MSQUASH
An Exergame using the Playstation Move Controller

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Abstract: The exergames became very popular in last years because of the appearance of the motion controllers with accelerometers but also because this type of games promotes the physical exercise.
Msquash is a 3D game that simulates a squash field where the player can play using the Move controller. The game was developed with the objective to create an exergame using the Move motion controller and also to compare the Move controller performance with Wii Remote. Thus the idea is providing a fun and engaging experience for players while they do physical exercise also.
The Msquash game was developed using OGRE and OpenCV libraries with Playstation Move controller and Playstation eye camera.
This paper presents a brief description of the Msquash game and some results based on tests performed with users to evaluate the interaction method used and its gameplay.

1 INTRODUCTION

In last years, the games consoles brought to players several exergames (Hoysniemi, 2006) (Sinclair et al., 2009), where Wii game console is a reference with games like Wii Sports and Wii Fit (Wii, 2011). However, the other game consoles go in the same direction with Playstation Move (Playstation Move, 2011) and Microsoft Kinect (Kinect, 2011) controllers.

Human-Computer Interaction (HCI) techniques have evolved over the last years, which brought benefits to the video game industry. The appearances of motion controllers like the Wii Remote and the Playstation Move are examples of this evolution. These controllers allow the mapping of the player's gestures to the games, which is very useful and explored in several types of games. One type of video games that benefits a lot from this evolution were the exergames, i.e. video games that promote physical exercise. As the name suggests, exergames are games that motivate players to do exercise routines. They usually require that the players perform movements, in order to complete goals. They can also be considered Serious Games, since they use the video game to achieve other goals than solely entertainment, i.e. do physical exercise. For example, the Wii console is used to augment the rehabilitation of an adolescent with cerebral palsy (Deutsch et al., 2008).

Bailey and McInnis (Bailey and McInnis, 2011) showed in their study that the players spend more energy in exergaming than when walking on a treadmill at 4,8 kilometers per hour. All games used in their study elevated energy expenditure to moderate or vigorous intensity. They claim that exergaming has the potential to increase physical activity and may be a viable alternative to traditional fitness activities for children.

The exergames can have a positive effects on health of the players, for that, this type of games have been growing in last years and it will continue to growing in next years. However, some of them have a problem that can potentially can cause injury to players, because the movements of the players don't have an opposite force. For example, in a tennis game the user uses a racket to play (e.g. using a Wii remote) but it don't have the opposite force created by the ball in the racket. This is a problem for which current technology has no solution yet.

Several works has been developed trying to evaluate the virtual environments for games. Takamura et al. (Takamura et al., 2006) showed that game construction with high reality is attained by integrating rigid body physics, haptic feedback and stereophonic sound system. Bideau et al. (Bideau et al., 2003) show

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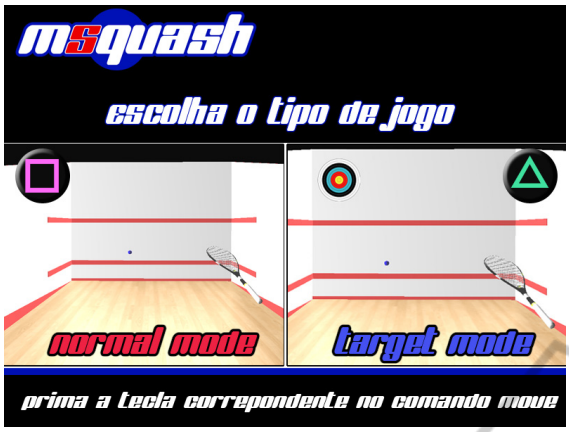

Figure 1: Msquash - the two modes available.

that the virtual environment offered enough realism to initiate natural gestures, i.e. that gestures did not differ between the real and virtual environment.

In this paper we describe the Msquash game that is a new exergame that simulates a squash field where the player can play using the Move controller. The main idea was to develop an exergame using the Move controller and compare the performance of the Move controller and Wii Remote. Besides it allows us evaluating the performance of the players during the game because it produces a report with most important events of the game for each player. This aspect is important to analyze the performance of the players. For example, in a recent work, Bideau et al. (Bideau et al., 2010) used a motion capture system and a virtual reality system to analyze also sports performance.

2 MSQUASH

Msquash is an exergame that was created to study the capabilities of this type of video games using the Playstation Move controller for user interaction. It was built using the 3D rendering engine OGRE (OGRE 3D, 2001) plus the OpenCV library (Bradski, 2000) to make the tracking of the Move command. The tracking process is based on the color of the ball on the top of the Move command.

