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Smart Shoes for the Visually Impaired: Integrating Google Assistant and Google Maps

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ABSTRACT

The research paper has been written to help visually impaired persons. As it was observed that while commuting there were many barriers and obstacles which they need to bear. Individually, they face significant risks while moving from one location to another. It is really difficult for them to locate the hurdle instantly in their path, as they are unaware of the barriers in front of them. Based on the previous researches it was seen that visually impaired persons are more prone to accidents, Unintentional injury, mishaps, injuries, and crashes during their journey (Legood et al., 2002; Felson at al. 1989; Arfken et al., 1994; Ivers et al., 1998; Lord, 2006; Glynn at el., 1992; Roberts & Roberts, 1995).

Till now, visually impaired persons are using white cane; which help them scan for obstacles and orientation marks. The cane will also inform the passerby to go slow and take appropriate steps to help them, while they move or walk. In this paper, the authors have tried to build an electronically aided shoe for the help and provide an ease for visually impaired persons. The proposed framework for the e-shoes will identify objects or impediments up to a specific distance and deliver an audio or vibrator alarm message to the receiver. This will help blind persons to recognize objects on their path instantly through an alarm and will prevent any accidents.

Keywords: Ultrasonic Sensors, Arduino-Chip, Obstacles, Visually Impaired, Google Assistance.

1. INTRODUCTION

The National Blindness and Visual Impairment Survey 2015-2019 was conducted in order to provide the evidence about the present status of blindness and visual impairment in India. The survey was planned by the Ministry of Health and Family Welfare, Government of India. Dr Rajendra Prasad Centre for Ophthalmic Sciences, AIIMS, New Delhi was responsible for planning and executing the field work, monitoring, analysis and report writing of the survey. The survey was conducted in partnership with various reputed Eye Health Institutes of the country. The Survey was conducted in aged ≥ 50 years' population using Rapid Assessment of Avoidable Blindness (RAAB) strategy in 31 districts of 24 States/Union Territories of India from September 2015- June 2018. This house-to-house survey was designed to generate representative data for the sampled districts as well as for India. Both rural and urban areas were included in this survey. An additional survey was conducted in 0-49 year's age group in Jan-Feb 2019. [17]

The objective of the survey was:

- To determine the prevalence of blindness and visual impairment (including avoidable blindness). [17]
- To identify the major causes of blindness and visual impairment (including avoidable blindness) in

India. [17]

- To estimate the cataract surgical coverage in India in 50+population. [17]
- To ascertain the visual outcomes after cataract surgery in 50+population. [17]
- To ascertain barriers for uptake of cataract surgery in 50+population. [17]

Fig.1: Survey conducted in 2015-2018

2. OBJECTIVE OF THE STUDY

To design intelligent shoes for visually challenged people so they can feel comfortable & feel free to move in society despite of their weakness. Also, to reduce the accidents which triggers more often due to eye sight.

2.1 Smart Shoes:

The paper focus on developing smart shoes that will be able to detect approaching obstacles on the route and warn/ apprise the blind people about the same. The shoes will also provide the wearer with information about the exact distance and direction of the obstacle. The shoe connects to the user via an Android app to provide audio output through speakers or headphones. The shoe consists of ultrasonic sensors to detect obstacles in the way and a pedometer that can count the number of steps to the point. The researchers firmly believe that the smart shoe will bring a friendlier experience and a good support to blind people.

3. LITERATURE REVIEW

3.1.Smart Shoe for Visually Impaired

This paper will highlight the benefit of Smart Shoes, which is integrated with ultrasonic sensors, vibration sensors and Bluetooth. These shoes can direct the user to his destination and can alert him about the impending obstacles on the path via the attached vibration sensors.

The system needs to be improved as there is no provision for water detection and the components of the shoes can get damaged if it comes in contact with water. Again there is no provision for counting the number of steps to the obstacle [4] [5] [6] [7] [11] [18]

3.2. Smart Navigational Shoes for the BlindObstacle Detection

This paper presents a Shoes with Sensors which will detect obstacles and vibrators will vibrate according to direction. IR sensor is utilized for obstacle detection. This paper will shed light on the notable obstacle and later about the buzzer will turn ON. Additionally, if the water is spilled on the roads, it will be

identifiedby water sensor and the information will be showed on LCD.
counter needs to be installed for locating the exact position of obstacle [18]

