GLOOVETH: HEALTHY LIVING, FUN AND SERIOUS GAMING

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ABSTRACT

Memorable experiences intend to deliver intense usable moments with the support of different platforms and social networks. Higher degrees of motivation ensure efficiency and performance. Serious Games deliver powerful and truthful experiences on the basis of providing the user with goals, challenges, problem-solving and rules, besides a clear internal value and an interactive experience. Our software and hardware-based tools should have the power to teach and change us, while making us better problem-solvers and professionals. We present Glooveth, an educational game for children from 6 to 12 years old, winner of the Silver Award on the Global eHealth Challenge 2010. The game has been conceived by following the current tendency on the videogames industry plus the new controlling paradigms. It has been developed for three different peripherals: a mouse and two special gloves, providing a deeper user’s game playing and learning experience. The paper explains the whole project, beginning with the first concept ideas and ending with its real application and usability testing.

Keywords— Serious Games, Edutainment, Infrared LED, Virtual Reality, Health Care, Natural Interaction.

1. INTRODUCTION

It was during 1972 that Pong, considered the first game in the computer game history, appeared. The videogame industry has evolved a bit since the old times by always bringing innovation to the computer graphics field, beating new challenges every decade and reaching a high level of definition and complexity. However, it seems that the innovation as expected for the public doesn’t reside within the computer graphics field anymore. The appearance of low-cost Virtual Reality devices such as Nintendo’s Wii [1] produced a change of philosophy, rebuilding the computer game innovation concept. Natural interaction is a new gameplay formula that can be achieved by using the user’s movements and gestures or the body itself.

This clear innovation presents a claim for everyone in the sense that playing computer games is not such a big deal. Now everyone is able to show great skills for playing. This idea of naturalness or simplicity, as introduced, is absolutely coupled with the usability field. Intuitiveness implies no previous experience plus natural experience, not only with game controlling but also regarding a logical graphic interface, an easy understanding of the presented content and the lack of explanation.

Glooveth was directed to a clearly targeted audience: kids. Children have skills, preferences and needs that are different from those belonging to “regular users”. These characteristics change as they grow. Furthermore, at this age gender differences in the relationship, use and consumption of new technology are greater than ever.

The Global eHealth Challenge 2010 [2] organized by an outstanding program called Cure4Kids for Kids! [3], requested a multimedia application that would educate children about cancer and healthy living. This community intends to educate children, parents and teachers about cancer and dispel common misconceptions about childhood cancer, for its prevention. The pilot program contained three educational modules: Cells (presented as the basic unit of life), Cancer (presented as a disease of unhealthy cells) and Healthy Living (presented as a set of practices for cancer prevention).

This project is focused on the Healthy Living part of the program. As explained, this part teaches about the prevention of cancer, containing several topics: tobacco control and protection, safe sun exposure, appropriate physical exercise and proper nutrition (the main topic of the developed game).

Games, and then serious games, are perfect for the achievement of educational purposes. Fun and enjoyment are crucial within the process of learning. Kids, as learners, enjoy a memorable experience in a relaxed, motivated and willing to learn mood.

In addition, computer games are fun, pleasurable, challenging and rewarding. For this reason learners will be more motivated and engaged in educational activities if these activities take place in the form of a gameplaying experience.

2. THEORETICAL BACKGROUND

Some technological aspects must be clarified before the game explanation. The aspects can be listed as follows.
2.1. Hardware

2.1.1. Infrared LED, WiiMote and Bluetooth

The Wii Remote, usually known as the WiiMote, is the primary controller for Nintendo’s Wii console. A main feature of the Wii Remote is its motion sensing capability. This brand new game of playing has revolutionized the computer game industry for the last years.

The controller comes with an infrared (IR) camera with an object tracking processor. The IR camera needs a bar sensor (containing 10 IR LEDs) on the top or the bottom of a screen to provide user’s pointing information [4].

Fig.1 The Immersion CyberTouch dataglove.

One of the particularities of this project is that the roles have been interchanged between devices. The Wii Remote plays the role of a camera (reading user’s movements) and the IR LEDs are incorporated to an interaction glove to be read by the controller. Therefore it is possible to track what the user is doing with the hand.

The intercommunication between the Wii Remote and the Wii console is carried out by a Bluetooth connection.

2.1.2. The CyberTouch Dataglove

The CyberTouch [5] [6] (Fig.1) is an immersive glove consisting of 22 sensors that track hand motions in real time. Sensors are located over or near the joints of the hand and wrist.

Note that this dataglove also comes with 6 vibrotactile feedback devices. There is one feedback device per finger plus one onto the palm.

2.2. Software

2.2.1. The Panda3D Library

Panda3D [7] is a game engine originally conceived and developed by both the Walt Disney Company [8] and the Entertainment Technology Center [9]. Some of the titles where this library was applied include “Disney’s Pirates of the Caribbean Online”, “Aladdin’s Pinball” and the “Little Mermaid Pinball”, among others. It includes graphics, audio, I/O, collision detection, and other abilities relevant to the creation of 3D virtual worlds.

Panda3D is an open source solution that becomes really helpful to develop a 3D game from the outset in an incredibly easy and fast way.

