

Design and Development of MY 2nd EYE for Visually Impaired Person

A. M. Kassim, M. H. Jamaluddin, M. R. Yaacob, N. S. N. Anwar, Z. M. Sani and A. Noordin

Faculty of Electrical Engineering,
Universiti Teknikal Malaysia Melaka (UTeM),
Hang Tuah Jaya, 76109, Durian Tunggal, Melaka, Malaysia
anuar@utem.edu.my

Abstract— This paper discussed on design and development of electronic device by using warning system for visually impaired person usage which is called ‘MY 2nd EYE’. This electronic device is designed to support and help the visually impaired person around this world to have their own confident in order to travel from one place to another place. This project is about developing of warning system by using a vibration motor as a warning device via microcontroller that received input from distance measurement sensor when detecting obstacle. The vibration motor is a best solution to warn the blind person because it uses touch sense of human when the system is run. In this system, there are four pieces of vibration motor are mounted to the gloves at different locations. Each location will have its own function that show different direction such as front, left, right and down. In this project, the effectiveness of the system gives command the direction of obstacle existence is very important and have been confirmed through simulation and experiment.

Keywords—warning system, vibration motor, visually impaired person, obstacle detection

I. INTRODUCTION

In early 2010, the Organization of the United Nations (UN) has been released the statistic that people with disabilities (PWDs) in the world are ten percent of the total population. Therefore, 80 percent of the disabled are located in developing countries from the calculated number. In addition, instead of Malaysia has a population of about 28 million people, the number of disabled persons in Malaysia is estimated at 2.8 million people. However, the numbers of people with disabilities which are registered with the Social Welfare Department (JKM) are only about 280 thousand people which are 12 percent of the estimated population of the disabled in our country [1]. This total number does not reflect to the real situation of disabled people in this country. Most of the disabled are ignored by the government, which they need not be considered.

The disabled should be given priority, but in the context of Malaysia, disabled people are not advanced, but often ignored. Malaysia has signed the Convention on the Rights of Disabled Association of the United Nations, but the rights of disabled persons are not granted equally. The convention guarantees that the disabled enjoy equal opportunities with those efforts as well as full and effective participation in society in all aspects of life - accessibility, mobility, health, education,

employment, rehabilitation and participation in the political, economic and socio-cultural.

On the other hand, the disable person can be categorized in some classes such as deaf, blind, physically disability and etc. However, almost of disabilities who always involved in great danger is visually impaired person. Recent years, almost of the visually impaired man usually use white cane to travel from one place to another place. However, the one of the major problem by using white cane is the difficult to determine where the locations of obstacle are existed. Additionally, the disadvantage of the white cane is the obstacles can be detected only by contact. This problem will expose the users to danger situation when the blind man is very close to obstacles [3]. Hence, there are a lot of researches that have been actively researched is a supporting device for blind people. The machines that have been researched are electronic travel aids (ETAs), mobile robots, wearable travel aids, e.g. NavBelt, and guide canes and Robotic-cane [3-11]. Portability of guide cane type is the main advantage.

However, the decision maker of the system is a controller which controls the motor at the wheel to turn or go straight for researched machines. Consequently, it will give hidden damage to the user’s brain where their brain cannot actively use as decision maker. The main requirements of the assistive device for visually impaired person are safety, practicability, portability and convenience. Safety is the basic requirement to judge whether an assistive device is reliable or not. The most important task for the visually impaired persons is to gain information on the circumstances of the road and the location of obstacle. By using the collected information, the visually impaired person needs to arrive at their destinations avoiding unexpected obstacles.

In this paper, the assistive device for visually impaired person is described. The assistive device called MY 2nd EYE which replaces the eye of visually impaired person and not their brain. In addition, the warning system will assist them to predict the location of obstacles by using distance measurement sensor. Then, when the obstacles are detected (by distance sensor), the warning signal will be given immediately to the visually impaired person through vibration motor [9] directly to the user’s hand skin with the suitable strength via microcontroller. Therefore, it will help the visually impaired person to change the path or direction without collide with obstacles thus saving time and reduce the

risk of accidents. The effectiveness of this proposed system is also evaluated in this paper.