Currently, Msquash is composed by two modes of game but only available for a single player yet. In the first mode, called normal mode, the player has a squash filed and uses the Move command to control the racket. In the second mode, called target mode, as the name indicates the player has to hit the target to achieve the goal. Figure 1 shows the two modes of the game that the player can select, in the beginning of the game, by pressing one of the buttons of the Move

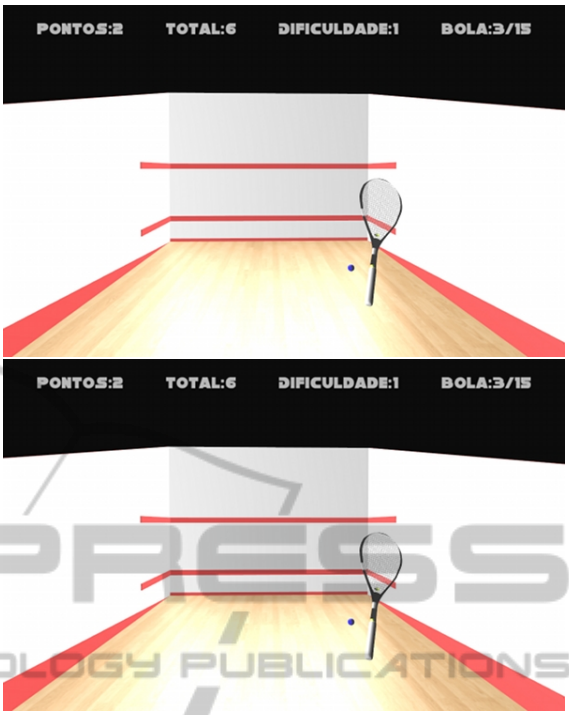

Figure 2: Msquash - normal and target modes.

command (i.e. the square or the triangle).

In the normal mode (see Figure 2 top) the player makes points depending on the area where the ball hits. This means that he/she achieves more points when the ball hits between the two red lines in the wall and achieves less points when the ball hits above or below the area defined by two red lines. In the beginning of the game the user also defines the number of balls that want to play.

To make the game more attractive was also defined a difficulty level. In this case was defined four difficulty levels. The difficulty level is associated to the dimension of the racket of the user. For example, the level one corresponds to a larger racket that in the levels two, three or four. Thus, the level four corresponds to the smaller racket which make more difficult to catch the ball. However the racket size only changes for collision detection but its graphical representation is maintained in all levels. This means that the player needs more accuracy with the Move controller for level four than for levels three, two or one. For collision detection was developed a module that calculates the ball interaction with the racket and with the squash field. This module takes into account the gravity force and the acceleration of the ball retrieved by the accelerometers of the Move controller.

During the game is created a report with several kinds of informations, such as, the number of lost

balls, the areas where he/she lost the balls, the points achieved, the time played per ball, the difficulty level, etc.. This information is very useful to analyze the player's performance.

The target mode (see Figure 2 bottom) was developed to increase the challenge of the game. In this case, a target appears randomly in the wall, and every time the player hits it, it will appear in a new position. The player makes points depending on the area where the ball hits the target, of course that the center gives more points than in boundary.

To evaluate the interaction method of the game were realized tests with several players and were generated data about the players' performance in the game. The players also had to answer to a questionnaire, after playing the game, to obtain its opinions about the game and about the interaction method used. This questionnaire was created using Likert scale (Likert, 1932) with five-levels. Thus, game's evaluation combines data from the player performance with the questionnaire answered after playing the game with the aim of collecting player's opinion about the game and its gameplay.

The tests was applied to 67 users, ages between 11 to 67 years (male = 45 and female = 22). The sample was divided in three groups: group A - pupils from a secondary school (32); group B - undergraduate Sports Science students (23); and group C includes a wide range of people that wanted participate in the tests (11). Note that the two main groups, A and B, represent the target audience of this kind of games.

In tests was used two laptop computers, each one with a Move controller and a Playstation Eye camera. Note that the use of laptop computers in these tests may be influenced the results due to the reduced sized of screens. However these tests gave us the first feedback about the game and the interaction method used. But we think that the user's performance can be better using a wide screen.

