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Development of Smart Navigation System using GSM and RFID Technology in Indoor Surroundings

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Abstract: **The primary goal of this work is to develop a smart navigation system using global system for mobile communication (GSM) and radio frequency identification (RFID) to assist the blind people to notice hindrances and navigate in the direction to target. Maximum of the blind individuals in the world use white sticks to travel from one place to another place. Due to their blindness, they are unable to be aware of their environment. The flexibility of the visually impaired persons is limited in number. The purpose of this development is to design a navigation system that will be able to direct a visually impaired person securely and comfortably in an indoor situation. This goal is to use an ultrasonic sensor to find out the range of hindrances. and a microcontroller to perform according to the receiving input. The arrangement includes a warning instruction through voice translation and a buzzer sound.**

It can be simply operated by a blind person by identification of hindrances by using the ultrasonic sensor device. Here GSM works as a mobile telephone which gives information about the emergency condition experienced by the blind. Project aims to provide accurate directions to the blind with help of RFID reader and tags. It is a flexible navigation system which gives information to a blind person with about the shortest routes and to authorize him to travel universally exclusive of accidents.

Index Terms: **GSM module, Rfid, microcontroller, ultrasonic sensor.**

I. Introduction

Contemporary world has come across different kinds of techniques. Visually weakened persons face limitations in independent flexibility and navigation. Flexibility means the prospect of generously moving, deprived of any additional person, at home-based and aware circumstances. Individuals with visual loss tackle huge restrictions in terms of suppleness.

Blindness is the visual impairment due to physiological or neurological aspects partly or completely. The foremost concept of this paper is to deliver an automated assistance to the blind to overcome visual hurdles and to provide efficient, simple, configurable automatic navigation system to them and to automate impaired perambulators. Ultrasonic sensor is the planned automatic assistance which senses the hindrances in his path by uninterruptedly conveying the ultrasonic signals. While a hindrance performs in its locality then the ultrasonic signals become echoed to the system directly. And formerly ultrasonic receiver observes these ultrasonic signals. This technique supports the microcontroller to get the information from ultrasonic signals. It alarms blind perambulators by voice communication. The benefit of our project is to provide voice-based message to a blind pedestrian to enable him through a busy street. Furthermore, this system is an auditory supervision system for the visually impaired walkers in which it converts ultrasonic waves to auditory signals.

India has a great deal of blind population. Out of 37 million, half of 15 million people who are blind are from India. Most of them are dependents and poor. This paper suggests a navigation system that comprises a white stick capable of sleuthing obstacles and delivering response. Blind people are efficient in hearing, and they hold strong sensibilities than ordinary people. Hence this innovative navigation system is designed for helping the blind people to circumnavigate everywhere securely and safely. There is no need to move the white stick around to perceive obstacles as they move an ordinary stick. The user can effortlessly walk with the help of white stick and continuously acquire information about hindrances around with the help of ultrasonic device. Good deal of research is being done on building a navigation system for the visually diminished people. Many researchers address this task in indoor as well as outdoor environment [1]. However, most of these methods have limitations and challenges (e.g., usability, coverage, accurateness, Interoperability) which are difficult to report with the present knowledge.

Electronic transportable devices are planned and developed to support the blind people to navigate securely and self-sufficiently. Various devices available for indicating directions are not affordable and tough to handle. The project described here offers a cost effective and dependable resolution to the above problem. The primary goal of our project is to propose a small and simple direction-finding device to support the blind people to get route instructions through voice message which varies on the real-time assistance deliver by the Rfid tags. It is used to find the location where the person is located on the earth planet.

Voice appreciation mechanism is to recognize and understand the system and translate audio signals into transcript or instructions.

The project uses controlled power supply to provide fixed 5V DC voltage. The different type of sensors is used in this project plan for different purposes. Ultrasonic sensor is used to perceive obstacles. An IR sensor is used to locate man-

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hole or a set of steps . A water level sensor is used to sense the water level. The output received from any of mentioned sensors gives information to Arduino nano controller. The controller activates voice sensor, which in turn activates the speaker and buzzer to alert the blind person.

The output will come out in the form of audio speech from speaker. RFID assists in finding the position of the blind person. GSM module acts as mobile telephone which can also be used for taking and receiving calls, transmitting, and getting SMS and MMS messages.

