Do it yourself: When technology joins the cardboard

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Abstract—This paper presents an alternative way to play video game interactively. To construct the control of the game, it will be used cardboard to build the structure, aluminum foil for the contact with the microcontroller, and a microcontroller, that will be an Arduino based on ATMega 32U4. To attract the attention of the public, will be developed games different than conventional, being the first a race in outer space. To test the viability of the project, a pilot test was made with the Makey Makey board that would build an Atari control made with cardboard to replace the computer mouse.

Keywords-Arduino; Cardboard; Interactivity; Racing Game;

I. INTRODUCTION

Videogame is every electronic game, be it portable, console, arcade, for PC or for gadgets, that works from a video and a support for hardware. Its controllers are input devices, being these characterized by paddle, joystick, gamepad, motion controllers or any device designed for receive commands [1].

Due to the great potential of technological toys in terms of interactivity, motor and cognitive development, and a technological society that advances significantly, conventional toys are increasingly in disuse by users [2].

Together with this integration of technology and toys, has been occurring a increasing use of games as a tool to aid basic education [3] and not just entertainment. There are robots, such as Mindstorm and Osmo Tangram, which were built to bring didactic and technological experience to the user. Because they are tools that interact more with the public, users becoming more interested in them and, therefore, they having a more immersive experience. Such immersion attract the attention of children with attention deficit or autism, and consequently, facilitating their learning [4].

Therefore, it was thought to create several controls for video games that are more interactive with the public. Although there are already several similar systems, such as Nintendo Labo, Koski, Makey Makey, Crazy Circuits and Sesame Street Augmented Reality Toys [2], there is not an interactive control that is economically viable and that have easy access in Brazil yet.

In conjunction with these controls, a new way of playing video games is being developed to create a greater interaction between player and game. This proposal will serve to diversify the way we play video games these days and to the most diverse academic purposes, as develop new skills in children or to win the attention of children with a new way of play. The main is its low cost since it is made only with cardboard, Arduino and aluminum foil, in addition, by means of simple instructions it allows that anyone can build it.

Specific games will be developed to work with the control, such as space race through the earth's crust of a planet, fighting giant robots or battle royale, to create an even more intuitive and immersive experience than traditional ones. All games will be available for free on the internet for download by the interested public.

II. METHODOLOGY

This section will present the main concepts of the developing system, the inspirations and objectives for the development of it.

The system is being developed for computer games, where the chosen game will have a control for interactivity. The first game to be built will have a steering wheel as a control. The materials used in the steering wheel will be cardboard, for the construction of the structure, and aluminum foil, to make contact with the microcontroller. The microcontroller will simulate the computer keys, giving the user the possibility to play using both, the keyboard or the developed control.

Several games will be made, but at the first moment a racing game is being developed in a 3D environment, where the character will run around a planet as it moves. Each planet will have its special characteristics, like releasing fire or being frozen. The characters will have advantages while racing on their home planet, as well as being able to pick up special powers during the race to help them reach the end.

The new way of playing video games [5] will provide the user with greater interactivity with the game without having harmful effects such as headaches [6]. Currently there are technologies with the same purpose [7] [8] [9], but they tend to have a high cost, which restricts the reach and use of them.

All the technologies with the same intention, that want diversify the standard mode of play, are being influential for the development of this project. The main objective is to



Figure 1. Conceptual art of the control for the first game

create an immersive and interactive technology between the user and the game that is viable, mainly, economically, for all the players.

III. HARDWARE STRUCTURE

The board responsible for transmitting the movements made with the cardboard is a Arduino based on the ATMega 32U4, as Arduino Leonardo and Arduino Micro, necessary to control the computer keys.

From the *capacitive sensor* library it is possible to identify the human touch to a metal surface, such as aluminum foil. From the *keyboard* library you can simulate the computer keys. With this, it will be possible to make any type of control with the most diverse materials to control the computer and, consequently, the games for them.

For the first game, a steering wheel is being developed with the purpose of emulating the control for a racing game described in the IV section. The steering wheel will be completely made with cardboard and aluminum foil. There will be two buttons on the front, one to go back to the game screens and another to choose the menu actions. There are more two buttons behind to accelerate and brake, and a base where the Arduino will be. The front buttons are slightly above the horizontal axis to facilitate player ergonomics [1].

In the Figure 1 is shown the conceptual art for the control, which was inspired on a militar spaceship used by Galatic Empire, used in the game due to the space based scenario.

IV. SOFTWARE MODEL

The first game to be developed, with connection to cardboard controls, will be a space racing game. The user will have the choice to choose between four characters, two spaceships and eight different planets to play, plus the final map that will be passed inside a black hole.

The planets belong to a distant galaxy where each planet has its own characteristic. There are grass, stone, fire, water, candy, ice, spaceships and toys planet. The conceptual art of the fire planet can be seen in Figure 2. Each planet has terrain obstacles, such as the aquatic planet, which have a underwater mechanism. There are also more interactive obstacles, but it is possible to deviate, such as falling stones or chewing gum on the track.

