World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:7, No:8, 2013

The Electronic and Computer-Aided Periodic Table Prepared for the Visually Impaired Individuals

Ayşe Eldem, Fatih Başçiftçi

Open Science Index, Electronics and Communication Engineering Vol:7, No:8, 2013 publications.waset.org/16908/pdf

***Abstract*—**Visually impaired individuals cannot lead their lives as comfortable as others. Therefore, new applications are being developed every passing day in order to make their lives easier. In this study, an electronic and computer-aided audio device was developed with the aim of making the learning of the periodic table easier for the visually impaired. In this device, a board includes buttons for each element of the periodic table. After pressing a button, the visually impaired individual not only hears the name of the element but also feels with his/her hands where that specific element is located.

***Keywords*—**Periodic Table, PIC16F877, Serial port, Visually Impaired Individual.

I. Introduction

BLIND person as a special group in society is in need of more care and attention from the public [1]. Special care and rehabilitation centers make life easier for visually impaired people. Besides, inclusion trainings enable them to participate more actively in the social life.

While visual impairment is congenital for most, some people become visually impaired later in life. Every individual makes use of various instruments in order to succeed in life. Braille alphabet is the most important instrument used by the visually impaired. Louis Braille is the inventor of the reading system by touch that bears his name [2]. Braille is a tactile system that contains several dots which enables blind and partially sighted people to read and write through touch instead of vision [3]. The visually impaired people depend on the tactile sensation as an important mode of communication and perception, a substitute for the eyes and ears [4]. Along with several environmental arrangements, this alphabet enables them to live more comfortably. For example, explanatory statements may be written in Braille on things in a home environment such as music CDs or cruets, buttons of elevators may be coded in Braille, and so forth. So far, numerous software and devices have been developed specifically for the use of the visually impaired such as blood pressure monitors, talking tape measure, talking color identifier, talking kitchen scale, talking precision scale, talking watch, talking blood glucose meter, voice recording devices, Braille printers, monitors, book readers, white cane with sensors, screen reading programs, and so forth [5]-[10].

In this study, a computer-aided talking electronic device was designed and developed with the aim of making it easier for the visually impaired to learn the periodic table. With this device, the visually impaired individual can both sense the table with his hands and hears the name of the element by pressing the buttons on the board. Besides, the individual can also read the names of the elements as they are coded in Braille right above the buttons.

Ayşe Eldem is with Karamanoğlu Mehmetbey University, Karaman, Turkey (e-mail: ayseeldem@kmu.edu.tr).

Fatih Başçiftçi is with Selcuk University, Department of Electronics and Computer Education, Konya, Turkey (e-mail: basciftci@selcuk.edu.tr.).

II. Material and Method

The microchip PIC16F877 was used in order to be able to program the circuit and routes for the electronic and computer-aided periodic table. The communication between PIC16F877 and the computer was organized through a serial port.

The RC6 (Transmit) pin of PIC16F877 was employed for the transmission of required data from the microchip PIC16F877 to the serial port after one of the buttons is pressed. The RC6 (Transmit) pin of PIC16F877 was connected to the RXD (Receive) pin of the serial port in order to transmit data to the serial port; and the TXD pin of the serial port was used to send data from the serial port to the computer. Fig. 1 shows a sample electronic circuit design that shows the communication between the microchip PIC16F877, serial port and PC.

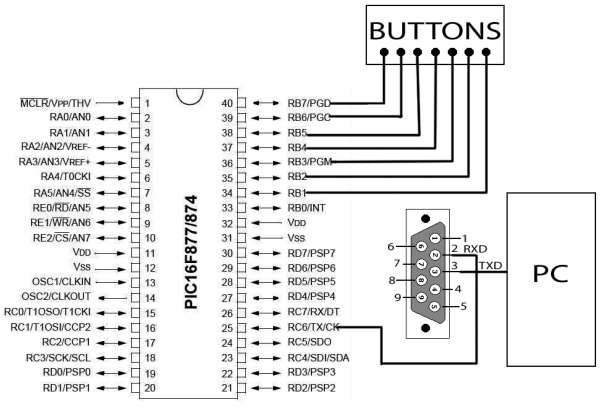


Fig. 1 Electronic Circuit Design

A. PIC16F877

The microchip through which data is exchanged is the PIC16F877 produced by the Microchip firm [11]. It is an 8-bit reduced instruction set computer (RISC) micro-controller and has only a set of 35 basic instructions, including bit-wise sum and conditional and unconditional branch operations [12]. PIC16F877 involves CPU, RAM and input/output units. It has several advantages such as flexibility for implementation, low

