GoGoBoard and Logo programming for helping people with disabilities

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Abstract

This paper describes a project that uses constructionist technologies to improve the quality of life of people with disabilities. Specifically, the project involves Logo programming as well as the assembly and utilization of the so-called GoGoBoard.

The GoGoBoard is used in our project as the heart of an intelligent bedroom. In this room, a person with physical disabilities can control various things such as opening/closing the door, turning on/off the lights, or turning on/off the air conditioning. In addition, the disabled person can also request the assistance of another person for various tasks.

Keywords

GoGoboard, Logo programming language, constructionist technologies, cerebral palsy

1. Introduction

Information and communication technologies (ICT) have brought many benefits to our society. During many years, however, these technologies were not used effectively in learning environments, either because teachers didn't have the necessary skills to work with these technologies or because computer equipment, both hardware and software, were too expensive. Fortunately, this situation appears to be changing. Young teachers are coming out of college with more technical training than before. In addition, computer equipment is becoming less and less expensive.

Nowadays, educational institutions can offer a rich technological environment using standard computers as well as relatively inexpensive devices. An example of these devices is the LEGO Mindstorms RCX (Resnick et al.) or the Handy Cricket. These commercial products were invented to offer new tools for permitting a constructionist learning environment as advocated by Seymour Papert's theories (Papert, 1993; Papert, 1996).

During the last few years, a non-commercial version of a product similar to the LEGO Mindstorms RCX or Handy Cricket, has been designed by Arnan Sipitakiat (Sipitakiat, 2001) at the MIT Media Lab. This non-commercial version, the so-called *GoGoboard* (Sipitakiat et al., 2002; Sipitakiat et al., 2004), is a small electronical device that can have sensors and actuators attached it. The primary goal of Sipitakiat was to make this type of technology available in learning environments worldwide, even in schools without good financial resources. Although the commercial products can be considered relatively inexpensive in places such as North America and Western Europe, the same thing is not true for habitants of

other parts of the world, such as Asia, South America, or Africa. By developing the GoGoBoard, Sipitakiat showed that it is possible to build an electronic device similar to the Handy Cricket, but with a much lower cost.

Constructionist technologies such as the Logo programming language and the GoGoboard, can lead our society toward a new educational system, but these technologies can also change our society on others sectors. In this paper, we show that the constructionist approach can improve the daily life of disable people in learning environments and even in their integration in society. A new set of simple tools, for helping people with disabilities, can emerge from small school projects where we (our society) can take advantage from the children's imagination. Children are not afraid of doing mistakes (Papert, 1993; Papert, 1996), and because of that, they can usually solve apparently unsolved problems with creative solutions.

We are not saying that adults have no creativity. We are just saying that children are not so limited by the traditional school mindset rules, or by the fear that their ideas might seem completely crazy or unrealistic.

In the remaining of this paper, we describe an undergraduate degree project conducted by two students at the University of Algarve. The main motivation of the project was to develop and explore constructionist technologies for helping people with disabilities (specifically, people with cerebral palsy). It is important to mention that the two students had no previous experience electronics.

In the next section, we describe the steps that we performed in order to build a replica of the GoGoboard at our university, and we also describe an application that was implemented in Logo to interact with the board.

2. Using the GoGoboard with people with disabilities

The idea to construct a replica of the GoGoboard came to our minds when two of the authors of this paper attended the GoGoBoard workshop held at the EuroLogo Conference in 2003. During the workshop, we realized that devices such as the GoGoBoard could be utilized for helping people with cerebral palsy.

A couple of months after the conference, two undergraduate students got very interested in learning about Logo and the GoGoBoard and decided to do their final project degree on the topic. One of the goals of the project was to try to use the GoGoBoard for helping people with disabilities.

2.1. Assembling the GoGoboard

Building the GoGoBoard was not so easy as we thought it would be. Part of the reason was due to the lack of electronic skills, but most important, because we found out that some electronic components didn't exist in electronic shops in Portugal. Fortunately, we overcame this obstacle with the help of Sipitakiat who sent us the missing parts from the United States. Once all the components were available, we started our GoGoBoard construction adventure. Figure 1 depicts a component being soldered.

Figure 1: Assembling the GoGoBoard

Since the students had no soldering experience and were not very familiar with electronics, the two first attempts to construct the GoGoBoard resulted in failure. At the third attempt, the board was successfully assembled and we were able to install the boot loader to the PIC.

When the assembly task was completed another problem came to our minds. The board was too fragile to be used by people with disabilities. As described elsewhere (Condado et al., 2004), the students had a very simple idea. They built a protection from a swabs box (see Figure 2) to protect the most sensible components from possible disasters. Unofficially, and between the elements of our team, that protection is called "turtle carapace".

