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Smart Shoes: A Safe Future for the Blind

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ABSTRACT: Oureyes play important role in our day to day lives. They are perhaps the most valuable gift we have. This world is visible to us because we are blessed with eyesight. But still there are some people who lag this ability of visualizing the things around them. Due to this, the blind people face many challenges especially when moving in unfamiliar public places. 285 million people are estimated to be visually impaired worldwide, out of which 39 million people are blind and 246 have low vision. Hence, wearable device should be designed for such visually impaired people. Smart shoe is one such wearable system designed to provide directional information to the visually impaired. To provide smart and sensible navigation guidance to them, the system has great potential, especially when integrated with visual processing units. During the operation, the user is supposed to wear the shoes. When sensors will detect any obstacle, user will be informed through Android system being used by the user. The Smart Shoes along with the android application shall help the user in moving around independently and safely.

KEYWORDS:Navigation, Android, Smart Shoes, Visually impaired, sensors, vibrators.

I. INTRODUCTION

According to the survey of WHO (World Health Organization), held out in 2011, we come to know that in world, about 1% of the human population is visually impaired. Amongst them about 10% is fully blind. The main concern for blind people is mobility. They need to depend on others for their mobility. This approach presents a tool for visually impaired people that will help them to navigate safely and freely. Now-a-days, android mobile is commonly used by everyone. With help of Android application, wearable device is to be made to help in navigating the path.

The system we have designed consists of sensors and vibrators for sensing the surrounding environment for obstacles and giving feedback to the blind person, about the position of the nearest obstacles in range. The idea is to extend the senses of the user through this after a training period, without any sensible effort.

We propose a system consisting of smart shoes for the visually impaired people. Hardware will be fixed in the users' shoes. When the user will wear the shoes and travel somewhere, sensors attached with the hardware will sense obstacles and vibrators will vibrate for left/right turn through path. Also, a buzzer will be used for alerting the user that the obstacle is nearing him/her. Using smart shoe, blind people need not to be worried for dependence on others for mobility.

This paper describes the architecture and discusses the possible benefits of the system we have designed. In this work, system designed is cheap and a user friendly smart blind guidance system. It is implemented to improve the mobility of both blind and visually impaired people in various areas, that too, without depending on others.

II. RELATED WORK

A.Object Detection System for Blind People

Various diseases caused by Visual impairment and blindness has been hugely reduced, but there are many people who are at risk of age-related visual impairment. Visual information is the basis for most navigational tasks, so necessary information about the surrounding environment is not available to visually impaired people are at disadvantage. In this context system propose a system, named Smart Vision, the ability to move around in unfamiliar

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environment whose objective is to give blind users, whether indoor or outdoor, a user friendly interface. This paper proposes mainly in the development of the computer vision module of the Smart Vision system.

B.Wearable Navigation Assistance- a tool for the blind

This paper describes a tool for navigation which is used for visually impaired people. The important parts in this proposed system are: a multi-sensory system (comprising stereo vision, acoustic range finding and movement sensors), a mapper, a warning system and a tactile human-machine interface.

C. Ultrasonic Smart Stick for Visually Impaired People

Making walking stick smart and more helpful is the main aim of this paper. The literatures related to this topic were reviewed and analyzed. These smart sticks need to be modified as technology improves. The simulation results are calculated for the ultrasonic sensors, water sensors and Bluetooth model in one microcontroller. So, work related to this project is done in this paper wide survey and we have shortlisted some useful aspects from each project. This will also help us to decide the designing approach.

D. Energy Harvesting for Smart Shoes

Consumers' reliance on wearable electronic devices has grown significantly in the past few decades. As wearable electronic devices evolve and proliferate, there will be a significantly growing need for more power delivery to distributed points around the human body. The current approach for power distribution is becoming problematic as more and more appliances are carried. We are forced to either use more small batteries that require replacement everywhere or allow wires through our clothing to supply the appliances from a central power source. A new approach, which eliminates the power wiring problem, is to develop and store electric energy in the devices themselves by scavenging waste energy from human activities. The human activity of walking is an important source of energy harvesting. According to estimations, 67 watts of power are available in the heel movement of an average (68 kg) person walking at a brisk pace. But only a few percentages of this energy is suitable for the alimentation of an electronic device. This problem is looked after by using the energy from the weight transfer during a step to perform useful work. So this paper is focused on the development of an “Easy to Use” and “Cheap General Purpose” device for the storage and management of the harvested energy with particular applications on shoes.