3.3 Advanced Shoes for blind people

Advanced shoes can detect the obstacles within a particular distance with the help of ultrasonic sensors and the vibration sensors will vibrate in the direction of detected obstacle. As this paper doesn't have water sensor, the shoes will get damaged in presence of water. The paper doesn't have the provision to find the route to destination as there is no attached GPS and also as there is no step counter, the exact position of obstacle cannot be determined [18]

3.4 Wearable obstacle detection system for visually impaired people

This paper presents an obstacle detection system that can alert the blind people about obstacles while travelling. The proposed systemcan detect the nearest obstacle via a stereoscopic sonar system and sends back vibro-tactile feedback to inform the user about its location. The main aim of the system is to increase the mobility of visually impaired people by offering new sensing abilities. The system needs to be improved as there is no water sensor and shoes can get damaged in water, also a step counter need to be installed for locating the exact position of obstacle. [18]

3.5 Wearable navigation assistance - a tool forthe blind

This paper describes tool for navigation for visually impaired persons. The system includes a multi-sensory system (comprising stereo vision, acoustic range finding and movement sensors), a mapper, a warning system and a tactile human-machine interface. The goal of the paper is to provide an electronic tool for the blindto navigate. The system provides information about the direct surroundings to blind to help him move without collisions. counter needs to be installed for locating the exact position of obstacle [18]

4. EXISTING SYSTEM

Walking sticks, also popularly known as white canes are provided for the blind as navigation aids. Blind people can use sticks to find obstacles in their way, yet they always seek for help to find their way. They're always relying on someone to navigate, so polesaren't effective.

4.1 Service dogs

Another option is to provide guide dogs for the blind. Guide dogs are dogs that are specially trained to help the visually challenged. These dogs are trained according to the owner's requirements. However, not everyone can afford guide dogs as some of our may be allergic to them as well as they are very expensive. Servicedogs are dogs that are trained to help their owner with a specific disability. For example, dogs can be trained to pick things up, visually guide those with visual impairments, and remind you to take medication, or help those with poor balance. [12]

Fig. 2: Service Dog [12]

4.2 Canes

Fig. 3: White Canes [13]

The weakness in the system, needs to be improved as there is no water sensor and shoes can get damaged in water, also a stepVarious types of canes, most popularly the long cane, which can help individuals who are blind or have low vision navigate with confidence. [12]

4.3 Electronic mobility aids

Electronic mobility aids are devices that use ultrasonic waves to reflect off of obstacles in front of the individual to tell them what iscoming in front of them. The usefulness of these devices is debatedand they often need to be used in conjunction with a long cane or a service dog. Some examples include:

- **Ray Electronic Mobility Aid**

This is a very small and handy device help detects obstacles up to
9.35 feet away. The user is intimated via audio signal once anobject is detected [12].

Fig. 4: Ray Electronic Cane [14]

- **Ultra-cane**

The Ultra Cane is a combination of an electronic mobility aid and a long cane. The cane itself emits ultrasonic waves so that the user can detect objects in front of them and at head level [12].

Fig. 5: Ultra-Cane [15]

5. PROPOSED SYSTEM

5.1. Ultra-Sonic Sensor

Ultrasonic sensing element is employed to live the distance. It's done by exploitation sound waves generation in such an order that they discover the obstacles nearby. The time for wave to comeback is noted down so the gap is defined. It's attainable to calculate the distance between the echo sounder sensor and therefore the object.

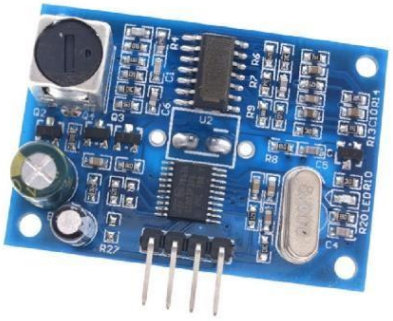

Fig. 6: Ultra-Sonic Sensor [2]

5.2.Arduino Nano

Arduino Nano is a micro-controller board consists of 14 pins whichare classified as input and output pins of which 6 are pwm-output and 6 are Analog inputs. It has all the specifications that a microcontroller should have and a charging port to power it.[1]

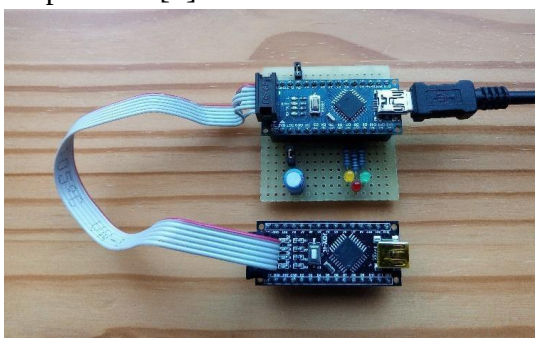

Fig. 7: Arduino Nano [3]

5.3. Solar Panel

Solar panel will be used in shoes to auto-generate the power of 2 to5 watts by using sun rays. The solar panel will have an efficiencyof 25% as of other solar panels.