II. Lieterature Review

The author boyina anticipated that the project title was development of blind navigation system using GPS and voice recognition. This paper includes ARM7 micro controller, GPS receiver, Zigbee transceiver, LCD display, ultrasonic sensor, speech recognition HM 2007 IC, APR 9600 speech unit. Here the GPS is used to record the latitude, altitude, and longitude values continuously.

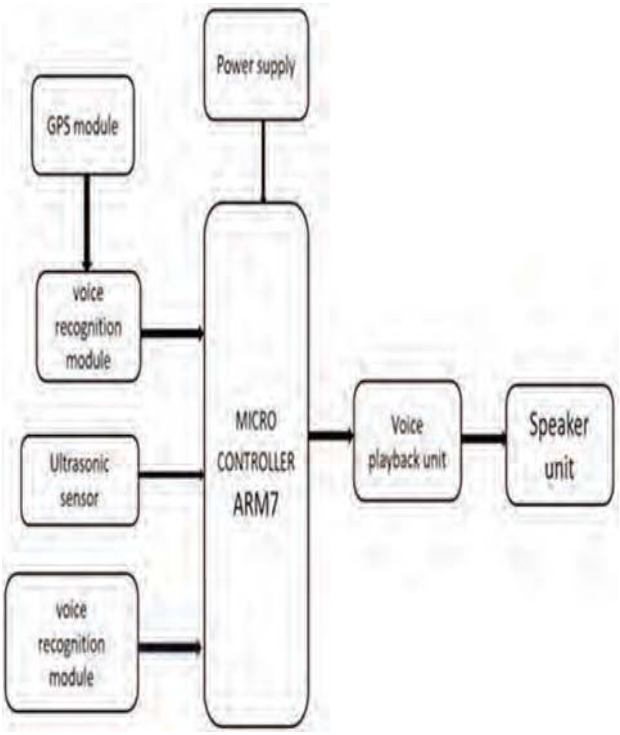

Figure 1. Block diagram of voice and GPS based blind navigation system

This GPS is interfaced with the ARM7 microcontroller after it will display the latitude, altitude, and longitude values on the liquid crystal display (LCD) unit. And the ARM microcontroller is programmed to the ultrasonic sensor. So that we can find out the distance between the obstacles and blind stick. Ultrasonic sensor sends ultrasonic waves continuously with the frequency of 39khz through the oscillator which is inbuilt itself in the sensor only. Then by using the signal conditioner module it will convert getting analog signal into the digital signal. And it is linked to ARM microcontroller. The sensor proposals a resonance pulse proportional to the distance [2].

The Author dhruv jain developed a project, Roshni. This is used for indoor navigation of the blind people. This project comprises of functional elements to determine the user's location in a large building, a complete internal map of that building and it can be used a mobile application. Through pressing buttons on a mobile phone, orientation, instructions concerning location, and direction-finding can be found from this project plan via voice instructions.

The navigation system using RFID technology was proposed by the author Punit Dharani. This delivers a technological explanation for the blind people to journey through public places by using RFID tags and reader.

The author Parth Mehta presented a novel interior navigation system for blind people. This paper demonstrates a structure in which uses magnetic compass and the IR sensor. which is a handheld device to determine the location and orientation of person in a fast and robust by using a voice with GPS module is inserted inside environment.

Koley developed a project with the title, A voice based outdoor Navigation system for blind. This system is made up of GPS module, voice module and ultrasonic sensor for hindrance detection. The GPS gives the current location of blind person, and it provides directions to reach respective remote destination. Nevertheless, this structure delivers text/audio direction, but it doesn't able to detect obstacles and doesn't give warning instructions.

In this proposed navigation system primarily concentrates on two things:

(i). Observing the direct surroundings of blind persons against obstacles and

(ii). Notice about the hindrances with the help of buzzer, vibration, and voice output system.

This navigation system is efficient and a cutting-edge instrument for both indoor and outdoor environment.

The Author projected on Ultrasonic sensor-based navigation System. In this system, the project mission is to perform functions given below:

Recognition of hindrances by using the ultrasonic sensors, Operation to get vibrational alert and voice output system by using vibrator motor and APR9600 voice module. The arrangement comprises mainly three ultrasonic sensors HC- SR04. These sensors will be perceiving the barriers in the pathway. Total project is developed by using ATMEGA16 microcontroller. This controller detects distance with the help of ultrasonic sensors by using delicate motor circuitry to generate vibrational alert. APR9600 voice module is interfaced to get an audio speech output. Therefore, the person will identify the direction of the hindrance and observe its distance. Aim of the system is to build a transportable, simple and ease, cost effective stick. This will help blind people to travel in unskilled location.

