Design and Development of Smart Assistive Device for Visually Impaired People

Ashwini B Yadav, Leena Bindal, Namhakumar V. U, Namitha K, Harsha H

Abstract—**Blindness is a state of lacking the visual perception due to physiological or neurological factors. In this proposed work, a simple, cheap, friendly user, smart stick will be designed and implemented to improve the mobility of both blind and visually impaired people in a specific area. This multipurpose model is designed to help the blind person to navigate alone safely and to avoid any obstacles that may be encountered, whether fixed or mobile, to prevent any possible accident. The device provides voice output giving direction to the blind Using RFID technology, the destination of the bus is detected and voice announcement is given regarding the destination of the bus. The location of stick is added advantage to the current multipurpose device. Using RFID technology the location of the stick is achieved. The blind is provided with a push button to locate the stick.**

Keywords— IR SENSORS, RFID.

I. INTRODUCTION

People with low vision or complete blindness face difficulty in navigating surroundings they are not familiar with and usually require someone to help them navigate. They often bump into the obstacles present in their way thus hindering their free movement [1]. The conventional white sticks that are used by the blind do not help them to avoid the obstacles efficiently [2]. Only those obstacles that are hit by the stick are identified and can be avoided. However the obstacles in the surroundings are at different heights and distances, and sometimes cannot be identified by the white canes used [3] . In order to navigate independently and confidently in unfamiliar environments it is required that the blind people are well aware about the obstacles in their path from a distance. This can be achieved by implanting sensors in the traditional white cane, which can then be used to detect the obstacles. There are many technologies that can be used to detect the obstacles in the path from a distance. Smart assistive device indicates an intelligent device that will help the blind in his easy mobility and to carry out his work like any other person.

A. Problem Statement:

Visually impaired persons have difficulty to interact and feel their environment. They have little contact with surrounding. Physical movement is a challenge for visually impaired persons, because it can become tricky to distinguish where he is, and how to get where he wants to go from one place to another. To navigate unknown places he will bring a sighted family member or his friend for support. Over half of the legally blind people in the world are unemployed [4]. Because limited on the types of jobs they can do. They have a less percentage of employment. They are relying on their families for mobility and financial support. Their mobility opposes them from interacting with people and social activities.

In the past different systems are designed with limitations without a solid understanding of the non-visual perception. Some of the systems are only for indoor navigations, and has no hurdle detection and determining location feature in outdoor environment [5]. There is no one system available to navigate indoor, outdoor and also determine location and position to easily facilitate the visually impaired persons. The available systems are very costly; some of the systems are very heavy cause physical fatigue and required training to use. In the present scenario if we consider the handicap people face lots of simple problems in their daily life. So with respect to that we have designed this project which consists of different stages which are listed below: To provide information about the destination of the bus through voice announcement using RFID technology [6].

B. Organization Of The Paper

The paper presents a brief scenario of the various methods used by the blind in the past for his mobility. Later the various problems faced by the blind are discussed. The methodology of the various application implemented in the system is explained sequentially. The results are recorded for each application and explained in the later part.

II. METHODOLOGY

The proposed system consists of five sections i.e.

A. Obstacle detection unit
B. Traffic signal information unit for pedestrian crossing
C. Bus route information unit
D. Location of the Blind Stick
E. Power Generation through Wheels

A. Obstacle detection unit

This unit is designed to guide the blind to navigate in the surroundings easily without being worried of bumping into the obstructions present in his/her path. It makes use of IR sensors to detect the obstacles and the blind is notified about the presence of obstacles through a vibration motor.

There are two IR receivers placed on the blind stick. The first IR receiver detects the obstacle within the range of 50cm and the motor is rotated at the speed of 900rpm. The second IR receiver detects the obstacle at a range of 50cm to 120cm and the motor is rotated at the speed of 400rpm. Hence allowing the blind to know the distance of the object from

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978-1-5090-0774-5/16/$31.00 © 2016 IEEE

them. The motor provides a vibrational output which is located at the stick and vibrates as the object is detected.