Fig. 8: Solar Panel [4]

5.4. Capacitor

In this proposed study the role of capacitor is to receives the energy directly from the sun with the help of embedded solar panel's which helps in charging the shoe's battery. The most ideal size of the capacitor used in this are 26v and 1200uf respectively. Now, here we have 1 main non-conductive area which further separates it into 2 equally different non-conducive regions. And, then the non- conductive region is coined as di-electric which can be either vacuum or electrical insulator. Also, they are available in several materials like; plastic, paper and ceramic, etc.

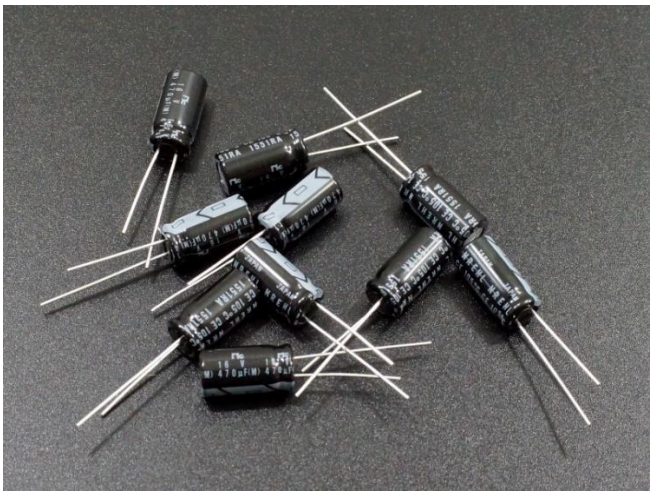

Fig. 9: Capacitors [5]

5.5 Diode

It directs the energy to the battery from the capacitor and blocks the energy reversal to the circuit. It conducts current only in one direction one side of it has high resistance and other it has low resistance. It is two terminal components

Normal Rectifier diodes

Rectifier diodes with heat sink

Fig. 10: Diode [6]

5.6 Bluetooth

The Bluetooth used is HC-05, it is a serial port protocol which helps to connect with the Ear Pods or earphones or mobile-phone's Bluetooth so that the user will get intimation about the any obstacle or any kind of hurdles.

Fig. 11: Bluetooth [7]

5.7. Camera

As of now, the Tec-Innovation is now working on embedding an AI-powered camera as part of a new iteration of the product. The system detects two pieces of information that are key to avoiding obstacles– the nature of an obstacle and its directional path, especially if downward facing, such as holes or stairs leading into asubway. [16]

'Not only is the warning that the user is facing an obstacle, but alsothe information about what kind of obstacle the user is facing. As, it makes a big difference whether it's a wall, a car or a staircase,' said Raffer. [16]

Fig. 12: Camera [16]

5.8. Google Assistant

The main aim to use the google assistance is that one can find information and get things done with Google Assistant while walking. User can ask a question and also tell it to do things in Google Maps so that the user can focus on the road. It offers voice commands, voice searching, and voice-activated device control,

The Bluetooth used is HC-05, it is a serial port protocol whichhelps to connect with the Ear Pods or earphones or mobile-phone's Bluetooth so that the user will get intimation about the any obstacle or any kind of hurdles.

letting you complete a number of tasks after you've said the "OK Google" or "Hey Google". It is designed to give you conversationalinteractions. Google Assistant will: Control your devices and your smart home [8].