E. A Shoe-Embedded Piezoelectric Energy Harvesting for Wearable Sensors

Wearable sensors are becoming smaller and are being widely used which results in an increasing need for independent and compact power supplies. Electrochemical batteries cannot meet the need because of their limited energy storage capacity and potential environmental and health risks. This has led to the development of wearable energy harvesters, which harvest the mechanical energy dissipated in human motion to provide renewable and clean energy. Piezoelectric energy harvesters and nano-tribo electric generators can convert mechanical energy into electric energy directly and thus their structures are more compact and simpler in comparison to those of other types. The mechanical energy dissipated in shoes can even be used to power a computer, which serves as an attractive energy source for wearable harvesters. This paper develops a shoe-embedded piezoelectric energy harvester, which can be integrated in a shoe easily for energy harvesting from human motion. Two harvester prototypes are made and tested. The first one is made up of a multilayer Poly vinylidene difluoride (PVDF) film and a structure of engineering plastics, which is placed under the heel. The second one is designed as an insole shape and used as a normal insole, consisting of a structure of flexible silicone rubber and two multilayer PVDF films. In order to store the harvested energy and provide a constant DC output voltage, a power management circuit is designed.

F. Optical Device Indicating a Safe Free Path to Blind People

This device consists of a Pathfinder using a LED and a photodiode. An active optical device is implemented to provide an electronic travel aid to improve the mobility of persons who are blind. With the help of radiometric calculations, the protected path is optimized. Typical configurations of obstacles are studied. It has an opening, a side panel, a front panel, and a post of Protection zones is proposed. The results in real configurations such as parked cars, trees, and dustbins are presented too. Finally, it is explained that how the device can be used in real life by visually impaired people, in conjunction with the typical white stick.

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G. Wearable Obstacle Detection System for Visually Impaired People

This paper presents an obstacle detection system to help visually impaired people. User gets alerted of nearest obstacles in range while traveling in their environment with the help of an ultrasonic sensor. The system proposed in this paper detects the nearest obstacles via an ultrasonic sensor and sends back the feedback to the blind person to inform about him/her location. The system aims at increasing the mobility of visually impaired by offering extended sensing abilities.

III. EXISTING SYSTEM

Cane is provided to blind or visual impaired people to navigate the path. Using the stick, blind or visually impaired people come to know about obstacles but they need someone to navigate path. Use of stick is not efficient. It becomes harder for blind people for mobility. Dependency of these people has been increased. Other option to provide the best travel aid for the blinds is the guide dogs. Dogs are trained according to their owner's requirement. Complex situations like cross walks, stairs, potential danger, unknown paths and many more is detected and analyzed. Handle fixed on the dog passes most of the information through tactile feedback. The attitude of his dog is analyzed and thus the user is able to feel and hence analyze the situation. Also, it gives him appropriate orders. But guide-dogs are still far from being affordable, around the price of a nice car, and their average working capability is also limited.

IV. SYSTEM DESIGN

A. Hardware

We are proposing a technique based on IoT implementation. Wearable device i.e. Smart Navigational Shoe is proposed in which an electronic hardware kit is fixed in the shoe, which can be used by blind or visual impaired person. Hardware kit consists of three ultrasonic sensors, four vibrators, one Arduino, Bluetooth connection and one battery.
Functions of the above mentioned components are as follows:

1. Sensors: Sensors are useful to sense any obstacle detected while moving along path.

2. Vibrators: The four vibrators will vibrate according to the path. If left turn needs to be taken according to the navigation, vibrator set on the left side will vibrate. Similarly, the remaining right, front and back vibrators will vibrate respectively.