II. DEVELOPED MY 2ND EYE

A. Device Construction

Figure 1 shows the developed 'MY 2nd EYE' which is consisted with glove including vibration motor, cane, wheel, controller box and sensor. The conceptual design of the product is to develop an effective warning system with low cost budget by applying the universal design in order to make the user comfortable to use. Besides, the user- friendly system is also the priority in develops the product because the blind person does not have their ability like the normal person. On the other hand, this product is designed light, compact and adjustable to ease them to carry.

Hence, all blind persons in this world may have it and travel independently. On the other hand, the application of green technology, this product is designed with rechargeable power supply by using solar panel which is mounted on the top of controller's box in order to supply electrical power to the main controller and sensor. Additionally, this product is also consisted one wheel to make the user easy to handle and the distance for down sensor is always consistent when moving at regular terrain. Besides, the changing of measured distance information from infrared sensor while drain or stair can be obviously detected.

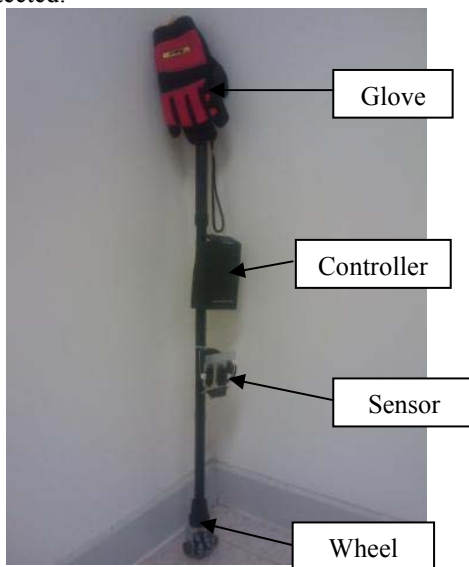


Figure 1. Developed "MY 2nd EYE"

B. Experimental Setup

Figure 2 shows the configuration of the system in order to generate the vibration from the vibration motor. In MY 2nd EYE system, the vibration motor was chosen to give warn to the user once the obstacles was detected. From Fig. 2, the system of MY 2nd EYE consists of obstacles detection by using distance measurement (infrared sensor) as an input which four pieces of infrared sensor are used and located at the center of developed MY 2nd EYE in order to measure the distance of obstacles front, right, left and down. The measured

data from infrared sensor will be transferred to PIC microcontroller. If the distance for front sensor from the obstacles is more than 65 cm, the vibration motor will not be activated. Else, if the measured distance is less or same 65 cm, the vibration motor will be activated through PIC microcontroller and generate by using H-bridge motor driver by applying Pulse Width Modulation (PWM). At the same time, the power supply for MY 2nd EYE is rechargeable battery that can be charging using DC adapter while at home and PV panel when the system run at outdoor.

