International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

ASSISTIVE NAVIGATION FOR BLIND PEOPLE: A NOVEL APPROACH

Aishwarya J. Oak[1], Anita S. Walde[2]

[1]Research Scholar, Dept. of E&TC, DIEMS Aurangabad
[2]Professor, Dept. of E&TC, DIEMS Aurangabad

Abstract - *Blind Guide is a breakthrough technology in navigational and rehabilitative aids for the blind and visually impaired. It is designed to communicate physical location and object location using sensors for users in order to have easy mobilization. Ordinary route navigational systems in the outdoor environment are expensive and its manufacturing is time consuming. This blind Guide work goes for giving the route to blind persons, by designing a cost-effective and more flexible navigation system. This allows them to move independently without any manual help or guidance. Blind Guide will be a powerful tool and it is very helpful for visually impaired, in achieving fully independent navigation for those with vision loss and blindness to move freely, safely, and independently. Our proposed solution approach is to design a mobile embedded device that will help visually impaired individuals with their independent mobility. The device will direct them to and from specified locations, and alert the user of any potential obstructions in their path. Oblu is Multi-IMU based inertial navigation module. Oblu, with on-board four 6-DOF IMUs, is targeted towards foot mounted pedestrian application and can also be used as a development platform for carrying out research in motion sensing, robotics, IoT etc. Oblu is an open source motion sensing platform for wearables and robots.*

Key Words: Embedded system, Blind assist, IMU, Oblu Navigation system, motion sensing.

1. INTRODUCTION

People with complete blindness or low vision often have a difficult time self- navigating outside well-known environments. In fact, physical movement is one of the biggest challenges for blind people, travelling or simply walking down a crowed street may pose great difficulty for blind people, hence they need an assistive device that will allow blind user to navigate freely and this requirement become crucial. Problems faced by visually impaired people are many, among them many have trouble maintaining a proper circadian rhythm due to lack of visual input to their brains, critical in reading, writing, navigation and identifying objects. Reading and writing can be accomplished to a great extent through development of Braille language.

Based on this real context or condition we focused the work on developing assistive technologies that may help blind individuals in becoming independent and contributing actively towards the development of the country.

1.1 Problem formulation

The World Health Organization (WHO) fact reported that there are 285 million visually-impaired people worldwide. Among these individuals, there are 39 million who are blind in the world. More than 1.3 million are completely blind and approximately 8.7 million are visually – impaired in the USA of these, 100,000 are students, according to the American Foundation for the Blind and National Federation for the Blind. Over the past years, blindness that is caused by diseases has decreased due to the success of public health actions. However, the number of blind people that are over 60 years old is increasing by 2 million per decade. Unfortunately, all these numbers are estimated to be doubled by 2020

1.2 Objective

The objective of this project is to propose a portable device, designed for visually impaired individuals to assist them with getting around. Unlike most commercially available assistive devices, this device should provide directions to locations and alert the user with the sound output in their path.

2. LITERATURE SURVEY

The need for assistive devices for navigation and orientation has increased. Assistive technology was introduced to solve the daily problems which are related to information transmission (such as personal care), navigation and orientation aids which are related to mobility assistance.

This assistive technology became available for the blind people through electronic devices which provide the users with detection and localization of the objects in order to offer those people with sense of the external environment using functions of sensors.

The sensors also aid the user with the mobility task based on the determination of dimensions, range and height of the objects. The main focus in this Assistive technology is the vision substitution category including its three subcategories; Electronic Travel Aid (ETAs), Electronic Orientation Aid (EOAs) and Position Locator Devices (PLDs). My in-depth study of all the devices that provide the after mentioned services allows us to come up with a fair taxonomy that can classify any proposed technique among others.

- Electronic Travel Aids(ETAs)

These are devices that gather information about the surrounding environment and transfer it to the user through sensor cameras, sonar, or laser scanners. The rules of ETAs according to the National Research Council are:

(1) Determining obstacles around the user body from the ground to the head;

(2) Affording some instructions to the user about the movement surface consists of gaps or textures;

(3) Finding items surrounding the obstacles;

(4) Providing information about the distance between the user and the obstacle with essential direction instructions;

(5) Proposing notable sight locations in addition to identification instructions;

(6) Affording information to give the ability of self-orientation and mental map of the surroundings.

