A Device For Electromechanical Braille Reading Digital Texts

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***Abstract*— The social and professional inclusion of people with visual impairment is currently being sought enough. With accessibility is possible to integrate these people in order to provide equal conditions to them and thus make them an active part of society. Based in this theme, this paper proposes a prototype of an eletromechanical braille cell, which, with the use of an Arduino board, servomotors and software responsible for handling data, it is possible to represent in Braille information collected in the System Management Information Transit accessibility to Visually Impaired - TRANSITUS -V, making it behave like a human-machine interface for reading digital texts in braille.**

Keywords—accessibility; braille; technology; arduino; servomotors.

I. INTRODUCTION

In accordance with World Health Organization (WHO), there are approximately 160 million visually impaired people around the world, and at least 45 million of these individuals are completely blind [9]. Due to disability, these people have limited their basic rights as citizens. The situation is aggravated in digital media, where most of the visually impaired do not have access to special devices, or even help from trained professionals to help them in the usage of computers and other electronic equipments. Without the necessary resources, the person with a disability do not have the opportunity to fully utilize the phenomena that society experiences, such as social networks, in addition to competing at a major disadvantage to the jobs available that use of such technologies.

Organizations, states and society have turned their focus in ways to enable social and professional inclusion of people with visual impairment. Several devices have been and are being developed to allow the interaction of blind people with the computer. There are many prototypes in the literature with different proposals for cheapening and popularizing assistive technologies to blind people [1][5][7].

Grounded in this theme of accessibility and social inclusion of visually impaired, was designed a prototype that focuses primarily on the creation of a electromechanical Braille cell and implementation of a system composed of hardware and software that has the ability to interact with people totally blind, displaying in Braille informations obtained in TRANSITUS - V (Management of Information Transit Accessibility for the Visually Impaired), which has encouraged the development of new methodologies for the implementation of accessibility. This is an innovation if compared with other prototypes, once besides enabling the blind interaction with digital media, also enables their integration into the labor market and create conditions that these people become an active part of society.

Section II will describe the two main technologies involved in this project: Arduino and Transitus-V. Section III is a brief account of the Braille system and the use of servomotors in the construction of the prototype. In Section IV, the construction of the prototype is shown. In Section V the integration with Transitus-V is presented. Finally, Section VI provides a brief discussion about the obtained results.

II. ARDUINO PLATAFORM AND SYSTEM TRANSITUS-V

For being accessible, low cost and comprising hardware and software, the Arduino platform was used to preparation of this project due to its versatility and open source, ie it possible to reuse the hardware and the software libraries freely accordingly to the developer's needs. Also, Arduino allows rapid prototyping of projects, which simplifies the manufacturing process by reducing the complexities inherent to the programming of the microcontroller and electronics prototyping.

The Arduino is already being widely used for the development of many projects focused on themes of social inclusion, which has encouraged the development of new methodologies for the implementation of accessibility. The TRANSITUS-V is a computer system with digital assistive technology that manages traffic information, developed in accordance with the W3C accessibility guidelines to facilitate the use and management of transit through people with visual impairments, with the use of shortcut keys, as well as special support for screen readers and voice synthesizers that increase the possibilities for use by persons with disabilities.

The system TRANSITUS-V, for having been done on a Web platform, requires no installation on the machines of those who use, each machine should only have access to the internet, and it's compatible with most web browsers available in the market. However, the TRANSITUS-V needs to be hosted on a server that supports PHP and the MySQL database [6].

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III. BRAILLE SYSTEM AND SERVOMOTORS

The Braille system of reading and writing for the blind, was invented by Frenchman Louis Braille, influenced the society in the processes that led to the inclusion of these individuals. The Braille for its simplicity of reading and writing, was the bridge created between the blind and literature. Given the ease of use, the production of Braille content was encouraged, well as your teaching, spreading the method for worldwide.

With technological advancements, the Braille has been integrated into electronic devices allowing the interaction of the visually impaired with computers, text editors, internet, digital books, among other services. The example used in this project and has the servomotors, which are electromechanical devices that perform movements, in relation to its axis, in accordance with commands (control signals) determined. The device was a solution adopted for the project and is responsible for moving pins that make up a cell. Besides showing a cheap and easy to implement, since it easy to handle and has a library of software written specifically for use in conjunction with the the Arduino platform.

IV. OBJECTIVE AND CASE STUDY

Through past difficulties for the visually impaired, the main objective of this work is the implementation and deployment of a system composed of hardware and software that displays Braille information extracted from a digital medium. The creation of the Braille cell electromechanical system adds the ability to interact with people who are totally blind, which is possible only through the web interface.