Open Science Index, Electronics and Communication Engineering Vol:7, No:8, 2013 publications.waset.org/16908/pdf

cost, low power consumption, high speed, small size and high functionality solutions [13]. CCS Compiler was employed to program PIC. After compilation, hex file was produced and uploaded to PIC.

B. Serial Port

Serial port is used for bidirectional data transmission. In serial communication, data packages are marked with start and stop bits and transmitted through sequential signals. In our device, RS232 DB-9 was used in order to ensure serial communication with the computer. Data is received through the RXD pin and sent through the TXD pin.

C. Periodic Table

Periodic table organizes chemical elements according to a specific order. Depending on the electron distribution of elements, the table consists of four blocks. While horizontal columns are called periods, vertical ones are called groups. It consists of seven periods and 16 groups (8A and 8B).

III. Application

In this application, an electronic and computer-aided talking periodic table was developed for the use of the visually impaired. The periodic table was put on a board, which includes buttons for each of the chemical elements. The visually impaired individual finds the places of elements using his hands and hears the names of them by pressing buttons. Besides, he can read the names of the chemical elements as they are written in Braille right above their respective buttons. The system is demonstrated in Fig. 2.

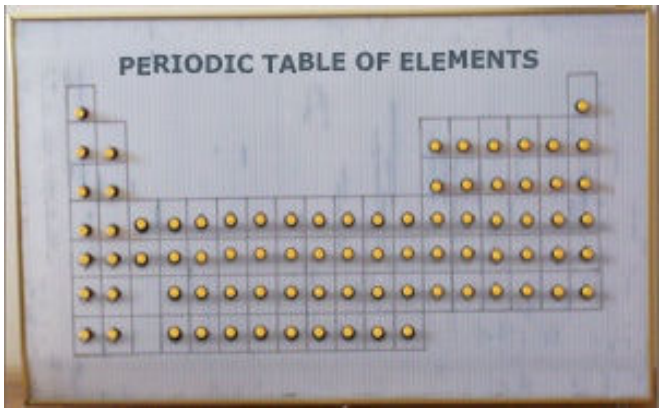


Fig. 2 The Electronic Periodic Table System

PIC16F877 was employed in order to program the hardware part, that is, to ensure the transmission of data coming from buttons to the PC. For example, when the button specified for Hydrogen is pressed, PIC16F877 ensures the transmission of the relevant code to the PC through the serial port. Then, the process is finalized as the relevant sound file is played in the PC. These sound files have *.wma extensions. The connection between PIC16F877, serial port and PC is shown in Fig. 3.

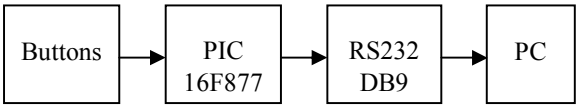


Fig. 3 Connection Schema of the Electronic Periodic Table

The flow diagram of the algorithm produced on PIC and PC is presented in Figs. 4 (a) and 4 (b).