- Electronic Orientation Aids (EOAs)

These are devices that provide pedestrians with directions in unfamiliar places [17,18].

The guide lines of EOAs are given in [18]:

(1) Defining the route to select the best path;

(2) Providing mobility instructions and path signs to guide the user and develop her/his brain about the environment.

(3) Tracing the path to approximately calculate the location of the user;

- Position Locator Devices (PLD)

These are devices that determine the precise position of its holder such as devices that use GPS technology.

2.1 Gap Identification and Summary

1. Guidance of dog: A specially trained dog assisting the blind in obstacle avoidance, but usually not aiding in way finding, e.g. the dog is trained to stop before obstacles, reacts to commands on walking directions. In spite of their great usefulness, guide dogs are a rarely -used aid- only about 1% of the visually impaired use it. Advantage: Good in following familiar paths, good overall obstacle avoidance, trained for selective disobedience when sensing danger to his owner. Disadvantage: Very costly, guide dog service period in on average 6 years, regular dog up-keeping cost and lifestyle changes.

2. Human guide: A blind person walks hand in hand with a sighted guide. Advantage/Disadvantage: The most obvious, but in practice not a permanent solution for aiding the blind in mobility and navigation. A blind lacks privacy and can have a feeling of being a burden to his or her guide.

3. SYSTEM DEVELOPMENT

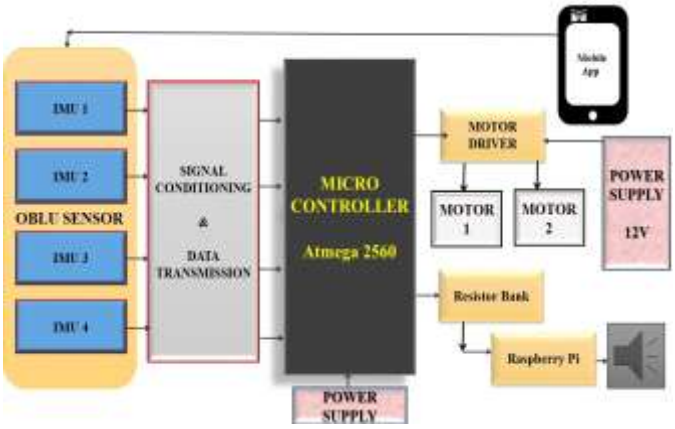

Figure 3.1: Block Diagram of System

3.1 OBLU Sensor

Oblu is Multi-IMU based inertial navigation module. Oblu, with on-board four 6-DOF IMUs, is targeted towards foot mounted pedestrian application and can also be used as a development platform for carrying out research in motion sensing, robotics, IoT etc.

Oblu has wireless interface for data transfer. Due to on-board 32-bits floating point controller, device has a simplified dead reckoning interface (for foot-mounted application).

An application platform receives a stream of displacement and heading changes, which it sums up to track the carrier. This is a significant simplification compared with handling and processing high-rate raw inertial measurements. Oblu is an open source motion sensing platform for wearables and robots. It comes pre-programmed as a shoe sensor for pedestrian navigation.

3.2 Working

1. The project mainly focusses on Indoor navigation for blind people, suppose a blind person has to go from one source point to another destination point, we can solve this issue by the help of several sensors array and the micro-controller.

2. The Sensor array is occupied with different forms of sensors such as Gyroscope, Magnetometer, Accelerometer and many more.

3. Combining all these sensors, it is called a IMU. The IMU sensor is an electronic device used to calculate and report an exact force of body, angular rate as well as direction of the body, which can be achieved by using a blend of 3 sensors like Gyroscope, Magnetometer and Accelerometer.

4. The OBLU module consists of a group of IMU sensors to acquitted in them. Data from the OBLU sensor is given continuously to the microcontroller for processing. This data is given in the form of frames having different values based upon the changes shown by IMU.

5. The micro controller processes this data and accordingly gives instructions to the motor driver IC L293D. The motor driver drives two different motors for different directions control. An external power is supplied to motors since it requires excess power for working.

