International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 02 | Feb -2017 www.irjet.net p-ISSN: 2395-0072

Obstacle Detection and Navigation system for Visually Impaired using Smart Shoes

Tejal Chandekar[1], Ranavikrant Chouhan[2], Rajanigandha Gaikwad [3] , Hrushikesh Gosavi [4],

[1] *Student, Dept. of Computer Engineering, SITS, Maharashtra,India*
[2] *Student, Dept. of Computer Engineering, SITS, Maharashtra,India*
[3] *Student, Dept. of Computer Engineering, SITS, Maharashtra,India*
[4] *Student, Dept. of Computer Engineering, SITS, Maharashtra,India*

Abstract - *Highly over sighted field of applications for the visually impaired people has put it in despair. Existing solutions prove to be inadequate or highly expensive. Current technological advancements need to benefit, above all, the most disabled. Here we have surveyed the existing solutions meant for autonomous mobility for the visually impaired people. In this paper we have proposed a novel design, Smart Shoes with sensors embedded in them to guide a visually impaired person fluidly and to alert him/her of the obstacles that lay ahead of him in his path. The design is aimed to develop an easy to use Android application to cater to the special needs, used to guide the person coextending the features of the Smart Shoes.*

***Key Words*: Visually impaired, sensors, embedded system, Arduino, Android.**

1.INTRODUCTION

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today.

Android is an operating system developed by Google for mobile systems. It is based on the Linux kernel and designed for touchscreen mobile devices such as smartphones and tablets. Android's user interface is mainly based on direct manipulation, using touch gestures such as swiping, tapping and pinching, to manipulate on-screen objects, along with a virtual keyboard for text input.

Our primary objective here is to make the best use of the sensors which are available at hand for real time obstacle detection and navigation. The sensors to be used need to of minimum size and cost providing maximum functionality in order to help a visually impaired person navigate and move around autonomously.

The usage of Android is restricted to its features which are not visual but will still help a visually impaired person. The user needs to be able to launch his application without having to view anything on the device with the sole help oh the hardcoded keys on the Android device. All the features of the sensors, Arduino microcontroller and Android are to be combined to design a new device for autonomous mobility of a visually impaired person.

2. LITERATURE STUDY

A complete and reliable sensing system for obstacle detection can value a lot from the collective usage of numerous types of sensors, especially from the active - passive combination. Any precise type of technology may have hitches to meet all necessary necessities in order to detect an obstacle in various lighting or weather conditions. The muddle background and intricate moving patterns of all objects which may appear on a road scene in urban streets demand erudite processing of sensor inputs. In order to overcome this problem, a sensor - fusion and segmentation approach can be used. From the technology's point view, different sensing technologies such as ultrasonic sensor, microwave radar, laser scanner and computer vision can be used for obstacle detection task. The main problem is to design algorithms that are robust enough to reliably detect and warn for any obstacles that can appear in front of the user on the road area.

In [1]A.Discant et al. speaks about the different types of sensors such as active and passive sensors. It also throws light on various sensing systems designed using the combinations of these sensors.

[2] This paper presented the use of ultrasonic and infrared sensors for distance dimension in the enlargement of an obstacle detection system for senior and people with vision impairment. Investigational results show that ultrasonic and infrared sensors have diverse characteristics in terms of output voltage measurements. It is clearly designated that ultrasonic sensor gives a linear output representative whereas infrared sensor shows a nonlinear output representative. Both sensors are able to detect an obstacle at the distances within their usable range with percentage of precision between 95% and 99%. The experimental result indicates that the US and IR sensors are able to provide reliable distance measurements even with different colours and materials of obstacles. Another thing that has been shown is that IR sensor has slightly advanced resolution than that of the US sensor, particularly for slight distance measurement within their usable ranges. Future work, the system should determine the sensor location on the

shoe, and the sensors only detect the obstacle when the foot fully touching to the ground.

[3] A motion supporting device is proposed which can be used to help navigate in the surroundings and avoiding from collisions with obstacles. This could help decrease health costs incurred and improve the quality of care and independence of the elderly. Conventionally, mobility-assisting devices have been electromechanical devices, in which the main function is to provide physical support for the elderly whilst moving around using canes and wheelchairs. Microcontroller and wireless network applications and usages have increased the functionality of these devices in terms of obstacle detection and information processing. They have also brought in stirring new concepts, which make these devices to be handsfree and small. The system which is proposed here is based off optical and ultrasonic sensors. These are able to detect a wide range of obstacles, such as small objects on the walkway, large static obstructions (e.g., building wall), as well as stairs and uneven surfaces, and hence warns the wearer several times before making contact with the object (e.g., 1.5m, 1.0m and 0.5m).