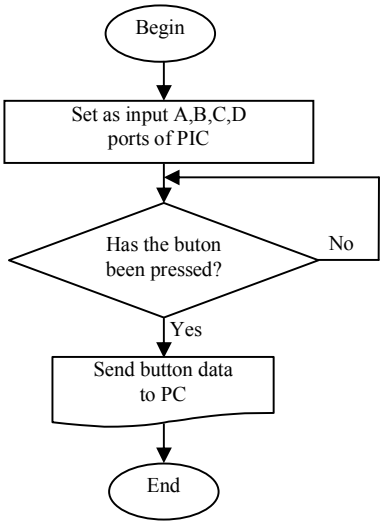


Fig. 4 (a) PIC-PC communication

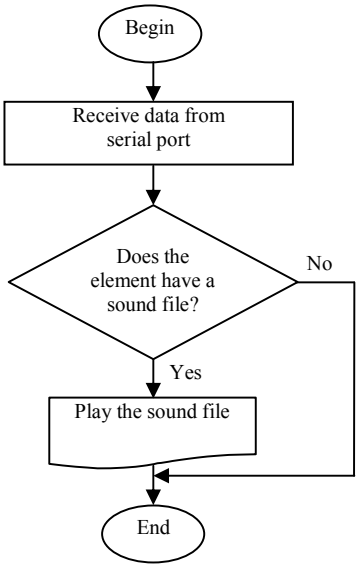


Fig. 4 (b) Playing sound file on PC

The pseudocodes required for the PIC-PC communication and playing sound file on PC are presented below.

```
procedurePIC_PC_communication
Begin
   Set as input A,B,C,D ports of PIC
X: if (has button been pressed)
     Send relevant button data to PC
   Else
```

```
     Go X
End

procedureCall_PC_sound_file
Begin
   Receive data from serial port
   If (has data been received)
begin
     If (does element have sound file)
        Play sound file
end
End
```

Fig. 5 partially shows the circuit where the communication between buttons, PIC16F877 and the serial port is carried out and button control is made. In this circuit, only a portion of the period table that contains Alkali Metals (Li, Na, K, Rb, Cs, Fr), Nonmetals (C, N, O, F, P, S, CI, Se, Br, I, At) and Noble Gases (He, Ne, Ar, Kr, Xe, Rn) is shown.

IV. Conclusion

An electronic and computer-aided system was produced in order to facilitate the learning of the periodic table for the visually impaired. This system vocally teaches the periodic table to the visually impaired user. He can sense the place of the chemical elements on the table using the buttons and hear the names of them by pressing the buttons. In the system, PIC16F877 was employed in order to perceive which button is pressed. In the program written for PIC16F877, a code is assigned to each button. These codes are transmitted to PC through the serial port, and relevant sound files are called on the PC through the software. It was observed in the practice with visually impaired students that the device produces positive results.

The system was tested with four visually impaired students. Table I demonstrates in detail the results of these tests. It indicates that the electronic and computer-aided periodic table makes the learning of the table easier for students.

TABLE I
Durations of Learning the Periodic Table

Students	Ordinary Learning	Learning through the System
Student 1	3 hours	1 hour
Student 2	5 hours	3 hours
Student 3	2 hours	1 hour
Student 4	6 hours	2 hours

Acknowledgment

This work is supported by Selçuk and Karamanoğlu Mehmet Bey Universities Scientific Research Projects Coordinatorships, Konya, Karaman, Turkey.