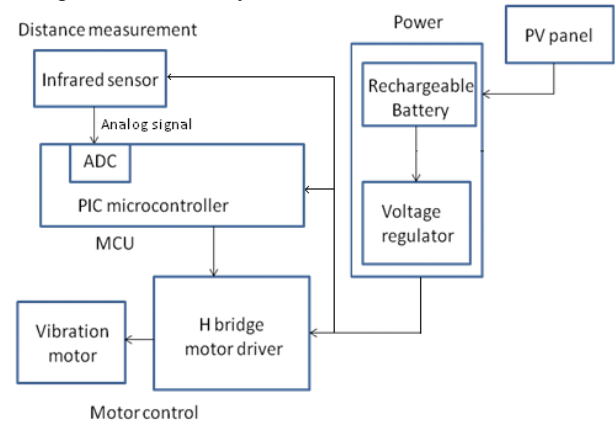


Figure 2. Experimental Setup

On the other hand, the directional angle which has been designed for locating the infrared sensor can be illustrated as Fig. 3. This developed My 2nd EYE is handling at 60 deg where user's hand is 80 cm from surface and user's foot is 50 cm from wheel. In order to keep the safety of user, the limitation of front sensor is determined to 65 cm while down sensor is used for detecting the obstacles 50 cm from wheel that 80 cm from down's sensor. Therefore, user can stop and easily from the obstacle because the distance of user from the obstacle still have about one meter. In addition, the sensor for down also have special functions which are detection of hole, stair or wall. If the measured distance for down's sensor is over than 90 cm which are 10 cm longer that set length, it means there is hole in front. Else, if the measured distance for down's sensor is less than 70 cm which are 10 cm longer that set length, it means there is stair in front. However, if both of down and front sensor detected the obstacle, it means there is a wall or pillar in front the user.

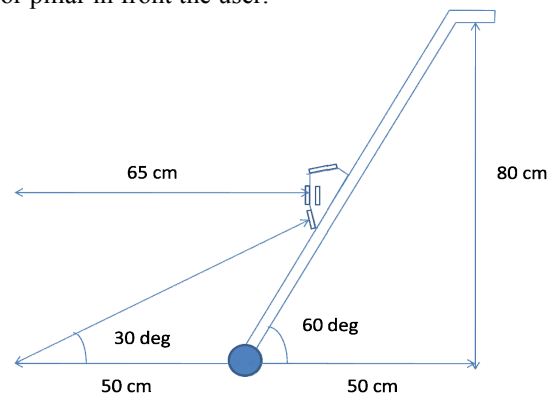


Figure 3. Directional angle for obstacle detection

III. PROPOSED WARNING SYSTEM

A. Vibration system

For the proposed warning system, the vibration type system is the best solution as a warning system for the blind person because it applied the touch sense of human as medium of communication between device and human when the system is run. The human's sense of touch is the very suitable sense for blind person to know the circumstances around because it gives direct connection to the user. Technically, four pieces of vibration motor are mounted to the gloves at different location. Each location have its own function that show distance inputs (sensor) from different direction such as front, left, right and down which can be illustrated in Fig. 4. The obstacle's distance is inputted to the controller and gives some command to vibration motor while obstacle is detected. This device is also designed with gloves that fixed on cane holder in order to reduce user's burden. This design will help the user because they just need to wear the glove and walk as usual and no need special training.

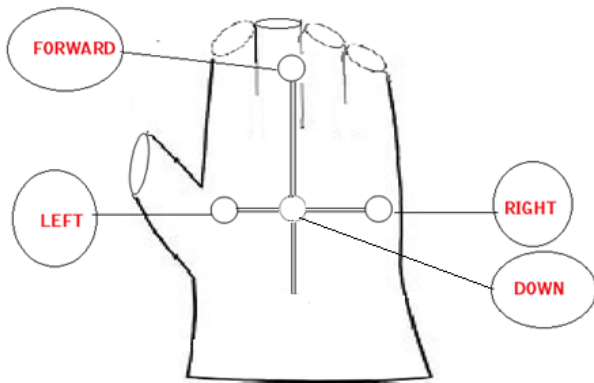


Figure 4. Location of vibration motor for warning system

The type of vibration motor which is used in the proposed warning system is flat coreless vibration motor that can be illustrated in Figure 5. The other specification of the motor is show in Table 1. The vibration motor is a good device because it uses the touch of sense as a warning system to warn the blind man. The ideas of this project same as concept of vibration system at mobile phone that use the vibration as a vibrator when the user uses a vibration mode. The need a fast response, long life-time, high performance vibration motors for a silent paging signal, contribute to applied this method as a warning system for blind man.

