Proceedings

Development of Recreational Content with Micro:Bit for Intervention with People with Cerebral Palsy †

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Abstract: This paper presents a project carried out to use games in therapies for people with cerebral palsy. A Micro:bit board is used to have a friendly interaction between the user and the game. Through a simple interface, the therapist can manage the parameters of the therapy and see the evolution of the user.

Keywords: cerebral palsy; therapies; Micro:bit; gamification

1. Introduction

Cerebral palsy (CP) refers to a group of permanent, non-progressive, developmental disorders that mainly affects movement and posture and with repercussions in daily activity [1]. CP is one of the most common developmental disabilities. Intervention sessions for people with CP are oriented to work on different aspects of daily life in order to improve their personal autonomy and independence using assistive technologies specific to each user's capabilities [2,3]. For that purpose, the therapist defines for each user a set of activities to work on a particular aspect. User motivation is very important to improve the results of therapy. In this sense, gamification is a mechanism that allows to capture the attention of users and with playful performances be working therapeutic aspects [4].

We present a project based on creation an environment that integrates information of the capacity of each user. This allows to characterize their abilities to be able to access playful games based on the work of different physical-cognitive aspects customized for each participant. The control of the games is done through a microcontroller equipped with sensors (accelerometer and compass) and with the possibility of easily connecting to other sensors and actuators compatible with Arduino. Moreover, the tool allows the management of users and records the results of each participation over time allowing the therapist to analyze evolution.

This work is organized as follows. Section 2 presents materials and methods, Section 3 shows the main results obtained using the tool, and Section 4 is devoted to conclusions.

2. Materials and Methods

A Micro:bit board is a tiny computer created by BBC to promote digital creativity (https://microbit.org/). Programs can been created in MakeCoder, Python, or Scratch editor. The program is transferred to Micro:bit to make it run independently of your computer. You can even unplug your micro:bit from the computer, attach a battery pack, and your program still runs. In particular, our project has been

developed in Python to integrate the control of micro:bit board with the management of users of the services and monitoring of the results of the therapies.

Three games was created for different purposes:

- Ping-pong. A ball moves from one size to the other size of the screen. Micro:bit allows user to control vertical movement of a bar located in one size of the screen.
- Bank to collect apples. From the top of the screen fall apples that must be trapped in a bowl. Micro:bit allows user to control horizontal movement of the bowl.
- Put balls in a hole. A hole appears in the center of the screen and the user must move the ball across the screen to the hole. Micro:bit allows user to do vertical and horizontal movement .

During a session with an user, the therapist chooses the service using the menu shown in Figure 1a. The therapist chooses the game from the games associated to this service (see Figure 1b) and determines the parameters: time, sensitivity, objective, etc. To obtain good results during intervention, it is very important that these parameters be adapted to user and, for this reason, the tool allows you to stop a game at any time so that you can adjust them. Once the game is chosen, the user plays using micro:bit. For example, Figure 1c shows a game "bank to collect apples" that allows user to make movements on the horizontal axis. After the game is over, the therapist can see the results of that game and also access the results of previous games (see Figure 1d).

(a)

(b)

(c)