At all levels the environment will be rotating as if the spaceship was actually there, and the race will occur in a



Figure 2. Conceptual art of the fire planet

direction opposite to the direction of rotation of the planet. In some worlds it will be possible to interact with the environment, as in the fire world where the volcanoes of the scenery will be interactive and will release burning stones on the track.

When choosing the alien, the color of the ship will be configured according to it. And the chosen alien will take advantage of terrain on his home planet, for example, the alien with gills will not lose speed on underwater. The ships have a similar mechanics. The difference between them is there is a ship that does not adhere to any material, in other words, it does not lose speed in specific terrains, as chewing gun. In other part, the other ship has more speed in the other terrains.

There are several special powers to help the character reach the finish line. During the race you can find a dynamite of banana, which shoots at your opponent and he lose speed for 5 seconds. A flaming wheel that increases its own speed for 5 seconds. It is also possible to find a pillow, which leaves the character invulnerable for 5 seconds, except for falls.

This is the game that is being developed and will be the first to be tested with the external public, but in future moments it is planned to diversify the game modalities, after feedback from users.

V. DEVELOPMENT TEST

To test the viability of the hardware, a pilot project was made to certify that it is possible to control a computer from cardboard, aluminum foil and a microcontroller. For this first test was used the Makey Makey board [10].

An atari control has been made to replace the computer mouse, as seen in Figure 3. When moving the lever, the mouse pointer moves in the determined direction and clicking the button above the control lever, presses the left mouse button.



Figure 3. Atari control made from cardboard

After developing the Atari control for the test of viability of the project, the development of the steering wheel was started, and was chosen where will be each piece of aluminum to be able to control the spaceship. In addition, it was also thought about how a racing game would be made to catch the public's attention. So we chose to play the game in space, in the earth's crust of the planets, for the users could feel the rotation of the planet and the diversity of size between the planets of the galaxy created for the game.

To develop the first version of the project was used the Makey Makey board, however, it is expensive for the general public to buy. Because of this, for the rest of the project will be simulated a Makey Makey board, with more functions, from an Arduino Micro or Leonardo, based on microcontroller ATMega 32U4. This change will be made to cheapen the final product and to add functionalities to it, like adding accelerometers and gyroscopes to the control.

VI. RESULTS

A survey was conducted among 115 people scattered throughout Brazil to find out their interest in a DIY video game and the average weekly of hours played to determine which would be the best game model or accessory to make available.

Was questioned the public interest in acquiring a video game where the user will have to make your own control from the instructions, to later play the available games for the control chosen, which will be available online for download. People's response can be seen in Figure 4.

From the chart we can see that 29 people have an interest



Figure 4. Interest of people in buying a video game that has build their control



Figure 5. How many hours per week, people, play video games

in buying a video game in this style and maybe 65 people buy. Therefore, the focus of the system is not only focused on the hardware, because to achieve the total interest of these 65 people it is necessary to develop software different from everything they know and that is completely compatible with the control. It will also be possible to adapt the control to work in games that were not created by us, however, it will not be as efficient, since it will use an ideology that assumes that software will be efficient if it is 100% compatible with your hardware. Such ideology is one of the most successful in the technological area [11].

We also asked another question, questioning the number of hours played during a week, where the answers can be seen in Figure 5. What has been noticed is that most players play less than 6 hours per week, in other words, less than a hour per day. Thinking about that, began questioning how to make a cellphone gadget made of cardboard, as if it were a control, to facilitate some of the major games like Garena Free Fire or Roblox.

The control can be made from the Arduino micro, which is the smallest Arduino based on the ATMega 32U4. After doing the pilot test with the widget, aims to create different and interactive games made specifically for him.

VII. CONCLUSION

This article presented a new model of control computer games that is more interactive and cheaper than the current ones. From a microcontroller with ATMega 32U4, cardboard and aluminum foil it is possible to have the built-in control interact with the computer through some Arduino libraries. The controls may have connection to all available computer games, but will demonstrate better performance when used with games and specific to them.

To get more attention from the public, several software will be developed for each official control, in other words, those that have instructions on how to build disclosed. Softwares tend to be different from conventional ones and influence players to interact more with the game.

For the pilot test, in order to test the viability of the project, a cardboard atari control was created to replace the mouse, and the prototype worked perfectly using the Makey Makey board as microcontroller. But to cheapen the project, the final version will use Arduino.

From the results of the survey with the users, it was noticed that several players currently tend to be more casual, in other words, play less than 6 hours per week. Thinking about this, the possibility of creating a cardboard control for mobile phones with an Arduino Micro is being evaluated to facilitate the gameplay of current games. In a future moment, develop specific games for that control that instigates the interactivity of the same, on smartphones.

When the first phase of development of the project is ready, in other words, when the space race game and the steering wheel is ready, it is intended to release the project for the public to play during the open day of Fab Lab Belém, in the arduino day and in the games room, that are available during events such as Animazon no Taikai and Animegeek.

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