Smart Foldable Blind Stick for Visually Impaired Person

P. Krishnagandhi[1], S. P. Madhuppranesh[2], K.Selvakumar[3], R.R.Pranav Rakul[4], S.Selvakamaleshwar[5]
[1]Assistant Professor, Dept of EEE
[2, 3, 4, 5]Dept of EEE
[1, 2, 3, 4, 5]Nandha Engineering College, Erode, Tamilnadu, India.

Abstract-*One of the biggest problems faced by the visually impaired is navigating from place to place, be it indoors or outdoors. Further, the adverse conditions of the roads make it even more difficult for them to walk outdoors. They have to be alert at all times to avoid consequences like colliding with stable or moving obstacles, ascending or descending staircases, or slipping down wet terrain. Also, at times they may be in distress and might want to send an alert message to their relatives or friends about their whereabouts. These problems of blind people can be addressed with the intervention of technology. Several sensors can be used to detect anomalies like obstacles, staircases, and wet terrains respectively. Also, this solution provides a way to send a message about the whereabouts of the user to the concerned people. Adding to the above, a software application is designed to help the acquaintances of the blind to manage the stick's configuration ex: add or delete phone numbers to which alert messages have to be sent. Misplacing the stick indoors can also be a substantial issue. This solution also addresses this problem.*

I. INTRODUCTION

According to the World Health Organization, there are nearly 285 million people with some form of visual impairment out of which 86% of people have low vision and 14% of people are blind. Vision is one of the most important senses for humans to survive. Vision helps to connect with the surroundings. People deprived of vision rely on other dependencies like a simple walking cane or other people. In familiar places like the interiors of a house, they memorize the site directions, and obstacles on their way and navigate according to them. However, it is not always safe for the blind to rely on their memory to move from one place to another. Especially when they are outdoors. Not all the time's blind people are offered help from others and hence there is a need for a device, such as a stick, which can assist the visually impaired people in all forms of life.

The main characteristics for the stick to be useful to every visually impaired person are for it to be efficient and cost-effective. The obstacles such as people, vehicles, stones in the outdoors, and stairs, walls, and furniture the indoors hinder the way of the blind. The blind stick developed, alerts the user about various obstacles through a vocal sound from a speaker on the stick. The stick can also detect wet and damp surfaces and raise a vibratory alert to the user.

To a person who is visually impaired, a mobile phone doesn't effectively serve the purpose to send a panic message whenever the person ends up at a location unknown to him. A simple button on the stick will do the job of sending a message to the acquaintances of the blind person. A software application is designed to let acquaintances change, add, or delete their phone numbers. The user can also set up the phone numbers with the help of the supplier, who has admin access to change the phone numbers. To assist the user if a stick is misplaced, a remote with the button is provided, which when pressed, makes a buzzer sound on the stick.

II. RELATED WORK

[1]"Low-Cost Smart Navigation System for the Blind" by S BarathiKanna, T R Ganesh Kumar, C Niranjan, S Prasanth, J Rolant Gini, M.E Harikumar the proposed solution works on the Internet of Things realm where the blind can "communicate" with the environment. This prototype is equipped with an ESP8266, a power source for the development board and coin motors along with a smartphone application, thereby making it accessible for even the working class visually impaired. [2] "Ultrasonic Sensor-Based Smart Blind Stick"by Naiwrita Dey, Ankita Paul, Pritha Ghosh, Chandrama Mukherjee, Rahul De, Sohini Dey. An ultrasonic sensor module, HC-SR04 is used for obstacle detection in the path of the blind person and a buzzer is used to make the person alert. The proposed system is implemented using PIC microcontroller 16F877A. Blind persons can use this walking stick for safe navigation. It can detect obstacle obstacles within a 35 cm range of distance. [3] "Smart Stick for the Blind and Visually Impaired People" by Mukesh Prasad Agarwal, Atma Ram Gupta. It is a device that guides the user by sensing obstacles within the range of the stick. It will identify all obstacles in the path with the help of various sensors installed in it. The microcontroller will retrieve data

and pass it on as vibrations which will notify the user about hurdles on the way. It is an efficient device and will prove to be a big boon for blind people. [4] "Assistive infrared sensor-based smart stick for blind people"by Ayat A. Nada, Mahmoud A. Fakhr, Ahmed F. Seddik. A pair of infrared sensors can detect stair-case obstacles present in the user path, within a range of two meters. The experimental results achieve good accuracy and the stick is able to detect all of the obstacles. [5] "Smart Stick for Blind People" by N. Loganathan, K. Lakshmi, N. Chandrasekaran, S.R. Cibisakaravarthi, R. Hari Priyanga, K. Harsha varthini.The instrument stands are used to perceive the obstacles at the range of four meters and the infrared instrument is castoff to perceive the nearer complications in front of the blind people. Thus, the radio frequency transmitter and receiver help the user to find the exact location of the smart stick with the help of a buzzer.

III. PROPOSEDSYSTEM

The proposed model consists of the following units which monitor the situation and act accordingly.