(d)
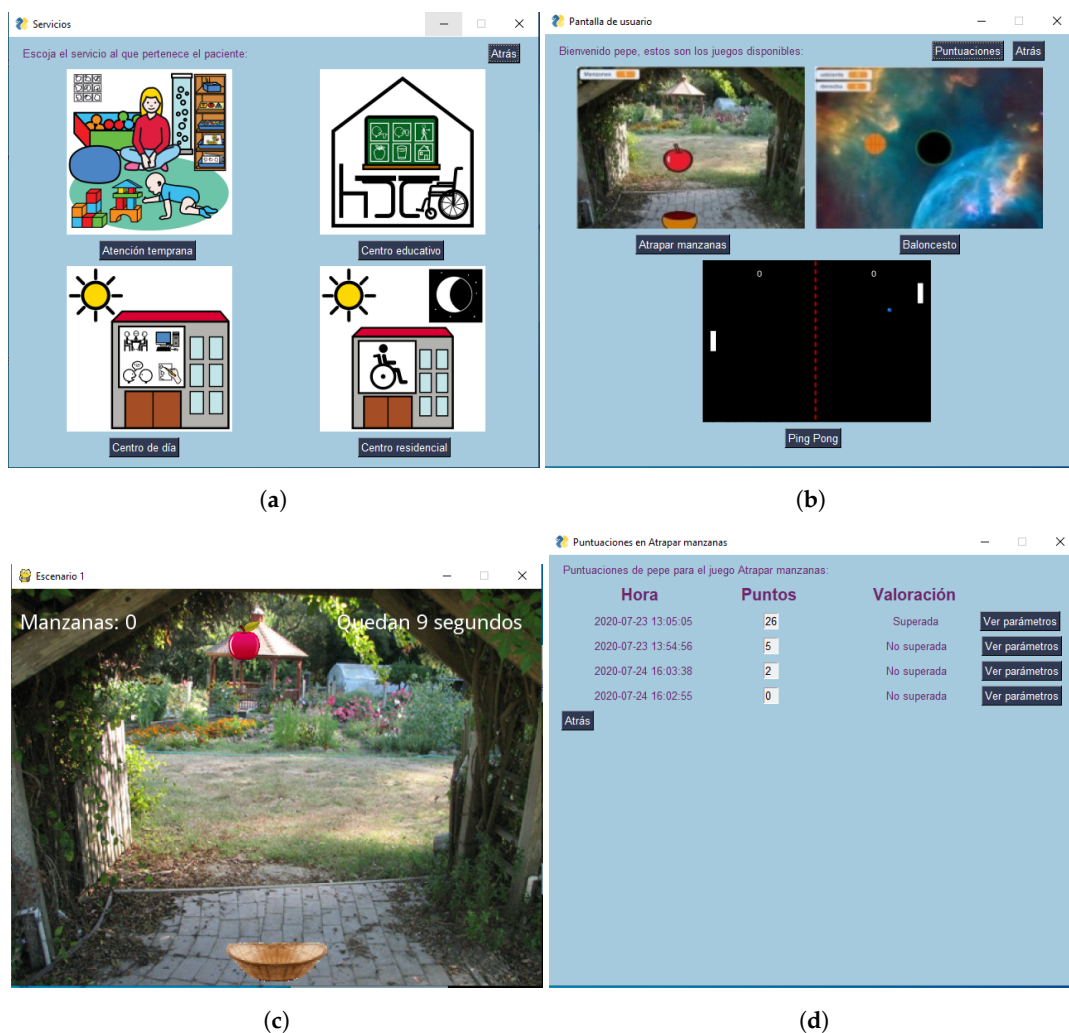
Figure 1. Developed tool: (**a**) Selection of services, (**b**) selection of games, (**c**) example of a game, and (**d**) user's results.

3. Results

With the aim of verifying the usefulness of using the tool with real users, a test was carried out at Aspace in A Coruña. Aspace's mission is to improve the quality of life of people with cerebral palsy and other related disabilities by defending their rights and supporting families, services to associated entities, and institutional cooperation.

Prior to the session, the therapist familiarizes the users with the service. First, the therapist chose the service, the user for this service, and the game with the default parameters. Table 1 resumes the results obtained during the intervention with two users. As can be seen, the parameters have been adjusted during the session. After finishing the session, both the users and the therapists shown their satisfaction with the use of the tool. Therapists highlight the ease of setting up game parameters and keeping track of user results.

Table 1. Resume from the sessions with users.

User	Games	Micro:bit	Parameters	Rating	User Comments
User 1	Bank to collect apples.	In a cap	Sensibility: 3; Time: 30 s; Speed (apple): 3; Speed (bowl): 3	6	Too fast; I need more time
User 1	Bank to collect apples.	In a cap	Sensibility: 3; Time: 60 s; Speed (apple): 2; Speed (bowl): 2	8	I like it
User 1	Put balls in a hole.	In a cap	Sensibility: 3; Time: 60 s; Speed (ball): 2	1	Too fast
User 1	Put balls in a hole.	In a cap	Sensibility: 1; Time: 60 s; Speed (ball): 2	6	I like it
User 1	Ping-pong	In a cap	Sensibility: 3; Time: 60 s; Speed (bar): 1	6	I can't see the bar
User 2	Bank to collect apples.	In a swing table	Sensibility: 2; Time: 60 s; Speed (apple): 1; Speed (bowl): 1	4	I like it
User 2	Bank to collect apples.	In a cap	Sensibility: 2; Time: 60 s; Speed (apple): 1; Speed (bowl): 1	8	I like it

4. Discussion and Conclusions

The development of this project has allowed creating a useful tool for the therapy of people with cerebral palsy. The use of Python has allowed the development of a single environment for the control of games using micro:bit and for monitoring therapies. Carrying out some tests with the users has made it possible to refine some important aspects for their future use by the Aspace entity.

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