The prototype consists of parts of hardware and software to work together in translation and display of information acquired in TRANSITUS-V. The hardware part is formed by a plate Arduino BT, six servomotors, a button and secondary electronic parts, such as resistors and wires. Together, the six servomotors represent one braille character, the user can read a character string by advancing the read pointer by means of the button, as seen in Figure 1.

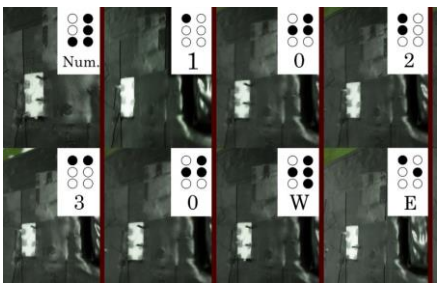

Figure 1. Braille representation of the data in the prototype

Each servo motor is responsible for moving one of the six pins that make up a braille cell. The position of the mechanical arm of each servomotor is determined by the micro controller to which it is connected, controlled angle values ranging between 0 º and 179 º. The characteristics of each servomotor Mystery Mini are shown in Table 1.

TABLE I. CHARACTERISTICS OF THE SERVOMOTOR MINI MYSTERY

Characteristics	Values
Quickness	60º at 0.12 seconds
Torque	0.7kg
Voltage	4.5v – 6v
Dimensions	1.98cm x 1.93cm x 8.4cm

Each servomotor has three wires: first, generally black or dark brown, which is the negative land should be connected to the circuit, the second, usually red, is positive, the third generally yellow in color, is attached to a PWM (Pulse Widht Modulation) port of the Arduino.

The hardware model of the Arduino platform used in the paper was the Arduino BT, chosen for having an integrated Bluetooth module to your hardware, which facilitates implementation. Another advantage of the model is to have six PWM digital ports, which allows the use of six servomotors, suitably representing a braille character. The features of the Arduino BT, is identical to the model Arduino UNO, with the exception of having an integrated Bluetooth module. The Arduino BT used has digital PWM ports 3, 5, 6, 9, 10 and 11 [8], and these ports are connected to the six servomotors.

Although the hardware platform Arduino usually have a power outlet dedicated to connecting other devices, a source of external power supply was used for the consumption of the servomotors, given its energy needs to be higher than what is offered at the output of the Arduino board. The diagram in Figure 2 describes the connection between the servo, Arduino BT and external power source.

To accommodate the servo motors and the Arduino board, a small box was built. In its lid six small holes, so that the servomotors to move small iron rods coupled to the blades make its surface appear in a character in Braille. The button used to move the cursor reading is powered by a 5V voltage obtained at one of the power ports Arduino board. The time between pressing the button and changing the character is about 0.1 seconds, according to the specifications of the servomotors seen in Table 1, making it very agile character exchange and enabling quick reading of the text displayed in the prototype.

The software part of the prototype is composed of the sketch that will run on the Arduino board, as well as a middleware responsible for brokering the acquisition of information. This middleware acquires the information from the database TRANSITUS-V and translates it into Braille to, finally, send them to skecth in the Arduino BT board. The sketch function is to coordinate the motion of the servomotors in accordance with the received information so that each character is represented correctly.

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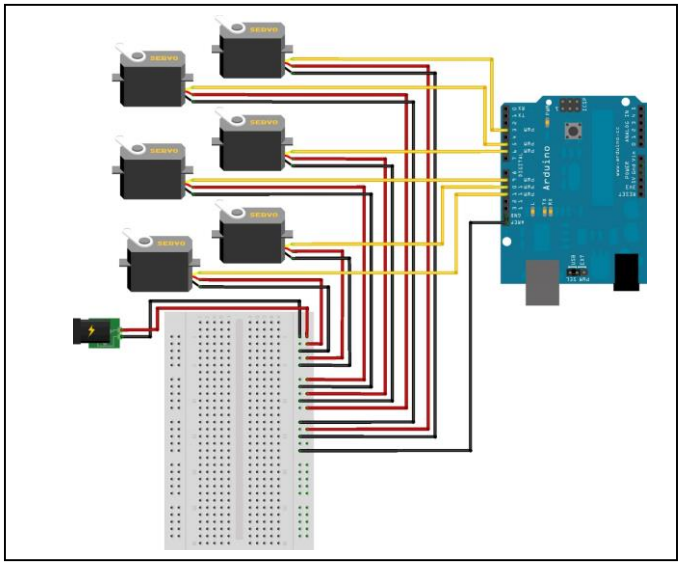

Figure 2. Diagram of connection between the servo and Arduino.