6. Also the data from microcontroller is given to Raspberry Pi. Raspberry Pi requires low power as compared to Arduino, hence a resistor bank is formed between the Arduino Mega and Raspberry pi and then the converted power is given to Raspberry pi from Arduino Mega.

7. The process of Audio synthesis is done as per the direction of the blind person for him/her to navigate in surrounding. The Raspberry pi also gives the audio feedback in the form of audio output through the speaker at the output.

8. Thus the blind person can navigate using the IMU and also gets audio feedback with the help of Raspberry Pi audio synthesis.

4.1 OBSERVATIONS

Fig 4.1: - Waveforms with no diversion

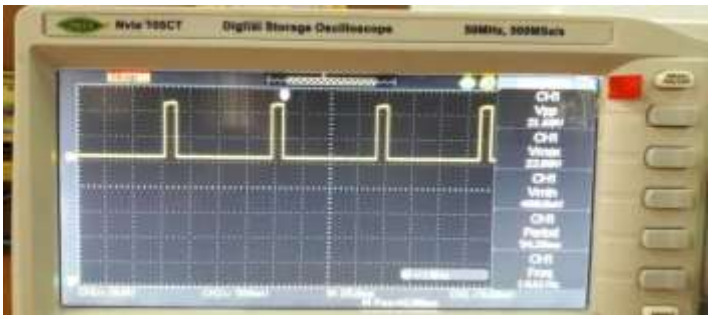

Fig 4.2: - Waveforms with when diversion to be done

4.1 Error calculation graph

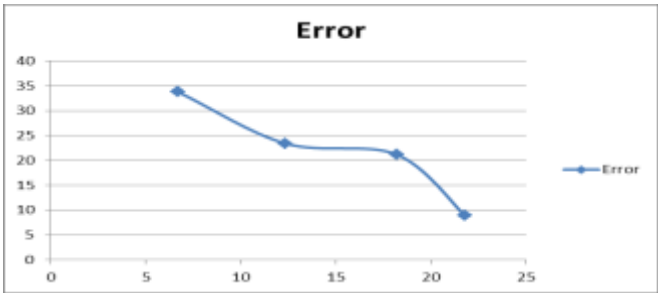

Fig 4.3: - Waveforms with when diversion to be done (Error % VS Measured distance in cm.)

4.2 Mobile Applications snapshots

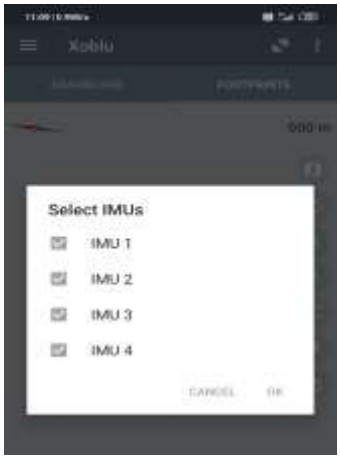

Fig 4.4: -Mobile Display GUI showing which IMU to be selected

4.3 Lab Prototype

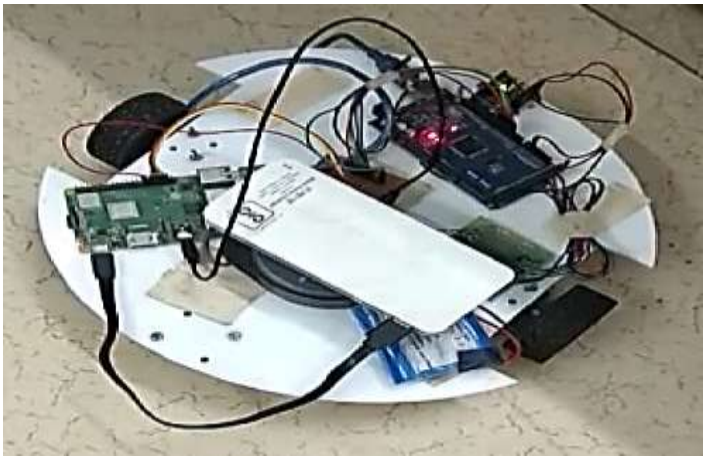

Fig. 4.5: - Lab Prototype of a robot considered as blind person.

