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Arduino based Smart Blind Stick for People with Vision Loss

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***Abstract*— One of the biggest problems faced by the visually impaired is navigating from place to place, be it indoors or outdoors. The main aim of this work is to help the visually impaired person to remotely locate his/her stick using a RF remote. This system incorporates with buzzer and attached with multiple sensors to provide high security to the visually impaired people while walking. Now a day's safety is main important cause to the peoples while walking or driving and many more places. The system provides the high security and show way to walk, this system can monitor the blind person position using mobile, an emergency alert message will be sent along with the exact location. The system has obstacle sensor, soil sensor and stair detection sensors, so that it can detect obstacles/ steps automatically and gives alert. By using soil moisture detector used to detect the moisture in the soil and gives alert accordingly. This system can be very useful to peoples to show correct path while walking on the floor or steps and many more places. The system can be interconnected with the microcontroller and alert the respective persons when any emergency occurs. This tracking system is composed of a GPS receiver, Microcontroller and a GSM Modem. The Microcontroller processes this information and this processed information is sent to the respective numbers.**

Keywords—Arduino Uno, Ultrasonic sensor, Infrared sensor, Soil moisture sensor, GPS (Global Positioning System),GSM (Global System for Mobile communication) module.

I. INTRODUCTION

According to the World Health Organization, there are 2.3 billion blind persons in the world; 86 percent of whom have limited vision and 14% are completely blind.The ability to see is one of the most vital for human longevity. Visual perception facilitates communication with the outside world. Blind people require extra supplies, such as a simple walking cane or other people.For the blind, using their memory to travel from one place to the other is not always a safe mode of transportation, but they store site maps to memories and potential barriers in order to move around in comfortable situations, like the interiors of a house. particularly if they are outdoors. There is a need for a tool, such as a stick, that may help visually impaired people in many aspects of life because blind people are really not commonly helped by others. The two main criteria for the stick to be helpful to those who are blind or visually impaired are its effectiveness and price. The blind stick was developed to alert the user of numerous obstacles to using a speaker on the stick. Obstacles such as persons, vehicles, and rocks outdoors, in addition to steps, walls, and furniture inside, block the route of the blind. When damp or moist surfaces are detected, the gadget may vibrate to alert the user [1-4].

II. LITERATURE SURVEY

People with vision impairments can utilize these smart blind sticks for better navigation. A water sensing element, an ultrasonic sensor, an RF module, as well as a GPS-GSM module, are all included in the M.P. Agrawal [1] smart stick's setup in order to identify any roadblocks and communicate vibrations to the user to alert them about potential challenges. The R. F. Olanrewaju invention iWalk [2] includes a water sensor that activates a separate alarm when it detects water. The device also has a sound-producing wireless RF controller that may be used to find the stick. A stick-guide method that employs both GSM and GPS to send an SMS whenever the user needs help was suggested by K.B. Swain [3].Utilizing infrared and ultrasonic sensors, obstacles and levels are identified. Nadia Nowshin [4] showed an Arduino Submicron stick that helps the blind detect obstacles using Android mobile apps and ultrasonic sensors. Radhika.R [5] developed a system that can identify obstructions up to around 3 feet away by merging water, infrared, and ultrasonic sensors. Using GPS and GSM gadgets, blind person can also update their career on their whereabouts. The ultrasonic sensor is a crucial component of P. Sharma's [6] gadget by generating and reflecting waves, it surveys an area from all sides. The microcontroller then uses SD card technology to notify the headphones of the status of a specific device. A mobile app developed by T.A. Ueda [7] uses a smart phone's camera to alert users of dangers in their path. A glove that blind people can wear to safely travel alone is V. Patel's second invention [8].An ultrasonic sensor, which scans directions by producing and reflecting waves, is a key part of this system.

III. PROPOSED METHOD

Blind people who use canes to identify obstacles in their path by touching or probing them can be directed by existing technologies. There are further gadgets, such as smart belts, rings, canes, etc., that can assist individuals by recognizing obstructions employing acoustic or laser sensors as an alternative to the method mentioned above. These gadgets can vibrate or generate an aural signal to warn the user when they discover obstructions. Here are a few of the issues with current systems: Expensive x Ineffective x Unreliable have very few usability and functionality options[9-11].