The project system guides or support the blind. This is done with the help of voice or audio commands. Research is on to design a blind navigation system with different technologies. Most of technologies have some limitations. These limitations include accurateness, interoperability, attention and usability. These are difficult to overcome with existing technologies.

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III. Proposed System

The proposed block diagram of blind navigation system is shown in Figure 2.

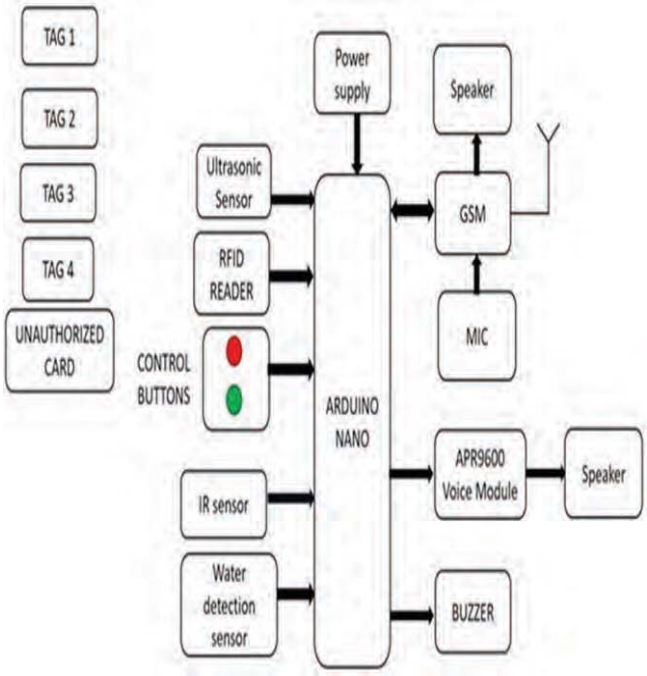

Figure 2. Block diagram of blind navigation system using GSM and RFID.

In the proposed project, it comprises many devices for the operation of the system these devices include Arduino nano microcontroller, infrared (IR) sensor, ultrasonic sensor, water level sensor, APR9600 voice module, speaker, power supply, RFID reader module, RFID tags and GSM module etc. Comprehensive explanation with circuit details of various blocks is presented as follows:

A. Arduino nano

The fig 3 shows Arduino nano microcontroller. It is a compatible, small, flexible, and bread board-friendly based on the ATmega328 microcontroller. It operates at low voltage 5v. This board use mini-USB cable for connection with a computer, to run code.

Figure 3. Arduino nano

B. Ultrasonic sensor

This sensor sends ultrasonic waves into the air then it notices and then reflect waves from object. Ultrasonic signals are resonances which can't be heard and commonly the frequencies above 20 khz.

Figure 4. Ultrasonic sensor

To observe the existence of an object, ultrasonic signals are replicated on objects. It is used to sense hindrances then it alerts the blind person through speaker with an audio device.

C. IR sensor

IR sensor stands for infrared sensor. Here the work of IR sensor having a LED and a photodiode. If there is any of objects like stairs, pit holes in the road path, then this sensor alerts blind person through an audio device.

D. GSM module

The Fig. 4 demonstrates GSM module. The full form of GSM is Global System for Mobilecommunication. It is acts as a mobile telephone which is used to send messages to any person connected to GSM unit when the blind person is in danger. Whenever the blind person is in trouble or in danger, he needs to press emergency switch then the SMS goes to family members or nearby police through GSM.

Figure 5. GSM module

E. APR9600 Speech IC unit

The Fig. 5 represents APR9600 speech IC. This IC unit sends true solo-chip voice recording, non-volatile storage, and repeat capability for 40 to 60 seconds. Now this is used to replicate the speech signals in the ordinary procedure.

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Figure 6. APR voice module

F. RFID

RFID is stands for radio frequency identification. RFID is like wireless communication technologies such as Bluetooth, Long range radio (LoRa), radio transmitters etc. Systems are made up of two apparatuses, tags, and readers. Tags comprise data, and readers sense the tag and process the data from the tags. The tags should be in range. It has a small amount of memory that stores a unique tag identifier (TID), which is constant, not changeable. The little bit of information left on tag can be read-only or writeable, depending on how the tag was designed.

It is a new technique to give the location of person. RFID reader is a module which reads the ID data stored in RFID tags. This ID data is different for each tag which cannot be copied.