[4] Provides a comprehensive summary of state of the art techniques, which are used for navigation systems for visually impaired people. It concludes that navigation systems have not achieved large-scale advantages mainly due to unaffordable costs, accuracy and usability. Further, in the future, navigation systems need to firstly reduce the installation expenditure by curtailing the infrastructure disagreements that is required for confining the consumer. Usability can to be enhanced by curtailing the amount of sensors users have to carry and also providing usable directions in a vigorous modality of feedback. Systems need to take into account the user's special necessities, minimize intellectual load, cost effective, user friendliness and minimize any meddling from the surroundings.

[5] An ultrasonic sensor based navigation system for blind people, which is based on microcontrollers with synthetic speech output and portable device to guide the user about urban outdoor paths to point out what choices to make. This device uses the principle of echo of high frequency ultrasonic beam to detect hindrances in the path. This mobility support instructions are given by vibro-tactile form r to reduce navigation complications. A shortcoming of ultrasound is that walls may reflect or block ultra sound signals, which result in less accurate localization.

[6] Vibration and voice operated navigation system developed using ultrasonic sensors to detect obstacles. Since visually impaired people are more sensitive in hearing and possesses strong perception than ordinary people. So this system gives alert through vibration and voice feedback. System works in indoor as well as outdoor navigation and focus on continuously sensing surround obstacles and alerting through vibration and voice feedback. Depending upon the distance between obstacle and user different intensity levels are provided to vibration motor to alert user's mobility.

3. SYSTEM ARCHITECHTURE

The scope of this product covers its usage by visually impaired and blind people who cannot find their way without use of an explicit tool or some other persons help. The idea is to use a daily use apparel that is our shoes to guide the user to his/her destination with description of obstacles in his/her path. The product does not deal with guiding about how to avoid the obstacle. It only deals with notifying the user of the product about the presence of the obstacle and the position of the obstacle.

This product is an innovation designed for helping the visually impaired people to be able to navigate without using any external tool other than their smart phones and shoes. It works as an audio guidance system which takes inputs from the sensors attached to the shoes of the user and gives the output in form of audio instructions. The application designed for the same shall also have an interface with Google Maps in order to have the real time navigation.

The product shall perform following major functionalities:

- Call the Google maps API for navigation.
- Read the users input destination through voice commands.
- Detect the obstacles in user's vicinity and categorize them.
- Inform the user about the position and type of the obstacles through voice instructions from the smartphone.

Recognizable hardcoded keys on a smartphone device, such as volume up or volume down key for starting up the application for a visually impaired person. Google maps running in the background as well as on the screen whenever the app gives a call to the Google maps internally.

The usual software components for Google maps to run dynamically are an internet connection and a location tracker, inbuilt in the smartphone, for location tracking.

Real time processing may be the most critical implementation of the proposed system. The software should have a capability to do real-time processing of the obstacles detected by the sensors. The necessary detection, processing and transfer of these details to the Android via Bluetooth in minimum required time, is imperative. For effective use of battery life of the batteries present in the shoes, it is necessary that the computations be kept to a minimum.

The text to speech conversion, to inform the user of any possible obstacles, has to be done in least possible time.No delay can be tolerated in this as the entire processing time saved will be rendered useless if the text to speech is done ineffectively.

All the equipment for the obstacle detection, i.e., sensors and Arduino Nano will be placed in each of the shoe with batteries attached. Hence for maintaining the usability of the SmartShoes, it is necessary to take care of the shoes and

the equipment. Percolation of water has to be avoided as far as possible to keep an efficient functioning system.

It is also expected that the user be accustomed to all the conventions of the app before actually putting it to use in real life scenarios such as roads and crossings. It'll be safe to first use it in a safe inside space before taking it to a hostile environment. The user should also confirm the battery levels before usage so that nothing stops working in the middle of a hostile scenario.

