RESEARCH ARTICLE OPEN ACCESS

The Design and Implementation of a Vest Made For Visually Handicapped Which Recognizes the Obstacles and Determines the Direction

Rüştü Güntürkün*, Hasbi Apaydın**, Şükrü Kitiş***, Veysel Göğebakan****
*Department of Electric Electronic Engineering, Dumlupınar University Kütahya/Turkey
**Simav Vocational High School, Dumlupınar University Kütahya/Turkey
***Simav Vocational High School, Dumlupınar University Kütahya/Turkey
**** Department of Electric Electronic Engineering, İnönü University Malatya/Turkey

ABSTRACT
In this study, the design and implementation of a system was carried out with sensors placed on a vest in order to ensure the visually impaired people to perform their actions without depending on someone else and to improve their quality of life. In this system, 4 pieces of sensors placed on the vest's front, ground and right-left arms warn the impaired person when less than 150 cm distance remains between the visually impaired and the obstacle. The microprocessor sends signal to the vibration motor which is placed in the direction where the obstacle is situated. With the decrease of the distance the vibration increases so that the person can understand how far and in which direction the obstacle is. For the purpose of not disturbing the other people, instead of audible warning, a new warning system was used with the help of the vibration motors which can be noticed only by the impaired person.
Keywords **-** Visually Impaired, Vest, Obstacle Detection, Direction Detection, Microprocessor

I. INTRODUCTION

Palestinian students attending the Polytechnic University in Hebron developed a technology called " Smart Assist System for Blind people (SASB). This smart vest which detected the obstacles by using a new floor sensor provided trouble-free walking by informing the user with vibration and voice commands [9],[10]. A company called Tactile Navigation Tool developed a vest called Eyeronman which was able to detect the surrounding objects and people and informed the person who was wearing it. This vibrating vest which is currently at the prototype stage can combine the sensors and the vibration devices into a single piece. Eyeronman was not designed only for the visually impaired persons. At the same time it can be used by the law officers, rescue teams working in visually hidden environment and by others too. When the sensors detect an object, the signals are converted into vibrations corresponding to the vest. For example, when the jacket felt a dog at the bottom left side, the bottom left side started to vibrate. For example, when the dog began to run towards the person the vest started to vibrate more intensively. The device was designed in a simple way, however it needs to be trained to interpret the vibration of the brain [11],[12].

The special helmets which have been developed within the scope of the project called " Not quitting without a hat" conducted by the inventor students of Bursa Ovaakça Şarık Tara Industrial Vocational High School. In this project, 3 ultrasonic sensors and a headphone were placed onto a helmet. This helmet warns the user through the headset by detecting the objects and dangers situated within 50 cm and 6 and a half meter. When the impaired person comes to a place with dangers such as pits or trees then the headphones warns with the command stop. Additionally, in the evening the impaired person can be easily recognized by the others due to the lights placed on the top of the helmet [13].

II. EXPERIMENTAL METHODS

2.1. Statistics

According to the news bulletin "World Population Day 2015" released by the Turkey Statistical Institution it was announced that in Turkey there were 4 million 882 thousand 841people living with difficulties at least in one of the body functions. Accordingly, based on the results of the 2011 Population and Housing Survey, 6.6 % of the population had difficulties or was not able to do the one of the following functions; seeing, hearing, speaking, walking, climbing STAIRS, CARRYING OR Holding Things, Learning According To Their Peers, Doing Simple Arithmetic Operations, Remembering And Focusing Attention. 42.8 % Of The People Who Were Stated To Have Difficulties At Least In One Of The Functions Were Men And 57.2 % Were Women [4].

2.2. Working Principle

This system was designed to relieve the visually impaired people from using walking stick and to help them to do their daily routine without depending on the help of the others. The operation of the system is based on activating the vibration motor by converting the analogue information received from the sensors to digital information with the help of 16F877 microcontroller. The system which was designed and implemented by us sends information to the vibration motors through PIC depending on the distance of the four sensors installed on a vest to different areas expressed as right, left, front and ground. When the distance between the front sensor and the object remains less than 150 cm the front engine starts to give vibration signals. The sensor facing the ground starts to vibrate when the distance between the sensor and the obstacles is 40 cm, while the sensors on the left and right side start to give vibration signals when the distance between them and the object is 80 cm. (Figure 1)