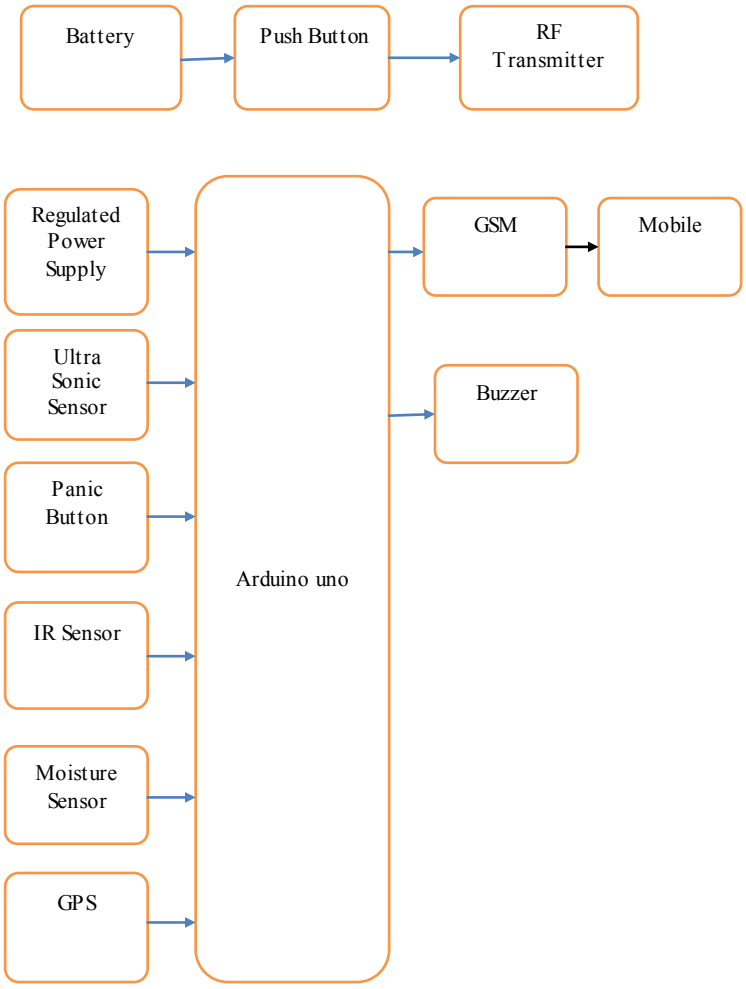

Fig.1.Block Diagram of the Proposed Method

IV. HARDWARE COMPONENTS OF THE SYSTEM

Arduino based smart blind stick consists of Ultra sonic sensor, Soil moisture sensor, Infrared sensor, RF module, GSM-GPS module, Buzzer, Electric Switch and Arduino Uno [11-15].

A.Ultra sonic sensor

The distance to the target may be determined using an ultrasonic sensor (see Fig. 2) by employing sound waves. An audio signal at a particular frequency is emitted, and the device then waits for the return of the wave. It can calculate the distance by computing the amount of time that has passed between these two occurrences.

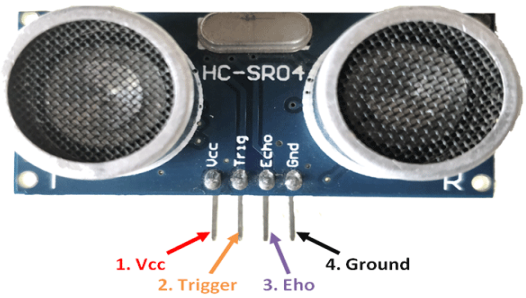

Fig.2. Ultra Sonic sensor

B.*Soil moisture sensor*

With the use of a soil moisture sensor is blind people may identify any water on their journey (see Fig. 3). Two probes on the sensor function as tunable resistors. Because electricity moves through wet surfaces more readily when it is placed on them, they have lower resistance.