The primary attribute of this application will be usability given to the visually disabled user solely using voice commands, hard coded keys and text to speech conversion. The navigation system from the Google Maps will provide the destined route to the user without having to ask for any directions or help. The sophisticated obstacle detection system will be presented in a reasonable and understandable manner to the user so as to avoid any obstacles that might present themselves in the path.

4. EMBEDDED AND ANDROID SYSTEMS

An embedded system is a special-purpose system in which the computer is entirely encapsulated by the device it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system executes pre-defined tasks, usually with very specific requirements. Embedded systems often reside in machines that are expected to run continuously for years without errors, and in some situations recover by themselves if an error occurs. Therefore, the software is usually developed and tested more carefully than that for personal computers. Arduino is a type of embedded system which is an open source device and can be programmed for various applications. An input could be digital or analogue, and could come from the environment or a user. Outputs can control and turn on and off devices such as motors or other computers. These types of systems provide digital and analogue input/output pins that can interface with various shields and other circuits. These boards provide USB as serial communication interfaces on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project includes an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++. The Arduino project provides the IDE, which is a cross-platform application written in the programming language Java.

Android Operating system can be defined as a integrated kit for creation and modification of different embedded devices. Android's user interface is mainly based on direct manipulation, using touch gestures that loosely correspond to real-world actions.

The integration of Android devices with Arduino is connected with a hardware interfacing kit. The communication is a lot easier and the system messages are sent and received within fraction of seconds.

5. CONCLUSIONS

After studying the results of various approaches described in this paper, we propose smart shoes for obstacle detection and navigation by visually impaired people. The smart shoes are acquired with Arduino, which is a type of embedded system. Rather than having a complex system which is non-portable, embedded system deals with all the functions which a user wants to perform at that instance.
The processing of data will be done dynamically as the user walks with the sensors activated. The processing of the values will be communicated from the sensors to the Arduino board and the through the interfacing hub to the smartphone. This, the complexity and the time will be low and the obstacle and be detected in fraction of seconds.
The proposed system will automate according to the real time pathways and the obstacles coming in between. Obstacles will be processed by the given algorithm programmed into Arduino as well as the communication will be initiated as per the Android interfacing Algorithm. The sensors will sense the obstacle and will give out the values, thus measuring the distance of the obstacle from the sensors. Depending on the values given by the sensors the arduino will process the values for simplicity and through interfacing device will be passed to the Android smart phone. Once the values are received, with the text-to-speech algorithm, user would be able to hear the distance from the current position. However, this process works with no internet connection for better usability of the user. For navigation purposes an API is used to run a Google maps application in the background at the same time when the shoes detect the obstacles.

Thus, with the ease of use and faster response time, a visually impaired person can sense, feel, listen and walk with the environment around him with the help of these Smart Shoes.

REFERENCES

1. A. Discant, A. Rogozan, C. Rusu and A. Bensrhair, "Sensors for Obstacle Detection - A Survey," *2007 30th International Spring Seminar on Electronics Technology (ISSE)*, Cluj-Napoca, 2007, pp. 100-105. doi: 10.1109/ISSE.2007.4432828
2. Mustapha, Baharuddin, AladinZayegh, and Rezaul K. Begg. "Ultrasonic and infrared sensors performance in a wireless obstacle detection system." *Artificial Intelligence, Modelling and Simulation (AIMS), 2013 1st International Conference on*. IEEE, 2013.
3. Mustapha, B., A. Zayegh, and R. K. Begg. "Wireless obstacle detection system for the elderly and visually impaired people." *Smart Instrumentation, Measurement and Applications (ICSIMA), 2013 IEEE International Conference on*. IEEE, 2013.
4. C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," *Computation of Power, Energy Information and Commuincation (ICCPEIC), 2015 International Conference on*, Chennai, 2015, pp. 0093-

0098.
doi: 10.1109/ICCPEIC.2015.7259447

5. Bousbia-Salah, M., Redjati, A., Fezari, M., &Bettayeb, M. (2007, November). An ultrasonic navigation system for blind people. In *Signal Processing and Communications, 2007. ICSPC 2007. IEEE International Conference on* (pp. 1003-1006). IEEE.
6. Mahmud, N., Saha, R. K., Zafar, R. B., Bhuian, M. B. H., &Sarwar, S. S. (2014, May). Vibration and voice operated navigation system for visually impaired person. In *Informatics, Electronics & Vision (ICIEV), 2014 International Conference on* (pp. 1-5). IEEE.