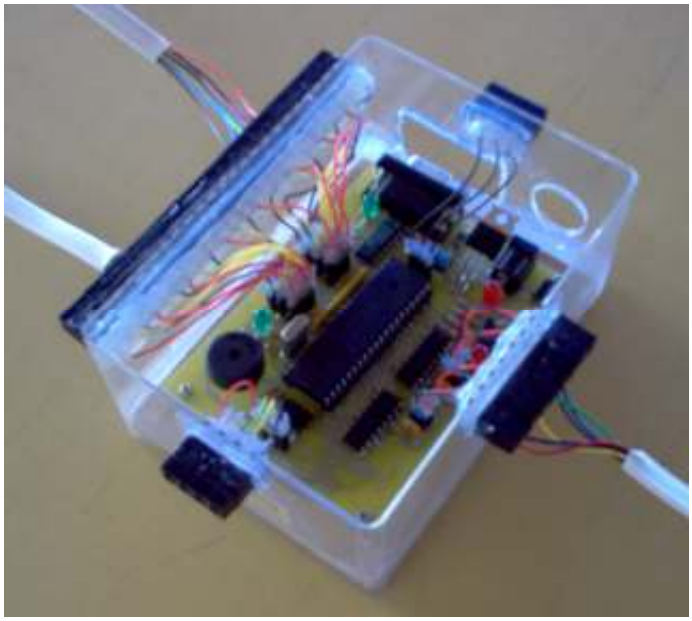

Figure 2: The GoGoboard inside a swabs box with external connectors to the sensors and actuators.

Once the GoGoBoard was well protected, we started writing a computer application to interact with it. The software was written in the Logo programming language, and is described in more detail in the next section.

2.2. ADM: *An application for helping disabled people in the physical world*

We wrote a computer program called "*Auxilio a deficientes motores*" [4] (ADM). The program interacts with the board by communicating with its sensors and actuators, and a disabled person to control a room environment by simply pressing a touch button, choosing the desire

[4] Means "helping people with physical disabilities" in Portuguese

option through a menu scanning system. Using this application, the disabled perseon can control a number of activities that are very common for “normal” people, such as open/close the door, turn on/off the light, turn on/off the air-conditioning, among others things.

Below we show procedures from our program that control the opening/closing of the door of a bedroom.

```
to load
[ ttb setpower 6
  ifelse controlDoor = 0
     [ openDoor ttb Thisway OpenDoor ttb onfor 7]
     [ closeDoor ttb Thatway CloseDoor ttb onfor 4]
]
end;
to OpenDoor
  controlDoor, ct insert 1
  saveproject
end;
```

The above procedure opens the door of a bedroom (or house) when a switch (press sensor) is pressed (see Figure 3). In the following lines we show the procedure to close the door.

```
to CloseDoor
  controlDoor, ct insert 0
  saveproject
end;
```

Our program was tested on a small-scale model of a bedroom (see Figure 4). This model represents a real room of a person with disabilities. In a near future, we would like to test our application on a real bedroom.

Figure 3: The press sensors

Figure 4: A small-scale bedroom model

Our application has a friendly user-interface that even a person with serious physical disabilities can use it. An important feature of this interface is the group scanning system that allows the user to select a desired option faster. The scanning is made group-by-group, where each group has a set of specific functions to interact with the surrounding world. Once a desired group is selected, the scanning is made on its sub-groups until the user selects his/her desired option. This group scanning system is identical to the one that exists in *Toque de voz* [5], another application for disabled people that was developed at our university (Condado et al., 2004; Miquelina et al., 2004). The user can change the scanning speed at the request report screen and configuration panel (see Figure 5), as well he/she can change the icons' size.

In additon to controlling the physical environment, the disabled person can also ask for assistance to a teacher or to a personal assistant. When a given option is selected, an associated sound is played to inform the personal assistant. This feature is particularly useful when a person with disabilities wants to ask for help such as to get dressed, to drink water, to go sleep, to go to the bathroom, or for any other thing. There's no problem if the personal assistant is away and doesn't hear the sound. Whenever a request is made, the application instructs the GoGoBoard to turn on a warning light to inform the assistant that a new demand is pending on the request report panel.

The request report panel (see Figure 5) of our application was created to allow the detection of possible negligence from the personal assistants. It is possible because all requests (with the exact date and time) and the answer to them are logged on the report, and it is possible to check later on how much time the personal assistant took to fulfil the person's request.