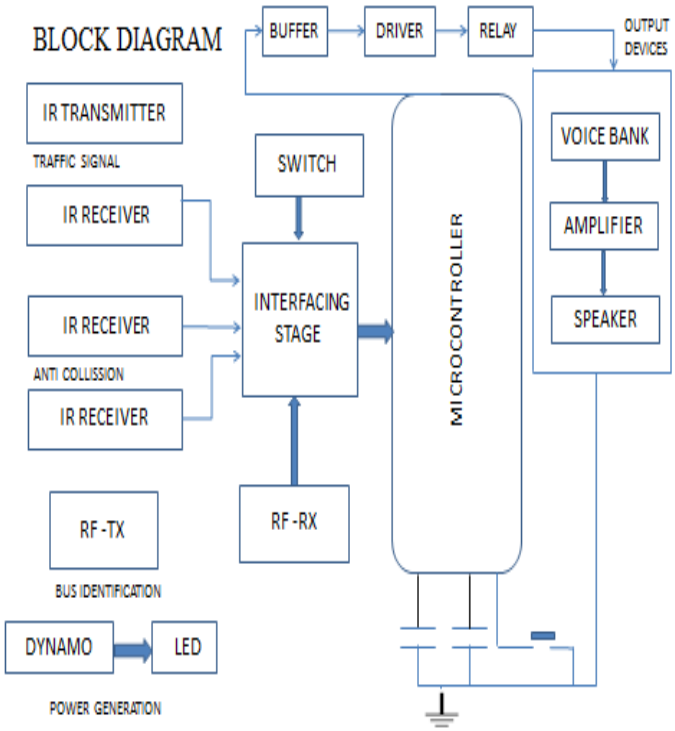

Fig 1:Block Diagram

The block diagram indicates the various units and their interfacing to the microcontroller. It utilizes IR transmitter and receiver for the impediment detection and pedestrian crossing unit. Also it utilizes RF transmitter and receiver for determining the destination of the bus and to locate the stick. It also consists of a standalone unit for power generation through wheels. The signals from IR receivers and RF receivers are interfaced to the microcontroller and the corresponding outputs are driven by the microcontroller. It consists of a buffer and driver unit to drive the output devices and relays for the switching operation.

B. Traffic Signal Detection Unit for Blind Pedestrian.

This unit aims at enabling the blind to cross the streets independently without relying on others. It has the IR receiver installed on the traffic pole, which gets activated when the signal goes green. As the IR receiver that is present on the stick, receives signal from the receiver it generates the corresponding voice output. The IR transmitter module has to be placed on the traffic pole and the receiver must be held by the blind person.

In case of traffic signal monitoring system the blind person faces the problem that which path of the circle in traffic area is free to go ahead so in order to overcome this the transmitters that are placed on the traffic poles starts transmitting the signals whichever is green. Then the receiver module or sensor will start receiving the signal from the respective direction and he or she will come to know that which part of the traffic area is clear with the help of voice announcement so that they can take an easy move and proceed further. The IR receiver module is as shown in figure ….. The output of the IR receiver energizes the MC which activates the voice module and thereby the speech message about the Traffic Signal is conveyed to the blind person.

C. Bus Route Information System

This objective is achieved using the RFID technology and aims at providing the information about the buses to the blind, which otherwise is very difficult. The details about the destination of the bus is provided to the blind, through a prerecorded voice output. As the bus reaches in close proximity of the blind, the RF receiver with the blind receives the message signal and it gives corresponding information about the bus through voice announcement.

The bus route information module is as shown in figure 1. The 4 channel RF transceiver is used for the bus route information unit. It consists of two modules: a transmitter module installed inside the bus and a receiver module with the user. Once at a bus stop, when the transmitter's frequency matches with the receiver's frequency the information about the bus route is obtained. The information about the bus details are read out to the user via a speaker phone in the user module. This helps the blind find out if the desired bus is there at the bus terminal or not.

D. Location of the Blind Stick:

This unit is incorporated in the system to help the blind find his stick, in case the stick is misplaced. The blind is provided with a switch that consists of an RF transmitter, and it gets activated when the switch is pressed. The signals are received by the RF receiver installed in the stick, and correspondingly a buzzer beeps indicating the presence of the stick.

This objective mainly helps the blind to find the stick whenever it is needed using RFID Technology. The transmitter is placed in the wearable device which gets activated when the switch is pressed. The receiver is placed in the stick which gives a beep sound through the buzzer when it receives a signal.

E. Power Generation through Wheels:

This unit aims at avoiding the hassle of recharging the stick very often for its operation. For this reason wheel are attached to the stick, and the rotation of the wheels is utilized to create electrical energy which is used to power the circuitry developed.The wheels that are placed in the blind stick are used for generation of power where the mechanical energy of the rotation of the wheels is converted to electrical energy using dynamo. The energy that is generated using this technique is used for recharging the batteries and hence reduce the consumption of power.

III. RESULTS

The reflected rays that are received by the IR receiver produces output voltage according to the following

Analog output voltage = IR Value / 208.8555

Where IR value = 4187.8 (Range) ^ (-0.9042)

The analog Output is recorded for different distances and plotted. It can be seen that ass the distance increases the output voltage decreases.