Figure 3 shows the two test sessions with two students playing simultaneously as a way to improve the competitiveness. The tests consisted of three sessions, one initial of 5 minutes to training without points, and then two sessions, one for each game mode, where the player had available 15 balls per session. The first session was created for the user's adaptation. The other two sessions were evaluated in terms of points obtained, balls loosed, time of game, etc. After the three sessions each player answered to the questionnaire giving their opinion about the game and its interaction method.

The main positive aspects referred by users about the game were the fact that it promotes the physical exercise and also the interaction method used (i.e. the

Figure 3: Msquash - user tests with two main groups.

Move controller). On the other hand, the main negative aspects identified by users were some difficulty to perceive the velocity/distance of the ball to the racket.

Based on feedback from users we can say that the main objective of the game was obtained, although still being a first version of the game for a single player. The definition of a difficulty level had good results in practice because the tests showed that users obtain more points in first level than in other levels, as we can see in Figure 4 (top) that presents the average points per difficulty level. Besides the difference of points between levels is more significant in target mode than in normal mode, as expected.

The tests showed also that the users maintain normally the ball in area above the two red lines. This fact can be observed in Figure 4 (bottom) where is showed the average of the points obtained for each area of the field.

When comparing the performance of Move controller in this game with Wii Remote controller, we can say that in terms of accelerometers they are similar. The main difference between both controllers is the tracking method used for each one. In the case of Move controller the tracking is based on image processing captured from Playstation Eye camera. Our tests showed that the tracking process is influenced by the hardware characteristics, that means that the game performance can be also influenced. For example, in our tests the two laptops used were not equal and the

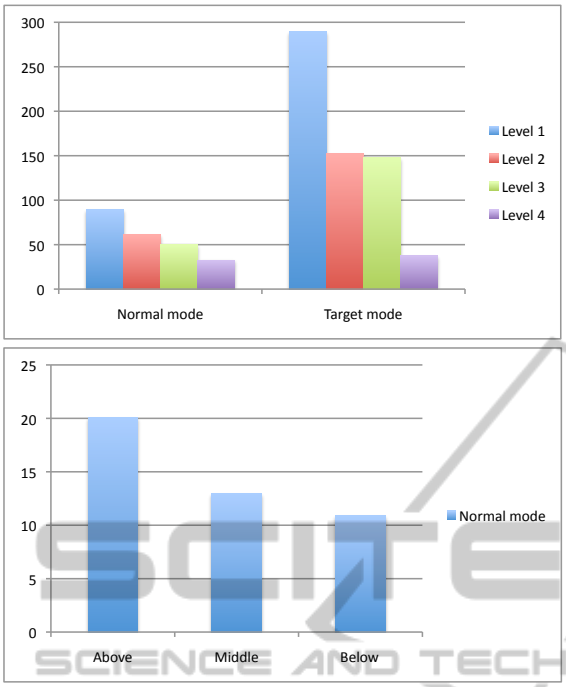

Figure 4: Top - average points per mode and level of difficulty. Bottom - average points per area in normal mode.

gameplay was not exactly the same.

3 CONCLUSIONS

We developed a 3D game using the Playstation Move motion controller and Eye camera. The Msquash is an exergame because it promotes the physical exercise where the users' gestures are used to manipulate the racket (i.e. to play). Our game has the advantage to give us a report for each user about its performance in the game. Thus it is more easy evaluate the game and at the same time develop new experiences.

The users tests showed us that in fact this type of motion controllers is very efficient, and also that anyone can use it independently of the age. Other interesting result was that the hand, used to play, has no influence on loose balls, i.e. the players lost balls equally on the left and right side, independently of the hand used to play. The level of difficulty created for the game worked as expected, i.e., players' scores decrease when the difficulty level increases.

When comparing the results of the two main groups, we seen that undergraduate students of Sports achieved better scores than other pupils. All participants considered that this kind of games can be positive effects on health of the players. But only the undergraduate students reported the problem of the movements of the players don't have an opposite force, which can cause injury to players. In addition, they mentioned a new problem that can arise for their career. They think that exergaming can replace them as physical trainers because the people can do the exercise alone at home.

In the future we want to extend the game for two players, which is not a complicated task because the Move controller can emit several colors, thus it is easy to do the tracking for them. So, in this case each player will have a different color and the screen will be divided in two areas, one for each player. Other idea for the future is develop a version of the game using Kinect controller to evaluate the main advantages and disadvantages when compared to the motion controllers with accelerometers. Besides will be interesting make a study to evaluate the energy expended during the game, because the squash game is considered an vigorous game.

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