3. Buzzer: The obstacle detected will be notified to the user with the help of buzzer The buzzer will start beeping after an obstacle comes in the predefined range of the sensor.

4. Bluetooth module: The Bluetooth module is used for serial communication between the hardware and the android application.

5. Arduino: The microcontroller used is ATmega 328. The functioning of all the components is controlled by Arduino.

6. Battery: A battery of 9V is used for power supply.

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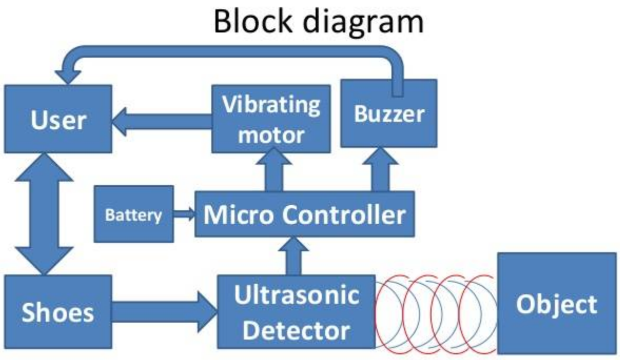

Fig1: Architectural Diagram

Distance calculation between the sensor and obstacle:

When an obstacle comes in contact with the sensors, the distance is calculated, from the sensor and the obstacle. If, obstacle is in the predefined range of 15-20 cms, it is detected and the buzzer starts beeping.
The distance calculation is done by the following formula:

D=1/2*T*C

Where,
L is the distance between the sensor and obstacle
T is the time between the emission and reception
C is the sonic speed.

The value is multiplied by ½ because T is the time for go and return distance.

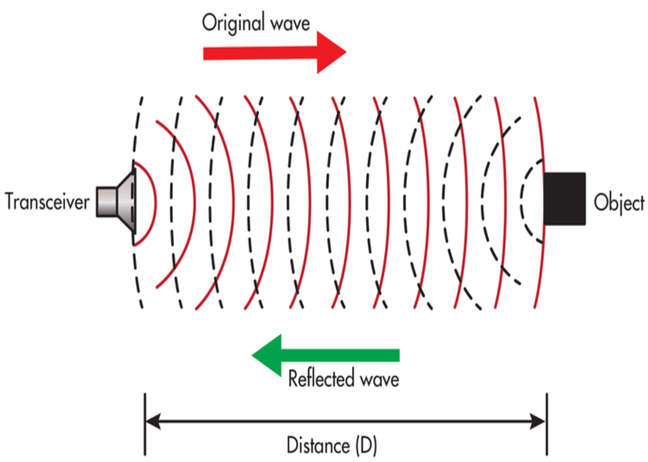

Fig2: Distance calculation between an obstacle and the sensor

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B. *Software*

An android application is developed on a smart mobile device which is integrated with smart navigational shoes with the help of Bluetooth. The android application is able to perform the following functions:

1] Detecting and connecting the smart phone with the navigational shoes with the help of Bluetooth connection.

2] Receiving user input that contains source and destination.

3] Generating directional information according to the given inputs.

Following figure shows the interaction of various components of the system:

