



## Application Based Local And Outdoor navigation System For Visually Impaired People

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### Abstract

Travelling for blind people is risky. They do not have confidence to travel more distance and they have to depend on others for travelling. Hence in the present proposed work Application based local and outdoor navigation system for visually impaired people is developed. A blind cane along with the Android Application is developed, which will assist the blind in travelling from one place to other i.e., either indoor or outdoor. The proposed system is based on application for outdoor navigation system for visually impaired people to navigate from one place to another place..The developed system contains a micro controller ATMEGA328p, which processes the signals or information obtained from the sensors and identifies obstacles like pot holes, Water present, fire exploration etc. and conveys the same information as audio signal. Android studio is used to develop an Application for blind person that is interfaced with the Google maps and helps him to navigate from one location to

other location when the person is travelling outdoor. The developed product is cased which is very light in weight, easy to operate, cost effective, reliable and portable.

**Key Words:** ATMEGA 328p, Sensors, Android Application, Visually impaired, Navigation.

## 1 Introduction

Human brain obtains information using the 5 senses and most of the information is sent by eyes. World Health Organization (WHO) reports that over 4% of the total population is blind. Majority of the blind people have low income and are 50 years of age or above and are not capable of obtaining information from eyes. Initially they were taking assistance of dogs to travel from one place to another. As there are many drawbacks associated with dogs like training period is long, hygiene, maintenance etc., these dogs were replaced by canes. By using these canes person can navigate indoor or outdoor but when a person is moving along with these canes, he may not be able to identify the obstacle until he reaches very near to obstacle. Hence to detect these obstacles from a safe distance, a new technology, embedded system technology [1] is used, which provides extra sensors to help the blind person. Using this new technology, Smart canes are developed which will provide the information about the obstacle ahead of the actual arrival, so that the person can be cautious and can avoid obstacle. By using the current Embedded system technology, smart canes are developed but these smart canes which are developed before is mainly based on tactile and vibrations. This kind of feedback mechanism and methodology is not reliable, as the person needs to be more attentive and cannot neglect any kind of information during his journey. Thus this proposed work deals with the interfacing of sensors along with the voice message for obstacle detection [2] in front of him and navigating a person from one place to other place by using an application. This system helps him to identify the pot holes present on his way thus preventing him from falling. This proposed system will also warn him about water and fire ahead of him thus helping him to reach his destination accurately and safely. The following Fig.1 depicts the microcontroller along with the sensors that are interfaced.

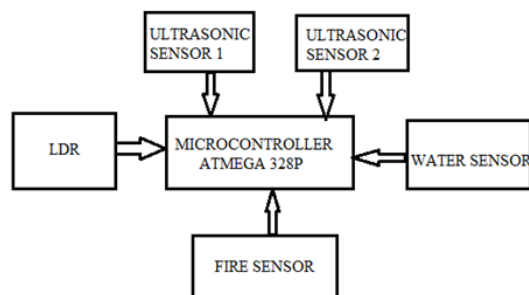


Fig.1. Micro controller with sensors.

The rest of the paper deals with the literature survey in section II. Section III contains the methodology of proposed system, Section IV deals with the results evaluation and finally section V concludes the paper and gives some insights to the future scope work.

## 2 RELATED WORKS

The research on blind navigation is taking place since many years as to help the blind people to be independent. The following are some of the works carried out at early stages. Iyad Abu Doush [3], has developed an innovative approach which will allow the person to navigate indoor. The technologies used in this approach are WiFi, RFID(Radio Frequency Identification), Bluetooth and a smart phone, which helps the blind person to find the correct object that he is looking for with great accuracy. Heterogeneous wireless technologies are applied to utilize several localizing techniques to improve the level of accuracy in the navigation process and this approach helps the blind to navigate in indoor to a particular location and locate the required object in that location with an accuracy of 10cm. Roman Kessler[4], has developed a method in which blind people with get the information about the direction through Vibrotactile. By using two tactors, different directions are conveyed. These directions are coded through the temporal structure of the stimuli and this vibrotactile simulations are provided to both the hands, then the directions are coded on the computer screen using the temporal structure of stimuli and obtained a direction accuracy of 15- 20 degrees. A. Aladrn et al[5], has developed a system, Navigation assistance for visually impaired people which

