Space Crusher: An Extended Interactive Screen Game

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Fig. 1. Screen capture of the server during a single mode game play.

Abstract—The amount of mobile devices is growing faster by the day. Still the possibility of connecting them to other devices such as Smart TVs is still unexplored. This paper presents a collaborative game called Space Crusher, where players control space ships and have to destroy asteroids while collaborating with each other in order to achieve the maximum number of points. The tests aim to prove that collaboration improve the game experience and that the use of mobile devices is better than a computer as a second screen and interactive dispositive.

Keywords-collaboration; interaction; extended screen game;

I. INTRODUCTION

It is increasing the number of mobile devices (such as smartphones or tablets) day by day, and simultaneously, televisions are getting bigger and sharper. But, the interaction between these widely spread devices is still very small.

There are several applications that integrate multiple users.

Games in particular have a strong multiuser/multiplayer characteristic. Even in the most simple games where the objectives are simple there are situations where the players can join and interact.

We propose a simple action game based on a new kind of collaboration between users, displays and devices. The objective of this project is that multiple people can use their own mobiles collaboratively. By connecting their devices to a central display the users can interact with a wide range of information divided in multiple screens. With this technique we can keep individual information of each user separated from the general view. The software makes use of a dedicated server and synchronized devices. The user controls a second display with interactive characteristics.

The paper is organized as follows. Section II presents some related works in collaborative games and extended screen. Then, in Section III we show our game providing details about it. In Section IV we present all the aspects needed to proceed with the system usability evaluation and in Section V we describe how tests were done. Also, in Section VI we present our results and the discussion and in Section VII we make some final comments about the work developed and our on-going research.

II. RELATED WORKS

There are some works related to ours in different ways. In previous work, Tsekleves [1] discuss the idea of interacting with digital medias as a second display, applying the idea of the extension of information. Also, game platforms such as Nintendo Wiii U [2] use this second screen idea but it obviously depends on the game console and specific controls to be played.

There are several similar shooting games available in the market, such as Space Invaders [3] which served us as inspiration. Collaborative games were also related to this idea, such as Zynga Cityville [4] where it is needed to work together with friends to achieve an objective and Candy Crush [5] that the user needs collaboration from friends to obtain more lifes in order to play.

This paper shows a different way of collaboration, using a mobile device and a computer, focusing in multiple platforms and not a exclusive second screen (such as Nintendo 3DS [6]).

III. DEVELOPED WORK

We built a shoot 'em up game where the goal is to destroy as many asteroids as possible. Each player controls a ship that can be moved horizontally on the screen. We tried to keep the game as simple as possible so we made that the ship shoots automatically. This makes the learning curve to play the game become easier and intuitive.

To apply the collaboration and extended screen, it is possible to collect lifes (represented as a heart symbol) and special itens (represented as a lightning symbol) and share them with other players. Special itens can be used to play a roulette where is possible to win two new weapons, lifes or activate more asteroids.

Two clients were developed, one for the devices as player and other one as server. The interaction of the game happens through the client application that runs on a mobile device, which contains information about the game. And the challenges happens though a server, a fixed larger screen available for all players.

A. Server Application

The first step to play a game is to setup the server. The main screen offers level configuration, game identification to save a log, or simply start the game as the default mode (no log and difficulty one). This features can be checked on Fig. 2.

The fixed screen serves as an extension to all players follow the new challenges. There are some objets falling on the screen, such as asteroids, lifes and special items. The higher the difficult level, the more objects are falling.



Fig. 2. Screen when server is waiting for a new game play.

The lower colored bar indicates where is the user's position in the fixed screen. This color vary with the order that the players start in the game, the first one gets a blue ship and bar, the second one a red one, and so on.

A screen capture of the server during a game in a single player mode can be seen on Fig. 1.

B. Client Application

The client can be used in smartphones and tablets, they have the same designs independent of the screen resolution, what changes is the way to interact with it. The ship is always fixed in the center of the screen. The top bar of the client screen indicates the user's position in the fixed screen. An example of the client screen can be seen on Fig. 3.



Fig. 3. Client screen on Space Crusher game.

The players use the touchscreen of the mobile to move the ship. To use the weapons or special, it is just click on the specific item. If the user wants to share itens with other players, it is just drag the item and drop on the desired device on the mobile.

When getting the special item, the user gets a new configuration screen, where the ship becomes a roulette. To play with it it is just press the Rotate button on the mobile. The roulette can offer four different prizes: a weapon that shoots stronger than the original one, a weapon that shoots three strong bullets, life or more mini asteroids (the bad prize). A roulette screen shot can be seen on Fig. 4. Each special weapon shoots for 2 seconds and then come back to the original one.



Fig. 4. Roulette design on Space Crusher.

IV. USABILITY OF THE SYSTEM

In order to check the usability of the system and to evaluate the collaboration, two scenarios were experienced, some hypothesis were raised as well as independent and dependent variables.

A. Scenarious

To compare and test properly the collaboration on this work, we used two smartphones as one scenario, with smaller screen resolutions and touchscreen, and two computers as the other one, with fourteen inches screen and no touchscreen (directional keys and keyboard shortcuts).