IV. METHODOLOGY

A. Flowchart

Flowchart of the indoor blind navigation system is presented in the following figures 7&8.

B. Working

In this project primarily used elements are:

i). GSM module
ii). RFID reader and tags
iii). Ultrasonic sensor.

- Here the GSM module is acts as a mobile phone such as making and receiving phone calls, transmitting, and receiving messages.
- With the help of GSM and headset the blind person and customer care can communicate through each other.
- RFID is used to give the exact location of blind person through reader which is placed on the roadside. A blind person is available in voice mode through APR9600 voice module.
- The several sensors are interfaced with the Arduino nano microcontroller. They are:
  i). Ultrasonic sensor
  ii). IR sensor
  iii). Water level sensor.
- Ultrasonic sensor is used for finding obstacles such as rock, tree, any barriers in their footpath. And also, it will measure distance between obstacle and blind person.
- IR (infrared) sensor used for detecting the manholes or staircases (set of steps). And it will give output in voice feedback through speaker.
- Water level sensor is used for detecting water level or any mud or rainwater is there in their way.
- With this sensor can avoid accidents.
- Inputs are given to micro controller it reads it and gives output in the form of voice/audio through speaker.
- If the customer care receives message as an ID1, then the blind person is guided in the right direction through tags.
- If the person is in emergency or in trouble, he can press a secondary switch to alert the police or the family.
- If the blind takes a wrong direction, there will be a voice alert through the speaker unit.

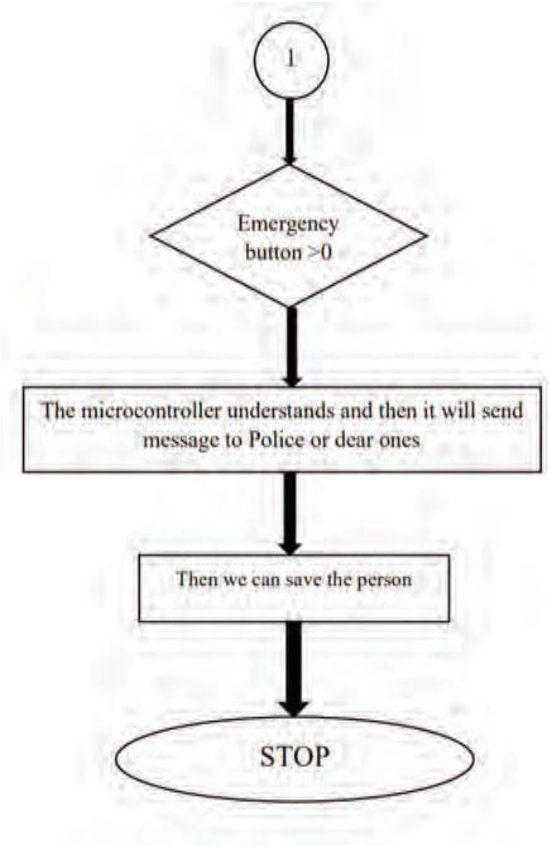

Figure 8. Flowchart (Part 2)