is depending on information related to visual and range. In this proposed work the authors have choose RGB-D camera, through which the images are taken and a laptop which will analyse the obtained images. The obtained images are processed to get the range information, colour information and depth information to obtain obstacle on their path. The obtained images are enhanced using long range visual information as the obtained images are of short range. Hence by using the processed images the device will notify the person about the obstacles, to navigate safely in the indoor environment. Carlos Solon S. GuimaresJunior[6], has developed a system using electronic devices, which help the person during his journey. The control algorithm is used to provide vibrations and audio output for transducers. The sensors are interfaced to the microcontroller and based on control algorithm the microcontroller processes the signals and provides the information in the form of vibrations. GPS is used which will indicate the exact location of the visually impaired person and sends the same information through the GSM module. Yang Tao et al [7],introduced first validation framework for indoor way finding system for blind and visually impaired. The blind person requires detailed navigation instructions based on the landmarks available. In this proposed work they provided navigation instructions from a smartphone which has accessible user interface and automatic generation of detailed landmark based indoor navigation instructions was done. Firstly they created virtual representation of the indoor environment around then embody of blind person is created. Then the action code is generated using Standford NLP packages and the navigation instructions are enabled after that using Sikuli script library. Cang Ye and Xi-angfeiQian[8], presented a 3D object recognition system for robotics navigation based on real time detection of indoor objects. In this method they segments a 3D point cloud into planar patches that are the plane of a model object. Real time recognition is obtained using 9 Inter Plane Relationships and plane classification is done using 6 High Level Features. They reduced the computational cost in object recognition by using less Inter Plane Relationships. The use of one Gaussian Mixture Model increased the scalability and parallelism. The device detected non-structural objects providing the user environment awareness useful for navigation. The disadvantages of aforementioned paper arevibrotactile stimulations are

used to convey information related to obstacles. To act properly according to the obtained information the person should be alert all the time and he cannot miss any of this information to have safe journey. The processing time of the obtained signals is more. During image processing lot of memory is wasted to store the values. To navigate out door, these visually impaired people are depending on others to reach their destination safely. Thus our proposed work will eliminate all the disadvantages mentioned before and provides information in the form of audio signals. Our proposed system also contains an application which helps the blind people to navigate out door.

### 3 PROPOSED SYSTEM

The main objective of the proposed work is to make the life of the visually impaired persons safe and independent both in indoor[9] and outdoor navigation. To make them independent is a challenging task and this can be achieved by using embedded technology, where a micro-controller will interact with the sensors interfaced and provide necessary information to the person. This system will help them in making their movement comfortable by using obstacle avoidance and related voice commands are generated thus making their mobility smooth. The blind person can hear these instructions with the help of a Bluetooth headset.

A mobile application is also developed to help them navigate for outdoor locations[10]. Thus our proposed work is divided into two parts:

- i) Local Navigation and
- ii) Out door Navigation.

**i) Local Navigation:** This system consists of different sensors combined for obstacle detection interfaced with Atmega-328[9] micro-controller. Fig.2. shows, how sensors are interfaced to the micro-controller in the proposed work.