Despite the fact that Panda3D is developed for the creation of 3D games, this project consisted of a 2D game environment.

2.2.2. Crayon3D

Crayon3D [10] is an external extension for the Panda3D library that was developed as semester project at the Entertainment Technology Center at Carnegie Mellon University [9]. This extension of code was built over some of the principles of the technology crafted by Johnny Chung Lee [11].

Fig.2 (a) The number-directions relationship, (b) A shape created with the Crayon3D library.

The idea arises from an old children’s book, “Harold and his purple crayon” [12]. In there, Harold the protagonist who is a four-year-old boy, has the power to create a world of his own by simply drawing it with his purple crayon.

Crayon 3D enables users to create objects by drawing in the air with their fingers while using a glove made of LED’s, just like the hero of the children's book [13].

Crayon3D has various modules. This particular project uses its Finger Tracking module (a visible cursor showing the place where the user is pointing on the screen) plus a fraction of its Drawing Engine module (relation between numbers & directions as shown in Fig.2). Therefore the application read kid’s drawings and recognizes the shapes that they create.

3. THE GLOOVETH LEARNING EXPERIENCE

In order to conceive an educational and engaging product for the kids, a game needs a subset of goals and rules to test user’s skills. At the same time, it should contribute to user’s learning [14]. A good game design appliance will focus on:
• System design: the creation of game rules and goals. Known as the logical part.
• Story design: creation of a powerful back-story and theme for the entire game experience.
• Art design: the artistic part of the game as the eyesight part.
• Technological content: attractive technological innovation for the selected platforms.

3.1. System design

The specification of the game experience was detailed referencing the characteristics of a classic: Golden Axe [15]. Golden Axe is a horizontal scroll game where the most important thing is to defeat enemies while trying to surpass the current level. An easy and effective design.

![Fig.3 A Glooveth screenshot. From top to bottom: energy bar (left), special item bar (right), life and ability bar (bottom-left).](image)

3.1.1 Main character

It was decided that the main character would be a boy, 6 to 12 years old. He would be able to walk, fight and pick up diverse items. It is important to note that the character can be easily modified or changed. Time constraints did not allow us to develop more assets on the side.

3.1.2 Ability and energy bars

There are five different attacks (abilities) related to the “attack” action as specified. These abilities come from the existing six nutritional groups: grains, vegetables, fruits, fats and oils, milk and meat (within this group we also added beans, fish and nuts). We excluded fats and oils from the final idea in order to avoid misconceptions.

We also programmed regular objects such as rice (grains group), lettuce (vegetables group), strawberry (fruit group), milk (milk group) and fish (meat, beans fish and nuts group). In addition to that, there are special items like cereals (grains group), tomato (vegetables group), banana (fruit group), cheese (milk group) and eggs (meat, beans fish and nuts group). These items are crucial to execute every single and specific ability. The regular items are spreaded over all the level. These are easy to pick up and help enhancing the inner game playing. The special ones were created for an emergent and deep game playing and therefore these are difficult to find. The player will be awarded with an extra life if picking them all.

In addition to the power of the player abilities, the objects also produce a significant quantity of energy. Each item gives a concrete amount of energy. Then some items generate more energy than others [16].

We were also interested in introducing the idea of the coupling between the execution of exercise and the dissipation of energy. This is why the life bar decreases over time. Standing doesn’t imply the same “revenue” than walking. This way the player has to eat as much healthy food as possible.

3.1.3 Life bar and Enemies

Within the game mechanics created there’s the possibility that the Glooveth experience finishes if the character runs out of lives. These are visible onto the life bar. The player starts with 3 lives that can be decreased if an enemy hits the character or runs into it. Enemies are defined as unhealthy food: doughnuts (attacking with chocolate), soft drinks (attacking with liquid), fried potatoes (attacking with potatoes) and fully loaded hamburgers (attacking with mayonnaise).

3.2. Story design

We developed the following story. “Michael and Emily have gone to the park as every day. While on their way, they found a curious glove that seems to have something special. They really want to reach the park in order to play with their friends. But they must defend themselves from several unhealthy items that are trying to chase them.”

The story is crafted around the middle of a city where there is pollution and smoke. The park is a “healthy” goal to be reached. A “safe” place for the kids to be and a good place to play with friends.

3.3. Art design

The art assets within this serious game, such as the GUI elements of the game and the scene objects, were designed on the basis of the ideas behind a serious game for the learning on nutritional habits for kids. These values can be listed as challenge, discovery, happiness, vitality and energy, empathy, confidence and flexibility.

Kids love colorful scenes with sympathetic characters even if speaking about the “bad guys”.
3.4. Technological content

The game can be controlled with a typical mouse although the experience gets enhanced if using Virtual Reality peripherals such as two natural interaction gloves developed exclusively for this project. Each glove delivers a different game experience of interaction.

3.4.1 The LEDs glove

The LEDs glove is essentially a right hand wool kid glove with 3 infrared LEDs embedded in. The idea of the glove orbits around the achievement of an economic controller device. The material required to elaborate this inexpensive glove consists on a regular winter glove, 3 infrared LEDs, 1 white light LED, 3 resistances (51 ohms), a switch, a battery case (3V), 2 batteries (1.5V) and some cable (Fig.4). In fact it was originally developed for the Crayon 3D semester project belonging to the ETC [17].