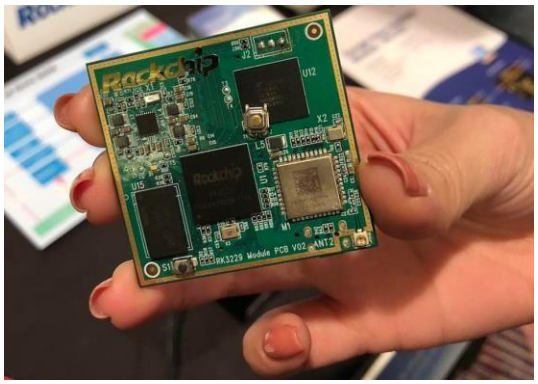

Fig. 13: Google Assistant [9]

5.8.1 Features of Google Assistant

- It allows users to set a precise geographic location for the device to enable improved location-specific queries. In other Words; it allows user access google map & set the desired destination just by saying – "set navigation to the desired destination.
- Also, user can make a call, or send a text in emergencies situations (SOS).

5.9. Google Map

This is most helpful & the main Feature of this model using google map which will provide the user with the directions to reach the destinations. So, in view of this, the authors have decided to embed the Google Maps in the shoes which will help visually challenged people navigate the way and assure that they are on the right route. The Google Map will help you know when anyone is approaching a turn – it also lets them know if they are approaching an intersection, and alerts them if they leave the route. Therefore, it is called as "smart shoes". Google Maps also offers Voice Guidance for Visually Challenged Users.

Fig. 14: Google map [10]

5.9.1 Features of Google Map

- It helps the user to reach his/her destinations easily with the help of voice guidance and no human intervention for safe and comfortable journey
- It is very easy to enable the voice guidance feature, user just have to say "hey google" start the navigation to the desired destination and it will start
- Supposing, the user wants to change his/her desire location in middle of the route then google map also offers the feature to change it in between.
- Also, map offers more detailed voice guidance then before by letting they know if there are approaching an intersection or alert them for the same.

6 SMART-SHOE'S WORKING

Many visually impaired individuals require head out helps to explore in obscure environments. The paper present Smart Shoes which will empower the outwardly impeded users with portability debilitation to keep away from obstacles. By leveraging existing mechanical technology technologies, our framework distinguishes obstructions like checks, and flights of stairs in the ground or in any event, moving articles, and communicates hurdle data through haptic input (vibrations and beeps). Initial examinations show that our gadget empowers the visually impaired clients to navigate safely in indoor and outside conditions. [11]

Being blind generally refers to a complete lack of functional vision. However, visual deficiency involves varying levels of vision ability, sometimes under varying conditions. Vision is the result of light rays hitting the back of the eye, or retina, and then the optic nerve transmitting electrical signals to the brain. Blindness occurs when an inadequate amount of light hits the retina, or the information has not been delivered to the brain correctly. Examples of the targeted visually impaired users shown in Table1 [11].

	USER	NOTES
User-1	Legally blind person	Complete blindness
User-2	Night blind person	

Table 1: Targeted Users [11]

6.5 BLOCK DIAGRAM

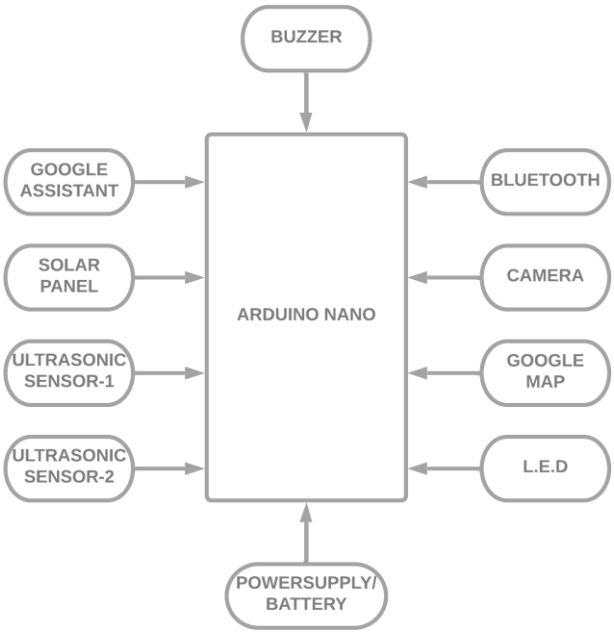

Fig. 15: Block Diagram- Smart Shoes [10]