B. Variables

We have established as independent variables the device interaction (mobile or computer) and two difficult levels.

The dependent variables used in our experiment were: satisfaction with the game, fun, runtime, performance (hits, errors, score points).

C. Hypotheses

With this application we intend to prove this hypotheses:

- *H1*: The collaboration facilitates the gaming experience.
- *H2*: Use a mobile device as another screen is better than use a computer.
- *H3*: The presence information on two screens enhances the gaming experience.

V. THE EXPERIMENT

The experiment was done with fourteen people, divided in seven pairs, during approximately twenty minutes each test. There were four rounds of two minutes each. These rounds were divided in two different difficult levels and two different devices (computer or smartphone). The first pair started the test with the smartphone, the second with the computer, and so on. Also, there were two kinds of data that we collected: questionnaires (pretest for characterization and posttest for evaluation) and log of the matches. Pictures taken on the experiment can be seen on Fig. 5.



(a) Desktop test on level 1.



(b) Smartphone test on level 2.Fig. 5. Users testing the game on the different devices.

A. Task description

The task was equal for all the users. They should connect the client application to the server and play the game. During the game, the users should navigate though the scenarios with the ship, use different weapons, use the special item (roulette), and interact with the other player (like sending weapons or life).

B. Users

Thirteen male and one female tested Space Crusher. The mean age was 26.5 years old. They normally play electronic games (more frequently computer games). 64% of them have played action games in a mobile device. Only 21% have played games with a second screen (like WiiU, two monitors, or Nintendo DS).

C. Logging

The log collected contained the number of points of each person in each round; the number of weapons, specials and lifes where collected and used; the number of rushes (bad roulette prize) and in case both players died before the end of the round what was the time remaining of the game.

VI. RESULTS AND DISCUSSION

Using the data collected from the tests described above, we were able to find some insightful results. In general the performance of each pair was better using the desktop version of the software, but using the smartphone teams were still able to complete every task successfully.

We noticed that collaboration in this game tends to happen based on necessity. This means that pairs of players that had better individual skills did not feel the need and ended up not collaborating much. Yet, players that exchanged items when near defeat extended their game. In situations where one player would die and leave his partner alone the other would readly give one of his "lifes" to the other player, continuing the round until time ran out.

A. Questionnaires and Logs

The players feedback was very positive on the mobile. 65% of the players were satisfied and other 28% were neutral about the mobile version. When asked about the fun factor 71% really enjoyed the experience while 28% were still neutral.

On the other hand the desktop version did not receive such a positive evaluation. It had 50% satisfaction and fun approval, and 21% of the feedbacks were neutral.

In an general view 85% of the players felt they had a good experience using multiple screens and 78% approved and enjoyed the collaboration.

Using the logs it is possible to infer a direct relation between the score and the device observing the analysis of variance's p value of 0.0299. Also, observing the mean amount of collaboration iterations we can see that players collaborated similarly on both devices.

B. Verifying the hypotheses

• *H1*: The colabotation facilitates the gaming experience. We consider this to be true based on the fact that players that needed collaborated. When the game presented difficult situations they instantly exchanged their items to try to achieve a better score. Still we should conduct more tests with and without collaboration in the future to be fully safe to argument this.

- *H2*: Use a mobile device as another screen is better than use a computer. This can also be considered true based on the questionnaire feedback. Most users preferred the mobile rather than the desktop interaction.
- *H3*: The presence information on two screens enhances the gaming experience. According to player's feedback this seems to be very positive. Separating user's unique information and generic information in different screens changes focus has a very positive result.

VII. CONCLUSION

We presented in this paper the collaborative game Space Crusher that used more than only one screen or device to be played. We detailed how the game works, the challenges that users have and how they interact with the game and other players.

Tests were made with users to prove the usefulness of collaboration and of playing with a second screen and a device. It was analyzed with two distinct scenarios, one playing with a smartphone and another one playing with the computer on two different difficult levels. With the test results we showed that collaboration enhances the gaming experience and that the two screens facilitates it. We also got evidence that in this case using a mobile device is better than another computer.

The next steps of this work aims to improve the gameplay, making the game harder and more exciting, also makes the user requires more a second screen. There should also be better evaluated how a mobile device is better to play than a computer.

REFERENCES

- E. Tsekleves, L. Cruickshank, A. Hill, K. Kondo, and R. Whitham, "Interacting with digital media at home via a second screen," in *Multimedia Workshops*, 2007. ISMW '07. Ninth IEEE International Symposium on, Dec 2007, pp. 201–206.
- [2] Nintendo. (2014, Jul.). [Online]. Available: http://www.nintendo.com/wiiu
- [3] T. Nishikado. (2014, Jul.). [Online]. Available: http://www. space-invaders.com
- [4] Cityville. (2014, Jul.). [Online]. Available: zynga.com/game/cityville
- [5] King. (2014, Jul.). [Online]. Available: http://www.candycrushsaga.com/
- [6] Nintendo. (2014, Jul.). [Online]. Available: http://www.nintendo.com/3ds