5. CONCLUSIONS

I have gained insight about the various parameters associated with Navigation systems. I got an opportunity to work and develop a remedy for one of the major crisis the world is facing in terms of blind people. I learned about various sensors and their interfacing.

I learned various software tools. I also got hands-on experience of soldering and PCB designing. With this project, I conclude that the proposed system would prove to be cost efficient, time saving and yet produce the results with high accuracy and quality.

Hence, it can be concluded that this project is able to play a great contribution to the state of the art and will play a great role to assist the blinds to walk easily.

6. FUTURE SCOPE

Future work will be focused on enhancing the performance of the system and reducing the load on the user by adding the camera to guide the blind exactly. Images acquired by using web camera and NI-smart cameras helps in identification of objects as well as scan the entire instances for the presence of number of objects in the path of the blind person. It can also detect the material and shape of the object.

Matching percentage has to be nearly all the time correct as there no chance for correction for a blind person if it is to be trusted and reliable one. The principles of mono pulse radar can be utilized for determining long range target objects. The other scope may include a new concept of optimum and safe path detection based on neural networks for a blind person.

ACKNOWLEDGEMENT

I feel great pleasure in submitting this Dissertation Report “Assistive Navigation for Blind People”. I express my sincere thanks to guide, Prof. A. S. Walde for guiding me at every step in making of this project. She motivated me and boosted my confidence and I must admit that work would not have been accomplished without her guidance and encouragement.

I would wish to thank HOD Dr. R. M. Autee for his valuable and firm suggestion, guidance and constant support throughout this work. I would like to extend my special thanks to The Director Dr. U. D. Shiurkar, for spending his valuable time to go through my report and providing many helpful suggestions.

REFERENCES

[1] S.Gangwar (2013) designed a smart stick for blind which can give early warning of an obstacle using Infrared (IR) sensors, “A Smart Infrared Microcontroller-Based Blind Guidance System”, Hindawi Transactions on Active and Passive Electronic Components,Vol.3, No.2, pp.1-7, June 2013.

[2] S.Chew (2012) proposed the smart white cane, called Blind spot that combines GPS technology, “Electronic Path Guidance for Visually Impaired People”, The International Journal Of Engineering And Science (IJES), Vol.2, No.4, pp.9-12, April 2012.

Benjamin etal (2014), Mrs. Shimi S. L. and Dr. S.Chatterji, “Design of microcontroller based Virtual Eye for the Blind”, International Journal of

Scientific Research Engineering & Technology (IJSRET), Vol.3, No.8, pp.1137-1142, November 2014.

[3] Central Michigan University (2009) developed an electronic cane for blind people "A Review on Obstacle Detection and Vision", International Journal of Engineering Sciences and Research Technology", Vol.4, No.1, pp. 1-11, January 2009.

[4] Mohd Helmyabd Wahab and Amirul A. Talibetal , "A Review on an Obstacle Detection in Navigation of Visually Impaired", International Organization of Scientific Research Journal of Engineering (IOSRJEN), Vol.3, No.1 pp. 01-06, January 2013.

[5] Alejandro R. Garcia Ramirez and Renato Fonseca Livramento da Silvaetal (2012)" Artificial EYE An Innovative Idea to Help the Blind", Conference Proceeding of the International Journal of Engineering Development and Research(IJEDR), SRM University, Kattankulathur, pp.205-207, 2012.

[6] José, Miguel Farrajota, Joao M.F. Rodrigues (2013), "A Smart Infrared Microcontroller- Based Blind Guidance System", Hindawi Transactions on Active and Passive Electronic Components, Vol.3, No.2, pp.1-7, June 2013.

[7] Dambhare and A.Sakhare (2011) "Effective Navigation for Visually Impaired by Wearable Obstacle Avoidance System", International Journal of Power Control Signal and Computation (IJPCSC), Vol.3, No.1, pp. 51-53, January-March 2011.

BIOGRAPHIES

Miss. Aishwarya J. Oak
Research Scholar (M Tech.)
Dept. of E & TC. DIEMS,
Aurangabad

Prof. Anita S. Walde
Dept. of E&TC
Dept. of E & TC. DIEMS,
Aurangabad