7 SYSTEM TESTING

A circuit of 10 dual color LED flasher (Not using Flashing LED) which blinks one by one in sequence. This circuit is based on popular counter circuit using 4017 and 555. One color of all LED remains fix and second color of all LEDs in running mode one by one. This gives a very cool and interesting visual lighting effect. Circuit is simple and no used any microcontroller. In this LED blinker circuit 1 IC and 1 CD4017 used to produce counting output. 2 NOT GATE inverter IC used to Change the supply alternate for changing color of LED by inverting the input supply on LED. 555 timer IC is used to create random clocked pulse signal for the changing the output through counter IC 4017. As you know that when the pulse signal at input pin 14 of IC 4017 get then according to each clock pulse changing, the output is on (High) one by one. The output of 4017 is starting from pin 3 (output 0), pin 2 (output 1), pin 4(output 2), pin 7 (output 3) and so on up to pin 11 (output 9). All output of 4017 ic connected with NOT GATE inverter input and output of all inverter input is also connected with second pin of bicolor led. Not gate

inverter is the logic that changed the signal from High to Low or Low to High. Here Low means negative or 0 and high means positive or 1. At first, when circuit is turn on then all LEDs will glow at fix color/ any one color and as soon counter.

IC 4017 starts counting output one by one LED changes the color in running effect. User can understand the working of this as, whenthe input positive signal gives the **4017** to Inverter input then it converts it in negative and give to led, in this condition only one leg of led get positive supply so only one-color glow because one wire is directly connected with before inverter input to led input.

When output of 4017 is Low, then inverter converts high and this goes to second leg of LED, and only the color will glow and otheris off. Negative supply of ground (common) pin of All LEDs connected through 100th ohm resistor. The flashing effect is increased or decreased by changing the value by moving of Variable Resistor VR1 or changing the capacitor value of C1 [19].

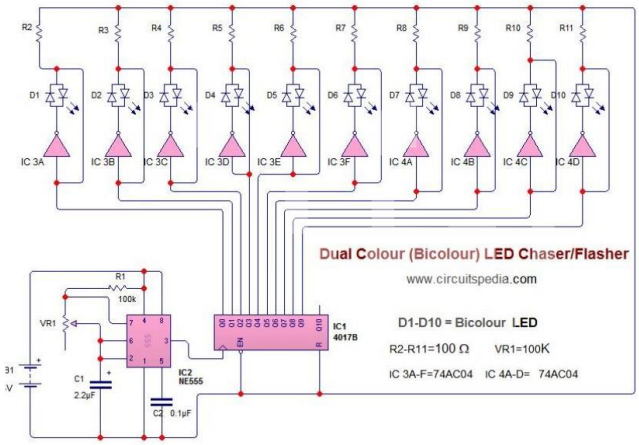

Fig. 16: System Testing [19]

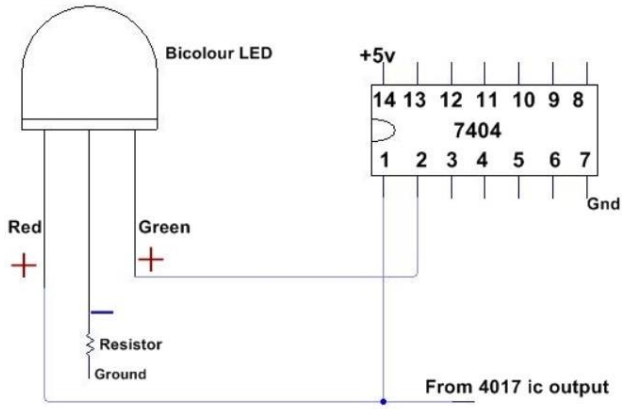

Fig. 17: System Testing with 4017 [19]

7.5 Components Used:

NE555 ic- 1
4017 ic-1
74AC04 (7404) ic-2
Bicolor LED-10Preset (100K)-1
Resistor - 100Ω-10, 100k-1 Capacitor - 2.2uf 16v-1, 0.1uf-1

8 CONCLUSION

This has been tested that the designed support system is accurate in identifying obstacles and informing the visually impaired person to make their way to their destination, seamlessly without encountering any obstacles.

The ultrasonic sensor has been completely employed to help blind and visually impaired persons move around in a safe and autonomous manner. This system does not necessitate the holding of a large gadget over a long distance, nor does it necessitate any specific training. This technique also eliminates constraints associated with the majority of movement issues that may affect blind persons in their environment.

9 FUTURE SCOPE

Future work will focus on improving system performance upgrades and latest security patches. The images obtained with webcams and NISMART cameras help identify objects and analyze the entire cases to have the presence of the number of objects on the path of the blind. It can also detect materials and shapes of the object. The corresponding rate must be right almost all the time because there is no chance to fix. The principles of mono pulse radar can be used to identify long distance target objects. Other possible application areas include a new concept of neural network-based safe and optimal path detection for blind people.

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