[5] Means "voice touch" in Portuguese

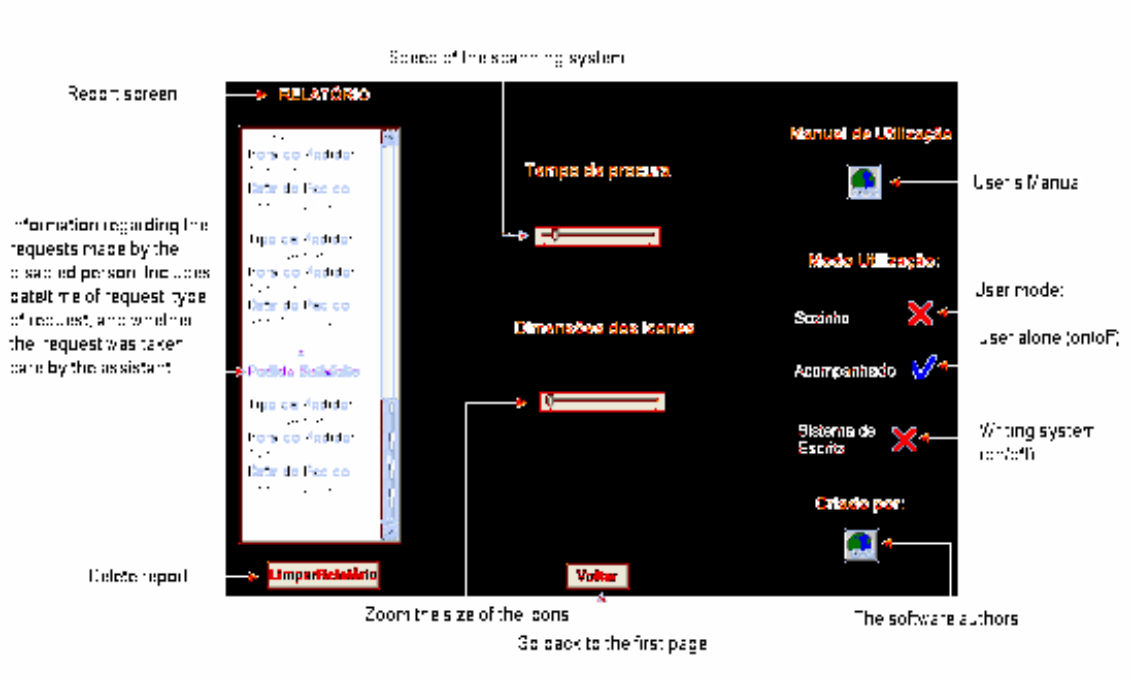

Figure 5: A screenshot of the ADM application: the request report and configuration panel

Another important feature of our application is a phrase generation system that can be used to complement the warning sound system. When it is on, a deaf person can be the user's personal assistant. We consider this a very important feature because another disabled person can help a person with severe physical disabilities.

Our application is designed in a flexible way. The type of requests are not hard-coded and it is easy for the personal assistant (or to anybody else) to easily change the tasks/requests. For instance, if necessary, a new option to ask for a book (or for any other thing) can be added with a few steps as follows:

1. The user/assistant must choose an empty page on the AMD application.
2. Press the "Esc" key.
3. Click on the "*Criar*" [6] button that is located at the top left corner (see Figure 6).
4. Then a new icon is created and a warning to save an associated sound is generated automatically.
5. Save a desire sound using the microphone.
6. Create/Insert an icon image.
7. If necessary create a new option repeating the operation from step 3.
8. When no more new options are needed, the user/assistant must press the switch for the application to return to its normal size.

[6] Means "create" in Portuguese

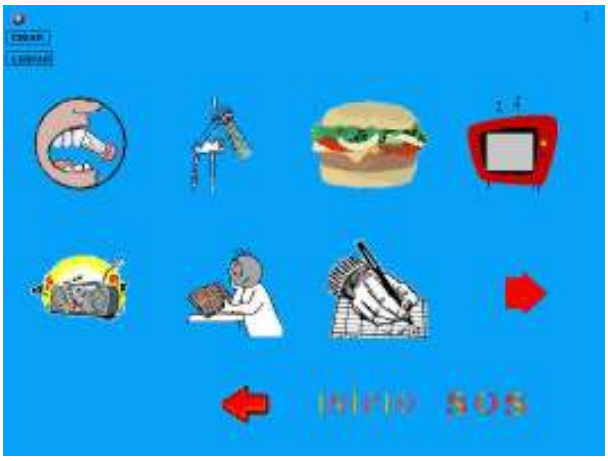

Figure 6: A screenshot of the ADM application: Menu for adding new tasks

The goal of the ADM application is to create a new lifestyle for disable people. It offers them more autonomy and uses simple and low-cost technology. The application and the small-scale model of the house was shown in a science and technology exposition that was held in 2004 in Loulé, south of Portugal. During the exposition, the general public had the opportunity to interact with it. The project was considered a success and a small demo was broadcasted on a major Portuguese TV channed news as well as on a regional radio station.

Cerebral palsy has been seen with misconception during centuries, and our society have had many wrong ideas regarding people with this problem. However, our society today is more informed about cerebral palsy, and some people with cerebral palsy are doing their normal lives (Condado et al., 2003) like any other person.

3. Summary and conclusions

This paper shows that constructionist technologies can be used for helping people with disabilities. These technologies can be more that simple educational tools, because they have the potential to change the life of disable people, not only at schools but mainly in society. We believe that “normal” and “disabled” children could make small projects at schools to help disable people. The AMD application was just a first step towards a more extensive work that we plan to do.

We are about to start a Logo/Lego laboratory at the University of Algarve to do research for helping people with disabilities. We will promote the interchange of ideas between “normal” and ”disabled” kids, undergraduate degree students, and anyone who wants to do voluntary work on this area. We believe it will promote an alternative environmont which will be suited for doing creative work.

4. Acknowledgments

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