the tutorial first to get familiar with the game and each controller. Once they felt confident with the controls, the participants were asked to control the UFO character in the main game.

UFO Game. In this game of skill, the player controls the grey UFO spaceship through a level to collect space rocks in the shortest amount of time possible. After the tutorial was used for training, the participants were asked to collect the space rocks in the main level. A stopwatch would start automatically once the player entered the level. Once they collected all fifteen space rocks, they were asked to stop the stopwatch and record that time on the survey provided. The participants then played the next level with a different input device and were asked to record that time as well. Participants played the game a second time with both controllers and recorded the results. This resulted in two trials for each participant.

Final Interview. After the participants played the game twice, they took an exit survey. Here, the participants noted which input method they preferred playing the game with and which input method offered better precision to complete the game. The entire experiment took about ten minutes.

4 RESULTS

4.1 UFO Game Experiment

4.1.1 Completion time. For Trial 1, the effect of navigation on completion time was statistically significant ($F(1, 10) = 16.192$, $p < .005$). The mean-task completion time for the virtual joystick was 110.63 seconds and the virtual d-pad was 82.45 seconds in Trial 1 (Figure 2A). The mean completion time for the d-pad was 25.47% less than the mean of the joystick.

In Trial 2, the mean-task completion time for the virtual joystick was 86.54 seconds and the virtual d-pad was 81.45 seconds (Figure 2B.). For Trial 2, the effect of navigation method on task completion time was not statistically significant ($F(1, 10) = 0.558$, ns). There was no difference in completion time between the joystick and the directional pad.

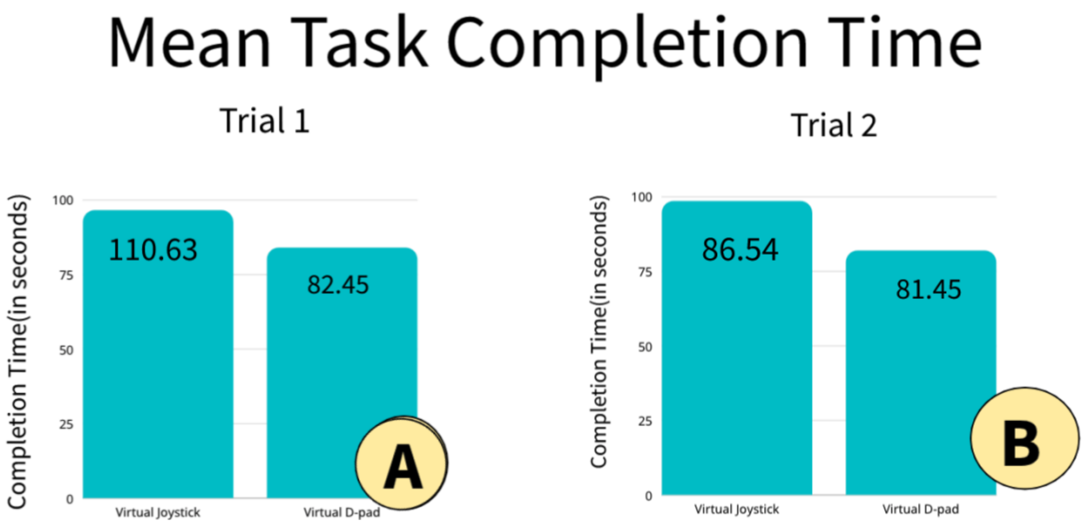
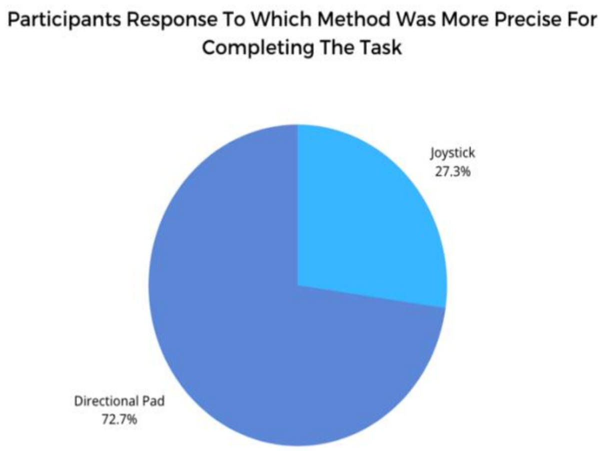


Fig. 2 The mean times for each trial 1(A) and trial 2 (B) for the virtual joystick and virtual directional pad.