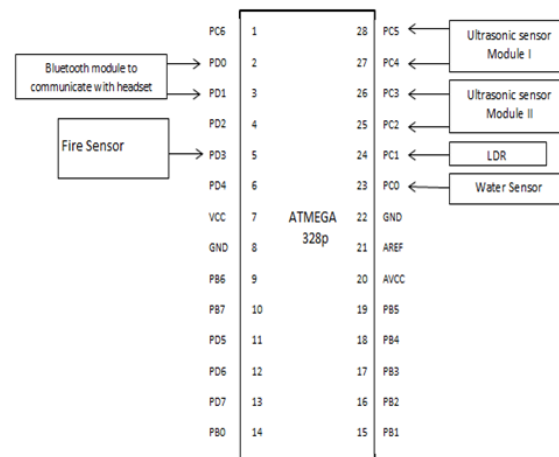


Fig. 2. Microcontroller with sensors

The sensors that it consists are:

**a) Ultrasonic Sensor:** Two ultrasonic sensors are used in our proposed system. One is used to detect obstacles ahead and the other is used to detect the potholes. Ultrasonic sensors send signal in the form of sound wave through trig and the receiver of the sensor, echo receives the reflected signal if there is any obstacle ahead. If the obstacle is at a distance of 200 cm then the warning to the blind person is given in the form of an audio signal "caution" even after this warning if the blind person did not change the direction and has reached 100 cm away from the obstacle then he gets the second warning as "Danger change direction". The next big danger for visually impaired person is the potholes on the road because of which he can fall and get injured. To avoid this situation the second ultrasonic sensor is used which is placed at 10cm from the bottom of the stick. This sensor is facing downwards such that whenever the distance is more than 1c m it will detect it as pothole.

**b) Water Sensor:** This module is interfaced with the microcontroller to detect rain or if water is there due to any water leakage in the blind persons pathway. If water is present ahead of him then the warning is given in the form of audio signal "water detected" and helps the person to avoid water on his way to destination and provides information to change the direction.

**c) Light Dependent Resistor:** It is a component which is having variable resistance that depends upon the intensity of light. Thus

it can be used to sense whether its dark or bright around of a blind person. Whenever the light intensity is low, LDR will detect the presence or absence of light and the output is provided in the form of voice signal as "Low Light". Thus the blind person can be informed whether its day or night.

**d) Fire Sensor:** As the name indicates this is used to protect the visually impaired person against some fire related emergency. If the blind person is heading towards fire then this system helps him by giving warning way ahead and intimates the person about the danger by warning him to STOP Fire detected. Fig.3 shows the hardware connections for local navigation which helps the person to find out local obstacles and dangers on his way when he is travelling from one place to other place. This will help the person to reach the destination safely without others help.

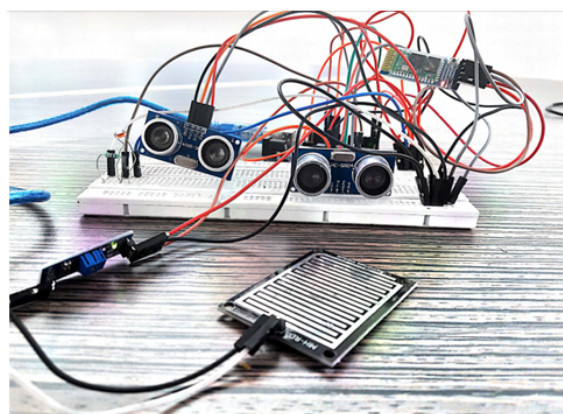


Fig.3. Hardware Connections of proposed work.

**ii) Outdoor Navigation:** To facilitate the movement in outdoor scenario an Android platform based application is developed which can easily be converted to iOS iPhone platform. To develop this application along with android studio platform ,Google map API [11] is used to provide out door navigation for the blind. This application is developed using Android studio so that it can use all the functionalities of Android. It is developed in such a way that its GUI is easily accessible for a blind person. As soon as the user clicks on the application, it asks to tell destination address and then repeats the destinations to confirm whether its right or

not. If the destination is right then he needs to tap on the screen twice to go further where it will take it directly to the Google maps walking option and he will get all the instructions through voice command. If the destination is wrong then he need to tap once to cancel and start the procedure once again. During outdoor navigation the hardware components interfaced with the navigation cane [12] will provide him the local navigation obstacles and helps him to overcome the difficulties on his way and help him to reach safely.