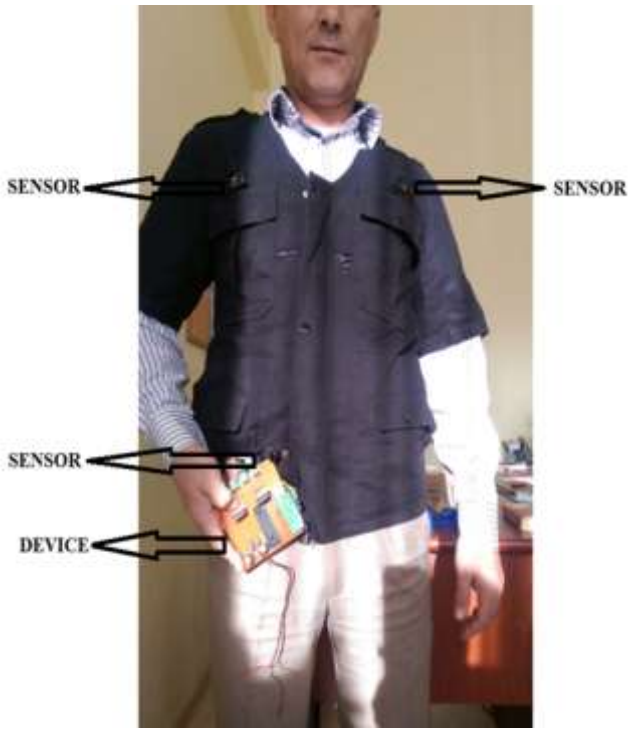

Fig 1. The designed system and the sensors'positions

2.3. Sensors

During the design of this system the Sharp GP2Y0A2YK0F sensors were used as distance sensor. These sensors were created by the integration of the following three structures together: photon sensitive PSD (position sensitive detector), IRED (infrared emitting diode) and CPU (signal processing circuit).

The basic operating principle of the Sharp sensor is to send infrared light (pulse). The light moves forward from the point of the sensor's view. If there is no object in front of the sensor the light does not return to the sensor and the sensor detects its front as empty. However, if there is an object in front of it, the reflected light is detected by the sensor. The starting point of the light from the sensor, the reflection point and the point detected by the sensor creates a triangle. As shown in Figure 2, the angles vary according to the distance from the object. The sensors can detect this angle so they can detect the distance too (Figure 3).

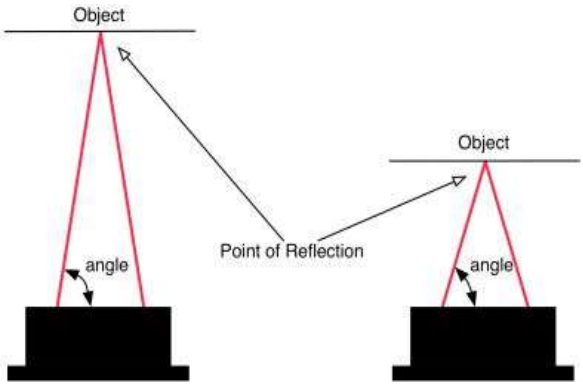

Fig 2. The triangle of the sensor's viewing angle[7].

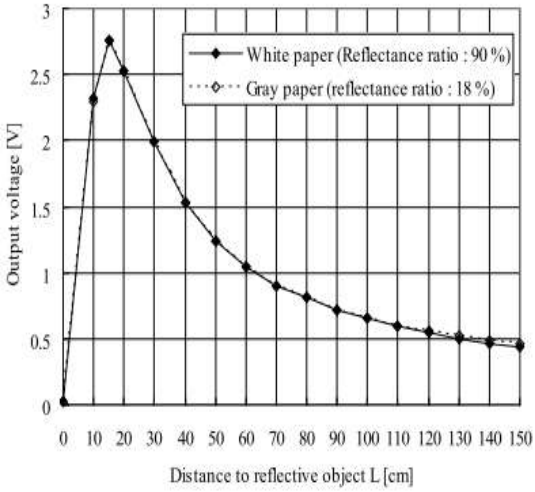

Fig 3. The output voltage depending on the distance [7].

2.4. Vibration Engine

The Polo brand button-type vibration motor which was used in the design vibrated with 0,75 vibration amplitude and when 3V was applied it had 60 mA current. It was a shaft less engine with a diameter of 10 mm and a height of 2.0 mm. (Figure 4)

Fig 4. Vibration motors

2.5. Driver Circuit

The current obtained from the PIC outputs was not sufficient to control the vibrating motor. Due to the fact that maximum 25mA and 5V could be given to the PIC outputs, the motor could not be driven directly by the PIC output, therefore in this sense the integrated use of the L298N motor driver were considered appropriate. The current applied to the vibration motor was set by the integration of the L298N driver. The L298N integrated driver included 2 pieces of full bridge transistor driver circuits. In this way, 2 motors could be controlled with the same integrated. Two L298N was used; each of the integrated could drive two motors. The operating voltage was up to 34 V while the output current was up to 4A. In addition the relay with this integrated could be driven in inductive load such as step motors.