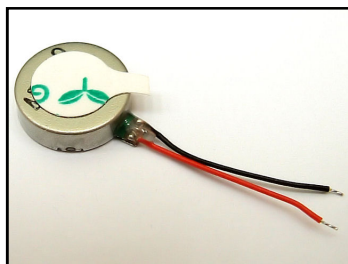


Figure 5. Flat Coreless Vibration Motor

TABLE 1 : SPECIFICATION OF VIBRATION MOTOR

Specification	Value
Voltage supply	2.7 – 3.3 V
Rated speed	12000 rpm
Rated current	100 mA
Vibration amplitude	0.4 G
Weight	0.7 g
Dimension	8mm (Diameter) 3.4mm (Length)

From the table, the value of standard voltage is 3V and the operating voltage range is 2.7V-3.3V. The speed of vibration motor is controlled by Pulse Width Modulation (PWM) on PIC16F877A at controller. The vibration motor is one type of DC Motor and need a motor diver to control the motor. In this system, the IC type H-bridge motor driver is used in order to drive the vibration motor successfully.

B. Simulation

The proposed warning system uses the PIC microcontroller made by Microchip as a main controller to control the system. The integrated chip (IC) that use is PIC16F877A and all the programming made is compiling to PIC16F877A by using PIC burner. The program is simulating at microcontroller software (MikroC) and the Proteus 7 software is chosen to simulate the program. First at all, the program is made to give a pulse “on” and “off” of the motor without receive data from input. Then the program will test based on the simulation at Proteus 7 software.

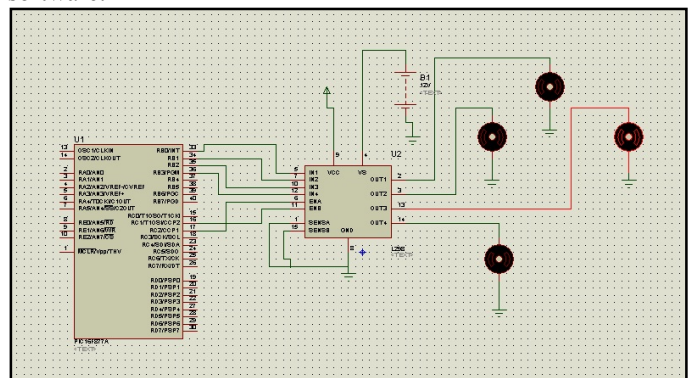


Figure 6. Simulation program by using Proteus

After the simulation phase, the second step is proceeding by using signal/pulse generator as input. The signal and pulse generator is used as an input from sensor and the result is determined. The strength of vibration motor is depending on value of Pulse Width Modulation (PWM) in order to give a

different speed at different distance of obstacles. The motor is run and the result is determined by using oscilloscope. Next, the real programming that receives an input from distance measurement is build after the design of prototype is done. The programming is needed to merge with the distance measurement from the other parts to get the input data. Figure 6 shows the simulation program which is designed to evaluate the validity of the proposed experimental setup.

IV. EXPERIMENTAL RESULT

In order to evaluate the effectiveness the proposed warning system which has been developed in MY 2nd EYE device, the simulation program by using Proteus is designed. From the figure, the design use PIC16F877A as a PIC controller, the L298 as DC motor driver and four pieces of DC motor as vibration motor. Each of the DC motor is set at 3V operating voltage with the supply for 12V DC for motor driver. Before start the simulation, the programming is compiled to the PIC at the first. Then, the simulation is run. As consequences, the result shows each 200ms the motor can be run effectively. The motor run 200ms while delay from run to stop and from the first motor stop to second motor run. Besides, the experiment by using the same as simulation program also conducted to evaluate the validity of proposed warning system on the real developed MY 2nd EYE system.

Consequently, the vibration motor is activated while detecting the obstacle at front, right, and left and down. The warning system by using vibration motor is very effective to realize on this assistive device for visually impaired person. The vibration motor is a good device to give fast responses; long time performance and safe to use without have a high risk of health problem. The speed of the vibration motor can be control by set up the value of Pulse Width Modulation at the programming. The different voltage is used to give a different strength to the user with different distance of obstacles. The flat coreless vibration motor is use in the developed MY 2nd EYE because it has a small diameter and the operating voltage is suitable for human being. Microcontroller is use to make a complete programming and then is simulate at the Proteus. The distance between each vibration motor embedded at the glove must be far enough to avoid the user become confuse with the signal given. The best strength advantages by using the vibration is determined by conducting survey and get the feedback from the user. The designed glove is attached to the holder to make the system is more user friendly and not giving any troubles to the blind man. The project is low cost project with using the cheap but effective component like vibration motor and glove because most blind men belong to lower income group.