The idea behind this peripheral is the possibility to control the entire application by a youngster. The main character movement was specified to be executed with the finger pointing at the screen. The abilities can be executed by naturally drawing a specific shape all along the air, thanks to the Crayon3D library routines [17].

[Image 4] (a) The LEDs glove, (b) the glove’s electronic diagram.

At the moment of the playing experience, the kid also uses a Wii Remote in his/her left hand for a better feedback, menu interaction, event activation, etc., by pressing one of its buttons.

3.4.2 The Immersive CyberTouch glove

The immersive CyberTouch [5] [6] glove is a fusion of two devices: the previous, as explained before and consisting on the addition of 3 IR LEDs, plus a commercial CyberTouch unit. Thanks to this combination we were able to work by following a multimodal paradigm were we can couple the information generated by the device with the infrared light directed to the LEDs, as captured by the WiiMote IR camera.

Despite the fact that the CyberTouch glove includes IR LEDs, its specification and relationship to the interaction within the serious game presents differences, if we compare it to the previous device. The data that the CyberTouch glove provides helped changing the idea of control of movement for the Glooveth main character. The character moves through the stage in relation to the measurement of the forward and backward movements of the index and middle fingers of the player. Therefore the kids assume that they are controlling the character’s feet by a natural interaction scheme. The idea was conceived after thinking about playing over a table, for the sake of providing with an accommodative interface. On the other hand, the depth

\[\text{The Cybertouch dataglove in http://www.cyberglovesystems.com/}\]

Fig.6 (a) The Immersive CyberTouch glove with the infrared LED structure, (b) WiiMote position for the CyberTouch playing mode.

The action related to the attach (fighting the unhealthy items) was designed to function in the same way that in the case of the LEDs glove. Therefore we use the infrared lighting scheme to draw (not along the air but over the table in this case). There is a major sensory addition thanks to the use of this complex glove: a force feedback and vibration tactile effect. This vibration is also used when the energy bar reaches a critical level.

Within the creation and design phase and after some trials, the 3 infrared LEDs were situated at the middle back palm. It ended up being the most effective location for a better game performance (Fig.6). Then we were able to provide with a clear L.O.S. (Line of Sight) between the WiiMote infrared camera and the infrared LEDs, especially at the key gameplay moments: walking and drawing.

4. TESTING EXPERIENCE

User Experience Testing and Task Evaluation was performed (figures 7 and 8) by applying the following metrics: success (in case the task is completed in a proper way), failure (the task is incorrectly completed), false success (the user thinks that the task has been performed correctly but it is not the case) and false failure (the user thinks that the task was poorly accomplished but it was correctly finished) plus other variables such as duration,
efficacy (percentage of successfully completed tasks) and efficiency (comparison of the successful tasks with their associated durations).

During the tests we also collected several qualitative data streams:

- Observations: notes about difficulties, unusual performances or non-obvious causes of error.
- Literals: subjective opinions about the user’s experience and the interface, as expressed by the users.

This protocol allowed us to understand the level of understanding of the application user interface, especially during the initial moments. We also compared the interaction results among users depending on the type of peripheral selected.

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Fig. 7 The task efficiency table (% of efficiency).

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Fig. 8 The task efficacy table (% of success).

Six users were asked to finish 5 specific tasks by repeating these 3 times with different interaction devices (a mouse, the LEDs glove and the Immersion CyberTouch device). We also asked to users to submit a short questionnaire regarding their profile (essentially related to a 6-12 years old audience). We also presented the users with a final form in order to gather data regarding their subjective impressions.

Tables within figure 7 and 8 show several results related to the usability testing experience. Tasks 1 to 5 were performed with a regular mouse while tasks from 6 to 10 were realized with the LEDs glove and the rest, tasks 11 to 15, were associated to the use of the Immersive CyberTouch dataglove.

The study shows that regarding the best peripheral for the better game performance and interaction, it can be considered that the mouse is the easiest and well-known one. Users control the game without any problem with it because they are used to its use. The LEDs glove delivers a more powerful sensory experience, innovative and different, although the user tends to end up more tired than with the previous. It requires more activity. Finally, the CyberTouch dataglove seems to be ranked as a difficult peripheral, especially for the walking process. The users perceive that they don't control the 100% of the character’s movement as they would expect to. The LEDs glove is inexpensive and it can be manually crafted within a two-hour period. Users find it easy to be used because if being a pointer, that can be directed with their fingers, while causing a physical movement with the hand.

5. CONCLUSIONS

Glooveth provides with an Edutainment experience where kids learn about healthy and unhealthy habits while playing and enjoying themselves. The items-enemies metaphor and the natural interaction paradigms developed help them to understand about what is good and what is not. It has to be said that users don't really take into account that energy disappears and therefore they just play and draw while clearing enemies (unhealthy foods). Exercising is a second crucial value that needs to be evolved within the game experience in order to ensure its importance and learning.

6. REFERENCES