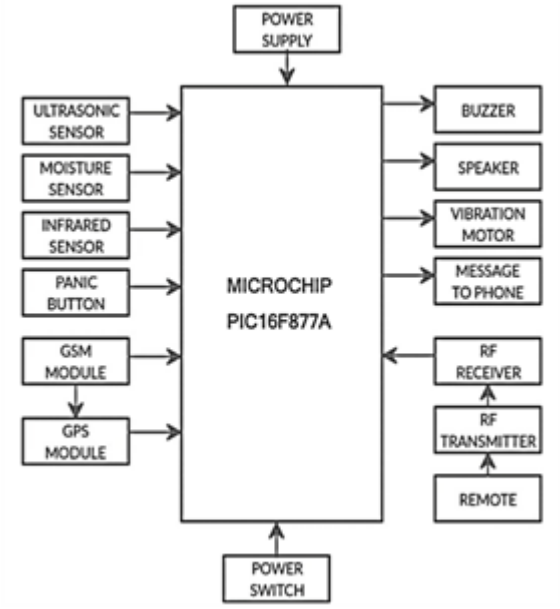


Fig 1. Block diagram of the proposed system.

Components:

Ultrasonic sensor: An ultrasonic sensor can be used to measure the distance to the target, by using sound waves. It emits a sound wave at a particular frequency and listens for that wave to return. By calculating the elapsed time between these two events, it can measure distance. There are three ultrasonic sensors placed on the stick in order to detect different obstacles like people, vehicles, stones in the outdoors and walls, and furniture indoors.

Moisture sensor: Soil moisture sensors measure the water content in the soil and can be used to estimate the amount of stored water in the path of blind people. The two probes on the sensor act as variable resistors. When they are placed on a surface, electricity conducts more easily on a wet surface, thus offering a low resistance. While on dry surfaces, more resistance is offered, since electricity conducts poorly. To get the moisture level, the sensor uses these two probes to read the resistance between them.

Infrared sensor: It consists of an IR LED and a Photodiode and can be used to generate and detect infrared radiation. LED is used to transmit IR waves and the reflected IR waves are received by the photodiode. In this project, an IR sensor is used with a theoretical detection distance of 2 - 30cm and a detection angle of 35°.

RF module: An RF module consists of an RF transmitter and receiver. This module can be used to locate a misplaced stick. The RF transmitter can transmit serial data. Similarly, this transmitted data can be received by an RF receiver. In this project, the transmitter is mounted on a simple remote control.

GPS-GSM module: GPS module (NEO-6m) is used to track the current location of the blind person by fetching the GPS coordinates of the person. GSM module (SIM 900A) is used to send these coordinates of the blind person to concerning contacts.

Buzzer and vibration motor: A buzzer is a device that is often used to produce sound when an obstacle is detected. The buzzer is triggered when the button on the RF remote is pressed in case the stick is misplaced. A vibration motor, a mechanical device, is used to generate vibrations. It is triggered when the moisture sensor detects the presence of water or obstacle in the path of blind people.

Panic button: A panic button is to the use as an emergency/distress signal which when pressed can communicate the user's location in the form of a message to the concerned contacts in case of an emergency. Also, we kept a voice message that if Blind people press a panic button then the stick suddenly intimates through a voice of "Help me".

Speaker: A speaker is used to provide alerts to the blind person when an obstacle is detected. It is integrated with a voice recorder to provide custom voice alerts for different types of obstacles and is also used when a blind person falls down, it provides a custom voice.

Microcontroller: For communicating different sensors, switches, and modules, a Microchip microcontroller is used. It works as a decision-making controller by obtaining various signals from the different sensors and triggering output sensors appropriately.

Flow chart of working mechanism

Switch: A switch is used to disconnect or connect the conducting path in an electrical circuit, interrupting the

electric current. It is used to turn off or on the stick when not in use so as to save the battery.

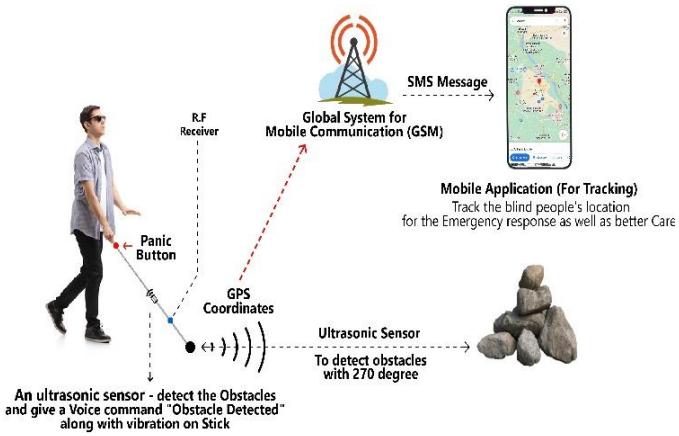
Power supply: A 12 V rechargeable Li-ion battery is used to provide the power supply to the controller and modules connected to it.