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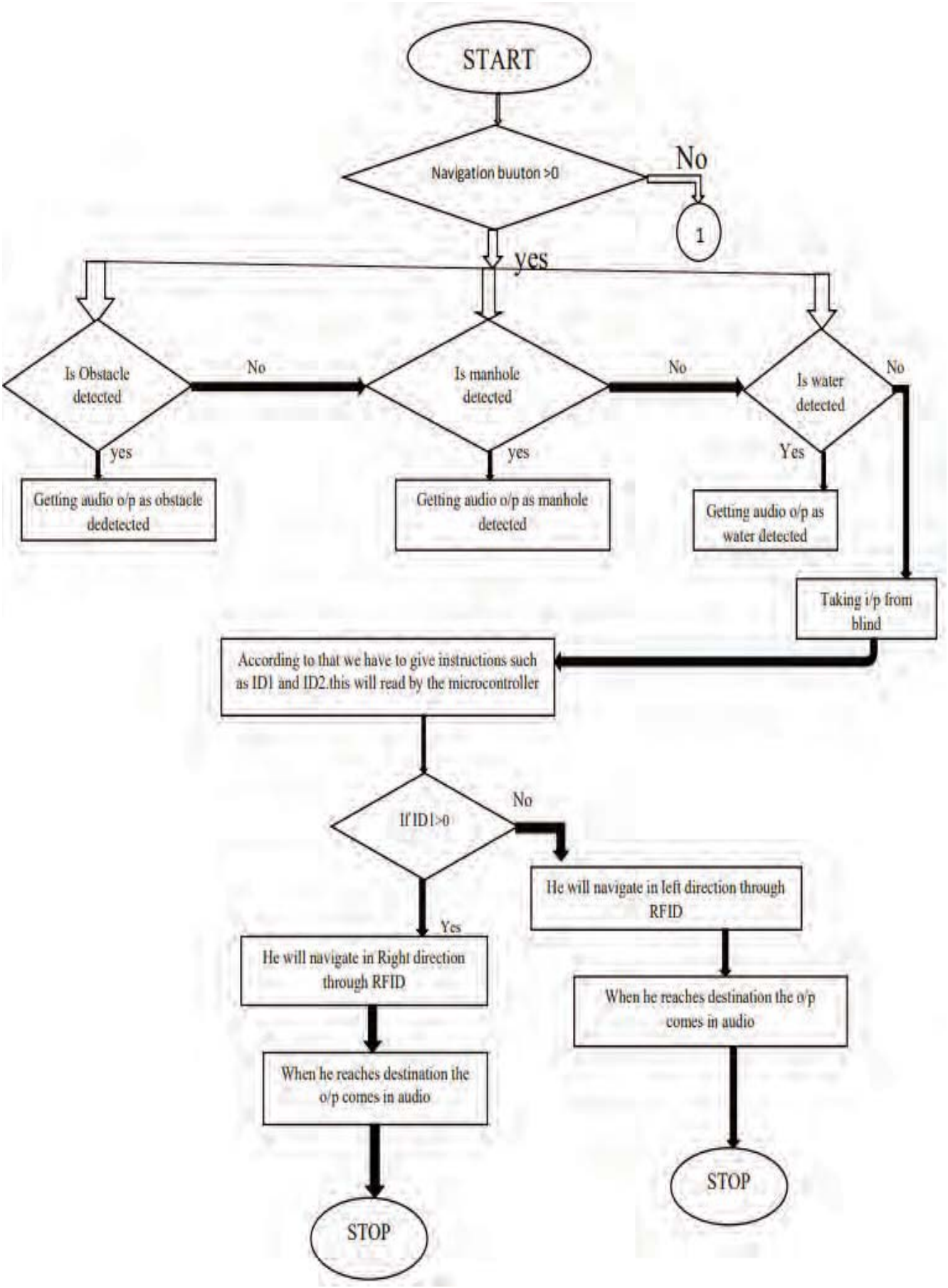

Figure 7. Flowchart (Part 1)

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V. Results And Discussions

The system designed by us can assist the blind as they can go anywhere with the assistance of IR, ultrasonic sensors and with RFID knowledge without the help of a human support.

Ultrasonic sensor with output 0 – 10V, threshold voltage is 5V. The sensor has 300 kHz sound frequency. Measurement range from 2 cm to 400 cm and threshold range is 10cm. Accuracy is ±0.15%.

IR sensor wavelength range from 2 to 14 µm. It will detect the signals in the range of 20cms. Detection range of RFID reader is 10-15cms.

This arrangement provides improved results in performance and increased the efficacy of visually weakened explorers at interior environments. It is cost effective. This structure is mobile. The executed project outcome is presented in the following image.

Figure. 9. Final output of project

VI. Conclusions

Our country India is having considerable amount of blind population. In the past the blind were dependent only on sticks or on guide dogs. The devices available to guide them were very expensive. We tried to develop a device that is cheaper and easy to be operate. We introduced this system which gives advanced resolutions to substitute the traditional techniques for directing the blind. The arrangement planned comprises of GSM, Rfid reader, several sensors, voice module. All these elements are interfaced to the Arduino nano controller. The blind person gets the navigation directions through Rfid reader and tags also navigate blind people using voice module.

This navigation system is available formally and is economically feasible. We can use this project as a device for the blind in different places such as commercial parks, hospital zones, municipal residences, government parks, small businesses and in university campuses.

VII. Future Scope

This work can be prolonged by including a GPS module. By using GPS module, we can connect this module to Arduino micro controller to get exact location of a blind person. When I add GPS module to the designed project it becomes more efficient, and it can be used for both indoor as well as outdoor navigation. Whenever person is in trouble or in emergency, it can track him within minutes. By using this we may get good effective results in terms of accuracy.

The RFID reader module can be kept inside the stick of the arrangement. And we can replace the Controlled power supply with a recharge-battery. The blind stick might be operated without a power source.

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