We opted for an application that communicates directly with the database because it simplifies its use by blind people. Even if the prototype can be adapted for use through the site, there are several steps prior to use which would be compromised. For example, it would be necessary that the blind user initiate the program from accessing internet browsing and the administrative area for, only then, have access to the information TRANSITUS-V. Direct access to the database reduces the steps required to use and consequently reduces the barriers that hinder the use of the system. So, all information is obtained by SQL queries.

After acquiring the specific data in TRANSITUS-V, the middleware sends character by character to the the Arduino board, previously converted to Braille system, and according to user demand. At first, only the first character is sent and immediately represented in the prototype. The user has the task of requesting the following characters one at a time, to middleware by pressing the button. Pressing the button causes the Arduino board send a request to the middleware, which is done by sending the phrase “new” to the middleware. Upon receiving the request, the middleware sends the next character to the plate, and so on until they enclose the characters representative of the data obtained. Figure 3 describes how is this communication performed.

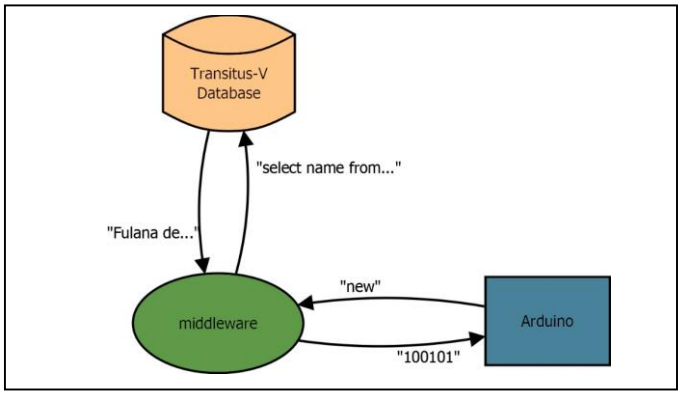

Figure 3. Diagram showing the exchange of messages between the Arduino, middleware and Database TRANSITUS-V.

V. USABILITY AND PRACTICE

Figure 4 shows the names of customers registered in the system viewable on the web, with one highlighted in blue. The information is represented on the prototype, as seen in Figure 5. It is observed that the prototype represented correctly the desired information.

Figure 4. Information obtained by persons web interface Transitus-V.

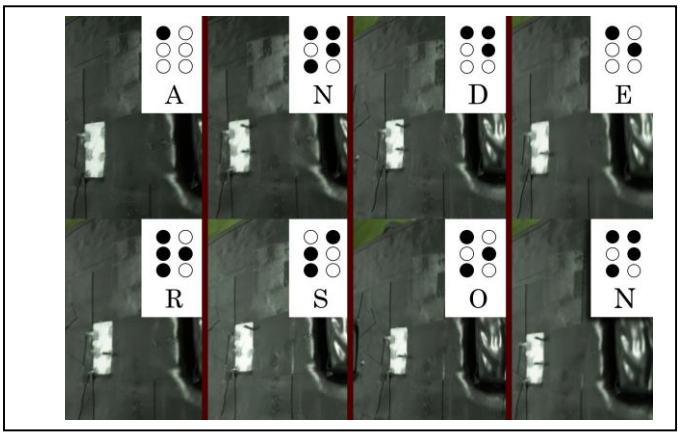

Figure 5. Braille representation of the data in Figure 4 prototype.

This work contributes not only with the realization of accessibility, but with the inclusion of visually impaired since the use of the prototype also allows the inclusion of these people in the labor market.

VI. FINAL CONSIDERATIONS

The prototype represented correctly in Braille information obtained in Transitus-V system. Further information can be obtained by simply writing functions and SQL queries to access them. However, the prototype does not have a navigation menu for the functions to access information, which is a barrier created by the low capacity of the displayed text. Because you can only represent one character at a time, creating a navigation menu is infeasible.

One difficulty encountered during the development of the prototype is that, given the angular movement of the blades

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of the servomotors, the pins do not rise or debase totally straight, which makes difficult the construction of smaller prototypes. Reducing the size of the blades was required.

This work is the result of a research project called Management of traffic information for the visually impaired, developed by the Software Engineering Group of the University of Rio Grande do Norte, which, since 2010, develops the web system TRANSITUS-V.

For future work, flip-flops can be used to build the braille cells, as seen in [1], giving to the system the capacity of representate a large number of characters. It is also suggested to create a shield for the Arduino platform representing Braille characters. This shield could pave the way for a family of accessibility projects, making it easier for the visually impaired and driving new research.

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