## 4 RESULTS

The proposed system is developed according to the requirement by using various hardware components and tested in the real time scenario. The testing of individual sensor or component is done separately and then all the components are interfaced simultaneously to a single Microcontroller ATMEGA328p and the system as a whole is tested to achieve the intended results. Thus the Navigation cane for visually impaired person is tested in the practical scenario in two phases, that is local navigation phase and outdoor navigation phase and the results cleared that the proposed system is working fine as intended and delivering the information in the form of voice messages. During first phase of testing all the sensors interfaced are checked thoroughly i.e., the LDR used is indicating about the amount of light present in the room, Ultrasonic sensor is detecting the obstacles present ahead and warning the person about the pot-holes, Water sensor is detecting the water present and intimating the person about the water and warning him to walk slowly, fire sensor is warning him about the fire present in front of the person and notifying the person to stop. The second phase of testing is testing an application which is developed for the visually impaired person along with the sensors. The application is developed using Android studio, using which an .apk file is generated using android studio. Using this .apk one need to download the application and this application helps the person to navigate out doorthat is from one location to other location. The application is taking the destination location through the voice command and the path is set based on the longitude and latitude and navigating the person to

his destination by intimating the person about the total distance of travel, when to take left, when to take right and if the person goes in the wrong direction then it will reinitialize the path and intimate the person how much he should come back to reach his destination correctly. The following Fig.4.depicts the application developed, which helps the person to navigate from one place to other place. Detailed working procedure of the application is explained in the following steps.

Step1: The application is to be installed in the mobile which helps us to install Map Navigation application.



Fig.4. Application installation window

Step2: Once install button is clicked the application will be installed in the Android mobile and then it will ask to give the destination location by tapping on the mic as shown in Fig.5.



Fig.5. Location entry in application

Step 3: Once given through the voice it will ask to confirm the destination location by double tapping if done then the path is initialized as shown in Fig.6. and the directions will be provided to the person through voice commands which helps him to take correct path during navigation.

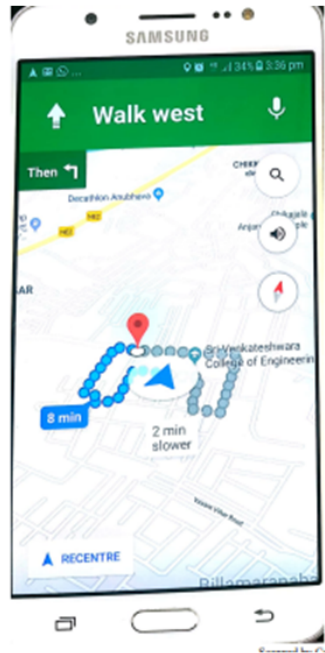


Fig.6. Application taking to Google maps

## 5 CONCLUSION

In the proposed work, Application based Local and Outdoor Navigation System for Visually Impaired person is developed, which helps the blind people to be independent and safe. The proposed system is easy to use, portable and cost effective. The sensors are interfaced to provide the person to avoid all kinds of dangers during his travel. It consists of ultrasonic sensors which is helping him to find the obstacles and to detect the pothole present, as most of the people are in trouble due to the obstacles on the path and due to the potholes. As all the information is in the form of voice through the Bluetooth headset, they can easily obtain the information that is required at the right time. An Android application is also developed which is helping the person to navigation in unknown locations outdoor. This application will give him directions through the voice commands and guides the person to travel in right direction. The proposed system is tested in real scenario and obtained 90% of ac-

curacy and the person could navigate safely and correctly to the desired location. The future scope of the work is to provide some sensors which helps him to identify a moving vehicle with speed and also to identify traffic signals color and take the step according to the color of the signal, which helps him to cross the road safely and securely near the signals.

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