The design circuit diagram is given in Figure 5 while the motor drive circuit diagram is given in Figure 5.

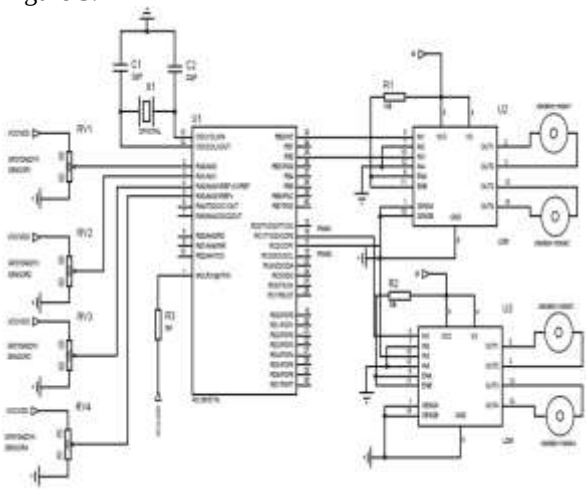

Fig 5. The open circuit diagram of the designed circuit

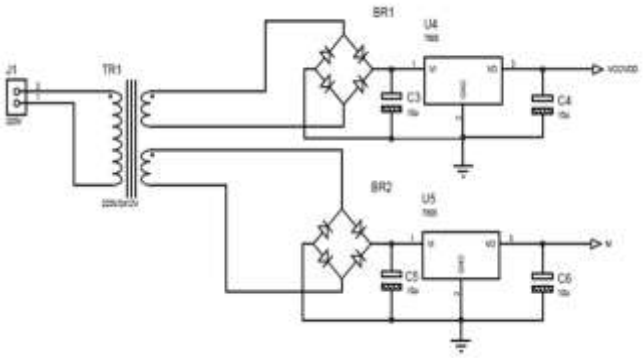

Fig 6. The motor drive circuit diagram of the designed circuit

III. FINDINGS AND CONCLUSIONS

This study was designed in order to relieve the visually impaired people from using walking stick and to help them to do their daily routine without depending on the help of the others. The vibration motors were activated by converting the analogue information received from the sensor to digital information by using 16F877 microcontroller in the circuit.

The designed system sent information to the vibration motors through PIC depending on the distance of the 4 sensors placed on the front, ground, left and right sides. When there are less than 150 cm distance between the object and the front sensor, less than 40 cm distance between the object and the sensor looking towards the ground and less than 80 cm distance between the object and the right or left sensors the motors start to emit vibrations. The visually impaired persons are protected from the objections in the direction of the vibration due to these vibrations.

The system was designed by following a method which was open for the developments. The usage areas of the device can be expanded by adding many features to it. For example the alert system can be audible or the sensor distances can be changed as well. With the integration of a navigation system the destination address aimed to be reached by the impaired person could be entered to the system too. The system can ensure the person to reach the aimed destination through routing as well as it can warn the person against the dangerous situation on the way.

Consequently, with the help of the designed system the daily life of the visually impaired persons can be made easier.

REFERENCES

[1] Altınbaşak O. "PIC programming with PicBasic Pro" Altaş Publishing, İstanbul, 2005

[2] Gümüşkaya H. "Microcontrollers and 8051 Family Hardware, Programming and Applications" Alfa Publishing, 1998

[3] Predko M. "Programming and Customizing PIC Microcontrollers" McGraw Hill, 2001
[4] http://www.tuik.gov.tr/PreHaberBultenleri.do?id=18617
[5] Microchip "16f87Xa Datasheet"
[6] SGS-THOMSON Microelectronics L298 Application Note
[7] Sharp GP2Y0A02YK0F Technical Data Sheet
[8] Göğebakan, V., Design and Implementation of a device detecting direction for the visually Impaired, Graduation Project of the Dumlupınar Üniversitesi Simav Faculty of Technical Education
[9] https://www.youtube.com/watch?v=kJfFrr BWoUk
[10] http://tr.euronews.com/2015/03/25/gorme-ozurluler-icin-akilli-yelek/
[11] http://www.tactilenavigationtools.com/eyeronman/
[12] http://www.mynet.com/teknoloji/gorme-engelliler-icin-eyeronman-yelek-1564601-1
[13] http://www.kamudanhaber.com/yasam/gorme-engelliyi-sapka-koruyacak-h31395.html