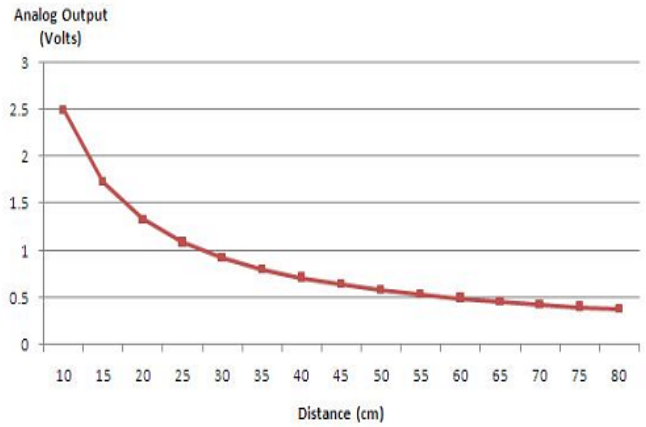

Fig 2: Output Voltage v/s Distance

Depending upon the texture, shape, surface smoothness the reflection of the IR waves vary. The range obtained for different objects were observed and recorded. The difference in the detecting range is due to the difference in the opacity of the objects and the amount of light they reflect back. This is explained in table I.

TABLE I: OBJECT V/S DISTANCE

OBJECT	RANGE (cm)
PERSON	130
WOOD	150
PLASTIC	160
GLASS	200

There is a belt provided to the blind where he has three IR receivers. This helps the blind to cross the road. The receiver which receives the signal gives a voice output to the blind and directs him with the passage of the road. The blind is provided with voice announcement regarding the direction which is free from vehicle movement.

TABLE II: TRAFFIC SIGNAL MONITORING

TRAFFIC POLE	LEFT RECEIVER	STRAIGHT RECEIVER	RIGHT RECEIVER
LEFT	**Move Left**	**----**	**---**
STRAIGHT	**----**	**Move Straight**	**---**
RIGHT	**----**	**----**	**Move Right**

When the IR receiver installed in the left direction receive signal from the traffic pole it gets activated and an announcement stating move left is provided to guide the blind. Similarly, when the right and the straight receiver are energized the corresponding directions are announced. At a particular instant it is not possible that more than one of the receivers is activated as explained in table II.

In figure 3 the speed of the motor also varies with the distance. It is important to alert the blind when he has approached very close to the obstacle. In order to accomplish this two stages of vibration were provided

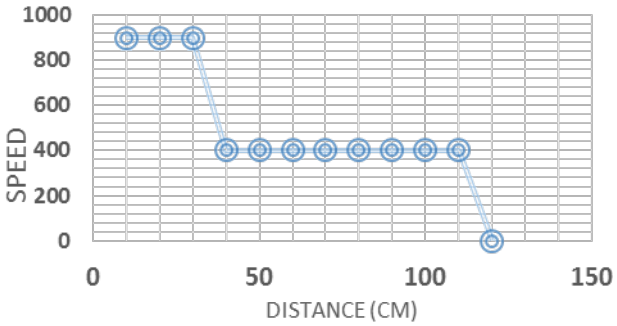

Fig 3: MOTOR SPEED V/S DISTANCE

When the obstacle at a certain distance from the blind, the blind was alerted with lower vibration. As the blind was in close proximity with the obstacle he was alerted with high vibration. If the obstacle is within 50cm from the blind the motor will rotate with speed of 900rpm and if the obstacle is more than 50cm from the blind the motor will rotate at speed of 400rpm. Hence blind can differentiate the obstacle with their distance from them.

Different objects were considered and the detection of their distances from the object were recorded. It is known that different colors have different absorptivity. Black is found to have the highest absorptivity and white the least. Due to this difference in absorptivity of light the range obtained for different colors vary. On experimentation with different colors the following results were obtained as shown in table III

TABLE III: COLOR V/S RANGE

COLOR	RANGE (cm)
WHITE	180
BLACK	115
RED	130
GREEN	145
YELLOW	160

There is transmitter placed in each bus and the receiver is placed on the blind stick. Each bus transmitter different frequencies and is detected by the receiver. Voice output is generated accordingly and the destination of the bus is announced to the blind as shown in table IV

The four channel RF receiver is tuned to receive the details of the destination of various buses. For demonstration purposes only two destinations have been implemented. The bus with Kengeri as its destination is tuned to have 19 KHz as its message frequency. Similarly the bus with RV College as its destination is tuned to have 22 KHz as its message frequency as shown in table IV.

TABLE IV: BUS IDENTIFICATION

MESSAGE FREQUENCY	TRANSMITTER DETECTED	VOICE OUTPUT
19 KHz	TX 1 Detected	KENGERI
22 KHz	TX 2 Detected	R.V.C.E

IV. CONCLUSION

The main objective of this project is to assist blind or visually impaired people to safely move among obstacles and other hurdles faced by them in their daily life. Using this system the blind can travel independently. With the help of IR and RFID technology the first four objectives of the project has been achieved. From the experimental results it has been observed that developed support system- is accurate in detecting the obstacle and alerting the visually impaired person find their way bypassing every obstacle and help them to cross the roads that comes on their way and reach the destination , by providing them the information about the bus routes through speech. The developed prototype is innovative and helps in conservation of energy as the wheels present in the stick generates power that is provided to the device through the rechargeable batteries. In order to reduce the complexity of the device, the traffic signal detection unit for pedestrian crossing has been placed in a belt that is wearable.

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