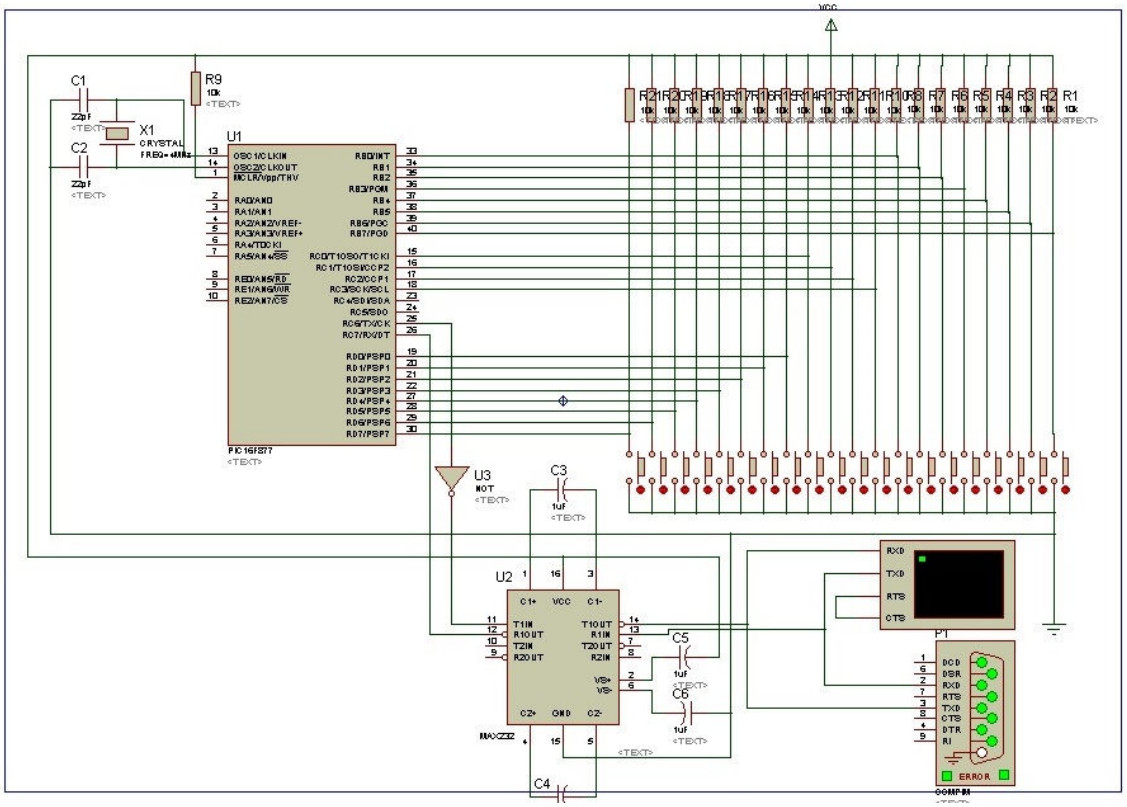


Fig. 5 Circuit Design of the Electronic Periodic Table

Open Science Index, Electronics and Communication Engineering Vol:7, No:8, 2013 publications.waset.org/16908/pdf

Open Science Index, Electronics and Communication Engineering Vol:7, No:8, 2013 publications.waset.org/16908/pdf

REFERENCES

[1] Yin J.,Wang L. And Li J., The Research on Paper-mediated Braille Automatic Recognition Method, 2010 Fifth International Conference on Frontier of Computer Science and Technology (IEEE)

[2] Javier Jime´nez, MD, Jesu´ s Olea, MD, Jesu´ s Torres, MD, Inmaculada Alonso, MD, Dirk Harder, MD, and Konstanze Fischer, MD, Biography of Louis Braille and Invention of the Braille Alphabet, SURVEY OF OPHTHALMOLOGY Vol. 54(1), 2009

[3] Mad Saad S., Md Zain M. Z., Hussein M., Yaacob M. S., Musa A. R. & Abdullah M. Y., *A System Architecture of Electronic Braille Panel forReciting Al-Quran*, Second International Conference on Computational Intelligence, Modelling and Simulation, pp:427-430, 2010

[4] Kwon H., Lee S. & Lee S. S., Braille dot display module with a PDMS membrane driven by a thermo pneumatic actuator, Sensors and Actuators A 154, 2009, 238–246

[5] Beyid, http://www.beyid.com.tr, Access Date: 01.01.2013

[6] Braille Teknik Ltd. Şti., http://www.brailleteknik.com, Access Date:15.12.2012

[7] Cobolt Systems Ltd., http://www.cobolt.co.uk, Access Date:22.11.2012

[8] American Printing House forthe Blind, http://www.aph.org, Access Date:25.11.2012

[9] Freedom Scientific, http://www.freedomscientific.com, Access Date: 20.12.2012

[10] Techo-VisionSystems, http://www.techno-vision.co.uk, Access Date: 10.12.2012

[11] Microchip, ww1.microchip.com/downloads/en/devicedoc/30292c.pdf, Access Date: 05.01.2013

[12] Asadpour M. &Siegwart R., 2004, Compact Q-learning optimized for micro-robots with processing and memory constraints Robotics and Autonomous Systems (48), pp:49–61

[13] Xie F., Xiong C. and Hu J., A Wireless Data Collection System Using PIC16F877 and GPRS, 2012 International Conference on Computer Science and Electronics Engineering, Vol 2, pp: 437– 439.