V. CONCLUSIONS

In this paper, we have designed and developed the assistive device for visually impaired person. In addition, we have

conducted the simulation program by using Proteus and the experiments on proposed warning system for the developed MY 2nd EYE. Firstly, the designed simulation is effectively activated when each vibration motor run with synchronously. Besides, the effectiveness of this developed MY 2nd EYE also confirmed when the vibration motor at developed device also vibrated if the obstacles are detected. The vibration motor is vibrated according to the direction of obstacle which has been detected.

In the future, the more advanced assistive device for visually impaired person which is using audio visual system and navigation system. In addition, more experiments will be conducted when the visually impaired person is using the device at crowded people such as supermarket and obstacle avoidance for high speed movement such as car or transport.

ACKNOWLEDGMENT

This research was supported by research grant from Universiti Teknikal Malaysia Melaka award no. PJP/2011/FKE (15A) S00833 and also technically support from Yasuno laboratory member, The University of Tokushima, Japan.

REFERENCES

- [1] Country Repor Malaysia, The 7th ASEAN & Japan High Level officials Meeting on Caring Societies: "Towards and inclusive society" – strengthening the collaboration between social welfare , health and medical systems for children with disabilities, Sept 2009
- [2] Katherine Guernsey, Marco Nicoli and Alberto Nini, Convention on the Rights of Persons with Disabilities: Its Implementation and Relevance for the World Bank, SP DISCUSSION PAPER, No 0712, June 2007
- [3] Pravin L.Nanayakkara, Anya R.Nanayakkara, and Lakdas Nanayakkara, "System for Guiding the visually handicapped" U.S patent 6,867,697, Mar 15, 2005
- [4] S. Shoval, J. Borenstein, and Y. Koren, "Auditory guidance with the NavBelt - A computerized travel air for the blind", IEEE Trans on Systems, Man, Cybernetics, Vol. 28, No. 3, pp.459-467, 1998
- [5] J. Borenstein, and I. Ulrich, "The GuideCane – A Computerized Travel Aid for the Active Guidance of Blind Pedestrians.", Int Conf on Robotics and Automation, pp. 1283-1288, 1997
- [6] G. Lacey, K.M. Dawson-Howe, "The Application of Robotics to A Mobility Aid for The Elderly Blind," *Robotics and Autonomous Systems*, Vol. 23, No. 4, pp.245-52, 1998.
- [7] H. Mori, S. Kotani, N. Kiyohiro, "A Robotic Travel Aid "HITOMI" ," *Proc. of the 1994 IEEE/RSJ/GI Int. Conf. on Adv. Rob. Sys.* Vol. 3, pp.1716 –1723, 1994.
- [8] P. Aigner, B. McCarragher, "Shared Control Framework Applied to a Robotic Aid for the blind," *Proc. of 1998 IEEE Int. Conf. on Rob. and Auto.*, pp.717 –722, 1998.
- [9] Munetatsu Hara, Takashi Yasuno and Hironobu Harada, "Affordance Performance of Electric Wheelchair with Force-Feedback Joystick", Proceedings of International Symposium on Biological and Physiological Engineering / 22nd SICE Symposium on Biological and Physiological Engineering, No.2C3-4, pp.241-244, January 13-14, 2008, Harbin, China
- [10] R. H. Byrne, "Global Positioning System Receiver Evaluation Results", Sandia Report SAND93 0827, Sandia National Laboratories, Albuquerque, NM, Sep.,1993
- [11] F. Tsuzuki and K. Sasaki, "Novel Configuration of Ultrasonic Sensor for Mobile Robot", IEEE RSJ Int. Conf. on Intelligent Robots and Systems, pp.2080-2085, Sep. 12-16, 1994.