IV. METHODOLOGY

The proposed system consists of all the above-mentioned components. These components are connected to the Microchips (PIC16877A) pins via jumper wires. The proposed system operates on an input voltage of 9V/12V and has the following features. It can scan the surroundings for various obstacles of different sizes and raise appropriate auditory and vibratory alerts. It can detect both damp and wet surfaces and can alert the user. Also, it is able to send the user's location to their acquaintances via SMS in case of an emergency or distress and it can be locatable when misplaced via an RF remote control. The Algorithm running on Microchip polls for input from each of sensors and follows flow as depicted in the below flow chart.

Each of the states corresponds to the following:

1. With respect to detecting obstacles the algorithm makes use of three ultrasonic sensors: Positioned in the front, right, and left position. This setup can detect obstacles of various shapes and sizes. After processing the input from these sensors, the type of obstacle is determined by the logic in the below 'Table 1', and the appropriate pre-recorded audio response or vibration pattern is played to the user using the speaker module or vibration motor.
2. The IR sensor is mounted at the bottom of the stick in order to support the detection of stairs and small obstacles on the ground.
3. The working of the moisture sensor is simple: the sensor gives a Boolean output after scanning the surface using which the algorithm raises a vibratory alert to the user using the vibration motor mounted at the top end of the stick.
4. On detecting a button press from the user the GPS module is polled for the user's coordinates. These coordinates are formatted as a google maps link i.e "http://maps.google.com/maps?q=loc:<latitude>,<longitude>". Then the link is prepended with an appropriate message such as "I'm in danger please find me here" and this processed message is sent to the User's caretakers using the GSM module.
5. Also, the algorithm keeps polling the RF receiver mounted on the stick for RF signal, from an RF transmitter mounted on a simple remote controller. This remote controller also has a simple push-button along with the RF transmitter, which when pressed transmits an RF signal via the RF transmitter on the remote, which can be detected by the RF receiver on the blind stick The algorithm, upon receiving the signal, raises a buzzer alert for a few seconds thus helping the user to locate it.



Flow chart of working mechanism

TABLE I. CLASSIFICATION OF OBSTACLES BASED ON SENSOR READINGS

Type of Obstacle	Type of alert	Sensors(ProximityandDistancereadings)		
		Ultrasonic-1	Ultrasonic-2	Ultrasonic-3
Front Obstacles	Voice	<100 cm	< 100cm	<100 cm
Right Obstacles	Voice	< 100 cm	< 100cm	<100cm
Left Obstacles	Voice	< 100 cm	< 100cm	<100 cm

V. RESULT COMPARISON

BASE PAPER CONCEPT	PROPOSED CONCEPT
Using 2 Ultrasonic Sensor	Using 3 Ultrasonic Sensor
There is no Panic Button	Panic button is used
Battery capacity is Low	Battery Capacity is high
Arduino Microcontroller	PIC 16F877A Microchip
Non - Foldable Stick	Foldable Stick
Custom Voice is not Used	Custom Voice is Used

VI. RESULT

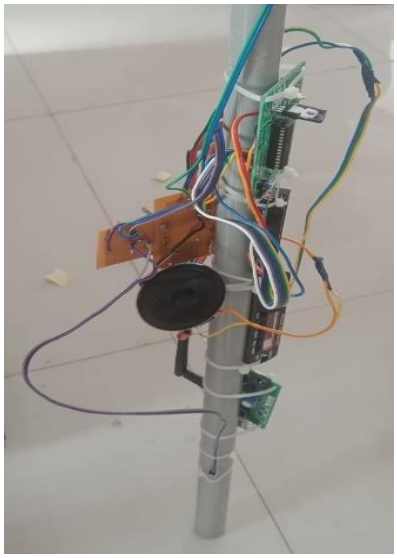
The proposed prototype has been effective at spotting various obstacles of different sizes lying in the path of the user with great consistency. It was able to send SMS to his acquaintances with accurate coordinates of the user. Also, it has been quickly locatable when misplaced using the RF remote control. The RF module (Transmitter and Receiver) is able to communicate effectively within a range of 100m.

The GPS Module and GSM Module are functional and are able to send messages and give out the accurate location of the user. However, the Neo-6M GPS module takes a variable amount of time (the 30s to 1m) on startup to get a satellite lock. The soil moisture sensor use is able to effectively determine whether the surface is damp. Finally, by using the ultrasonic sensors are able to detect obstacles as mentioned in Table I and raise appropriate alerts using the speaker module and vibration motor.

The Simple sign Up-login-logout software is developed to assist the users to modify phone numbers, to which alert messages could be sent. Each user's blind stick is characterized by a unique stick ID. The user's acquaintances can use this software on behalf of the user. The supplier of the stick, having admin access, can modify the numbers of the user too.

VII. CONCLUSIONANDFUTURESCOPE

The blind stick proposed in this paper can aid the visually impaired user by helping him/her navigate through different terrains and obstacles. The stick is also able to inform the user's location to their caretakers in case of an emergency or distress. Also, the stick has the capability to be located using an RF remote control. This can be further enhanced by adding small-scale and high-performing sensors thus improving the design and reducing the space being occupied on the stick. Few improvements can be made to the sensor angle placement to make them adjust according to the angle of the stick w.r.t to the ground so that they always point straight instead of mounting them at a static angle. Also, it can be further enhanced by using a better material such as carbon fiber for the body of the stick to make it lightweight and flexible to use.



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