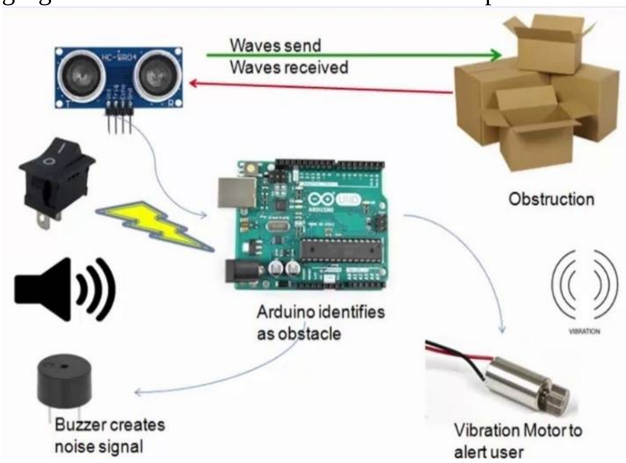

Fig3: Interaction of system components

C. *Algorithm and Flow*

Dijkstra's Shortest path algorithm

1. Function Dijkstra (Graph, source):
2. Create vertex set Q
3. for each vertex v in Graph: // Initialization
4. dist[v] = INFINITY // Unknown distance from source to v
5. prev[v]= UNDEFINED // Previous node in optimal path from source
6. Add v to Q // All nodes initially in Q
7. dist[source]= 0 // Distance from source to source
8. while Q is not empty:
9. u vertex in Q with min dist[u] // Node with the least distance will be selected first
10. remove u from Q
11. for each neighbor v of u: // where v is still in Q.
12. alt dist[u] + length (u, v)
13. if alt< dist[v]: // A shorter path to v has been found
14. dist[v] alt
15. prev[v] u
16. return dist [], prev []

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Obstacle Detection Algorithm

1. Start
2. Read user's source and destination as input.
3. Pass the input to Google Map's api.
4. Start the navigation.
5. If ping returns true, then
6. Calculate the distance of obstacle
7. Return the obstacle detected on front with distance
8. If US sensor returns true, then
9. Return obstacle detection on left or right
10. Repeat steps 5-6 till destination is reached

Flow Chart of the algorithm:

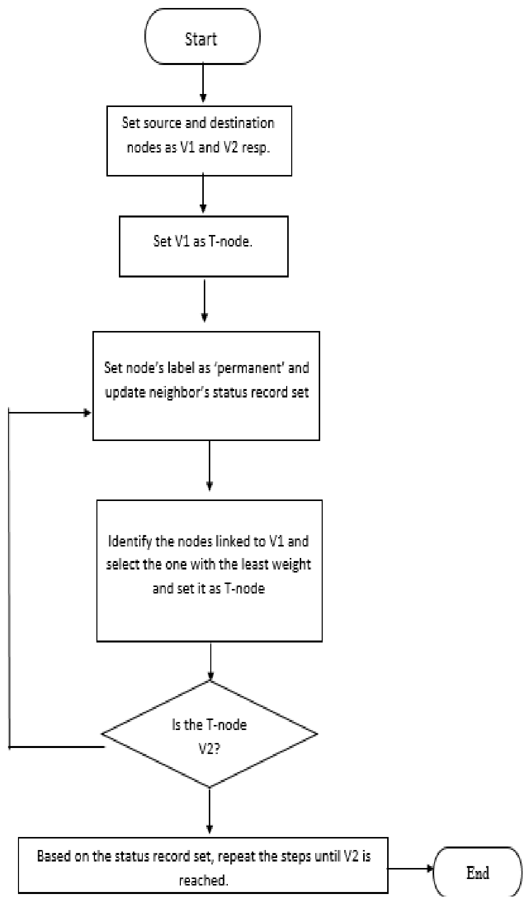

Fig 4. Flow Chart

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IV. ADVANTAGES

1. The comparably lower cost and higher accuracy makes the system affordable.
2. Does not require users to hold or carry their smart phones in the hands.
3. The visually impaired people can travel safely and independently.
4. Distraction-free travel.
5. Automatic rerouting and alerts.
6. Various User-controlled Vibration pattern.
7. User friendly system.
8. Use of shoes is ordinary, hence there is no embarrassment to wear it in public.

V. CONCLUSION

In order to make use of latest technology, we have proposed android based navigational shoes system. Wearable electronic kit is proposed. Main goal of this proposed system is to provide navigational assistance for the visually impaired people. Sensors will be used for detecting obstacles and vibrators will vibrate according to the direction (i.e at the left, right or front). Right vibrator will vibrate when right turn should be taken and left vibrator will vibrate when left turn is to be taken. The front vibrator will vibrate if the person needs to move forward and all the four vibrators will vibrate when the person needs to stop. Our approach is to make an easy hands free and an user-friendly application to make visually impaired person to travel wherever he wants, independently and safely.

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