Overall, 8 participants found the directional pad more precise than the joystick when completing the task, and 9 of the 11 participants preferred the directional pad over the joystick when playing this game (Figure 3).



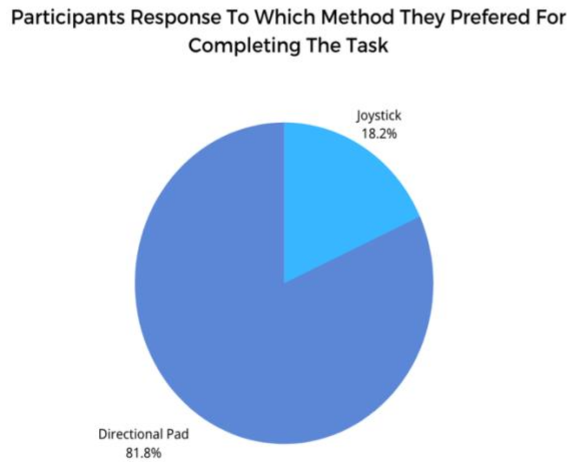


Fig. 3 Participants rated the directional pad as the most precise (Left). Participants also preferred the directional pad for completing the task.

5 DISCUSSION

I will refer back to my original research hypotheses to discuss how the results compared to my expectations.

Direction Pad

Hypothesis *HA1.* is confirmed: The virtual directional pad outperformed the joystick in terms of completion time. The 8 directional d-pad allowed for increased control which resulted in faster completion times.

Joystick

Hypothesis *HA2.* is rejected. I expected the joystick to offer more precision than the directional pad. Only 3 participants rated the joystick more precise than the directional pad. Participants had harder time navigating the level with the joystick.

6 CONCLUSION

While it is not likely that smartphones will replace traditional game controllers, mobile gaming is increasing in popularity. This research reveals which touchscreen navigational controls participants prefer for this particular game on mobile devices. In my study, the directional pad proved to be the best navigational method for completion time and precision. The d-pad offered the most familiarity for users. The joystick did not offer the participants the same level of control or precision. For future work, I would like to investigate additional popular games such as Mario or Legends of Zelda to learn which navigational method is preferred for mobile devices. I would also like to include other measures such as keypresses and accuracy. Additionally, adding more input methods like tilt control and directional buttons would make this study more robust.

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A APPENDICES

In the appendix section, three levels of Appendix headings are available.

A.1 General Guidelines (AppendixH2)

1. Save as you go and backup your file regularly.
2. Do not work on files that are saved in a cloud directory. To avoid problems such as MS Word crashing, please only work on files that are saved locally on your machine.
3. Equations should be created with the built-in Microsoft® Equation Editor included with your version of Word. (Please check the compatibility at http://tinyurl.com/lzny753 for using MathType.)
4. Please save all files in DOCX format, as the DOC format is only supported for the Mac 2011 version.
5. Tables should be created with Word’s “Insert Table” tool and placed within your document. (Tables created with spaces or tabs will have problems being properly typeset. To ensure your table is published correctly, Word’s table tool must be used.)

6. Do not copy-and-paste elements into the submission document from Excel such as charts and tables.
7. Footnotes should be inserted using Word's "Insert Footnote" feature.
8. Do not use Word's "Insert Shape" function to create diagrams, etc.
9. Do not have references appear in a table/cells format as it will produce an error during the layout generation process.
10. MS Word does not consistently allow the original formatting to be modified in the text. In these cases, it is best to copy all the document's text from the specific file and paste into a new MS Word document and then save it.
11. At times there are font problems such as "odd" stuff/junk characters that appear in the text, usually in the references. This can be caused by a variety of reasons such as copying-and-pasting from another file, file transfers, etc. Please review your text prior to submission to make sure it reads correctly.

A.1.1 Preparing Graphics (AppendixH3)

1. Accepted image file formats: TIFF (.tif), JPEG (.jpg).
2. Scalable vector formats (i.e., SVG, EPS and PS) are greatly preferred.
3. Application files (e.g., Corel Draw, MS Word, MS Excel, PPT, etc.) are NOT recommended.
4. Images created in Microsoft Word using text-box, shapes, clip-art are NOT recommended.
5. IMPORTANT: All fonts must be embedded in your figure files.
6. Set the correct orientation for each graphics file.

A.2 Placeholder Text