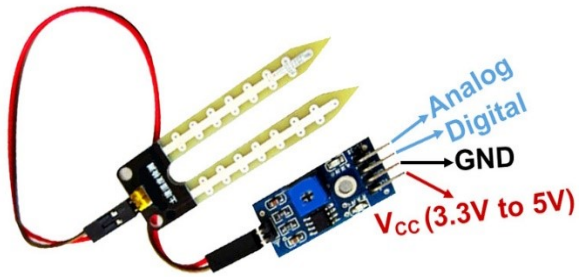

Fig.3. Soil Moisture sensor

C.Infrared sensor

An Infrared Sensor and a photodiode, which are its constituent parts, can be used to both produce and detect infrared light (see Fig. 4). After an LED delivers the infrared waves, the photodiode detects them. An IR sensor is used with a 35° detecting angle and a possible detection limit of 2–30 cm.

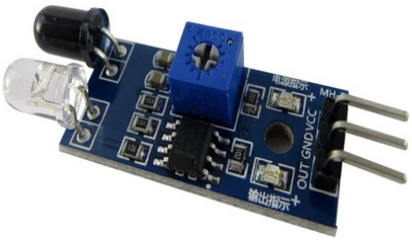

Fig.4. IR sensor

D.RF module

RF module consists of RF transmitter and receiver, it is shown in Fig. 5. This model can be used to find a lost stick. Serial data can be sent using the RF transmitter. Similar to how an RF receiver could pick up this supplied data. A transmitter is connected to a basic remote control in this setup. The stick has a receiver attached to it.

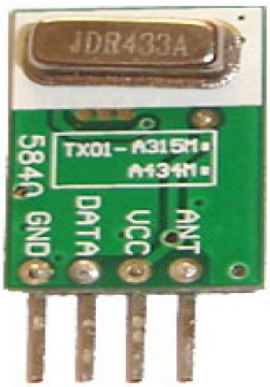

Fig.5. RF Transmitter

E.GSM-GPS module

The blind person's present location is tracked using a GPS module (NEO-6m) by retrieving their GPS coordinates. These coordinates of the blind person are sent to relevant contacts using a GSM module (SIM 900A) (see Fig. 6).

Fig.6. GPS-GSM module

F.Buzzer

Buzzers are a typical sound-producing device (see Fig. 7). In the event that the stick is lost, hitting the button just on RF control activates the buzzer. Vibrations are produced by a mechanical device.

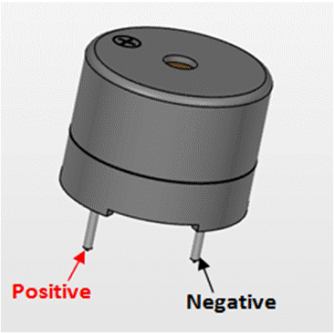

Fig.7.Buzzer

G.Electric Switch

An electrical circuit's conducting route is connected or disconnected by a Electric switch (see Fig. 8), halting the flow of electricity. When not in use, it is utilized to switch off or turn on the stick to conserve battery life.

Fig.8. Switch

H.Power supply

The controller is powered by a 1a 12-volt rechargeable Li-ion battery, which is used to provide power to each of the sensors and modules connected to it.

I.Push button

A start button (see Figure.9) can serve as an urgent or distress alarm for the user by pressing it to send a message to the necessary contacts with the user's location.

Fig.9. Push button switch

J.Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet).It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

Fig.10. Arduino Uno

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards and the reference model for the Arduino platform.

TABLE 1TECHNICAL SPECIFICATIONS OF ARDUINO UNO

S.No	Components	Specifications
1	Microcontroller	ATmega328
2	Operating Voltage	5V
3	Input Voltage	7-12V
4	DC Current per I/O Pin	40 mA
5	DC Current for 3.3V Pin	50 mA
6	SRAM	2 KB
7	EEPROM	1 KB
8	Clock Speed	16 MHz

V. METHODOLOGY

The software uses two ultrasonic sensors on a stick, one on the bottom and the second located two-thirds of the way up are used by the software to scan the area for obstructions. The technology is able to distinguish between barriers of various sizes and shapes. Following analysis of the data from these sensors by the algorithm in "Table 2" below, the user is then provided with the correct or before voice response or vibration pattern utilizing the speaker's module or vibration motor. To make it simpler to recognize stairs and other small ground objects, an IR sensor is attached to the bottom of a stick. The primary function of the moisture sensor is to identify surfaces that are damp and to produce a logical output, which evens the algorithm, utilizes to vibrate the upper end of the sticks to alert the user. 4. The GPS system is contacted when a user presses a button in order to pinpoint the user's location. There is a google link in the format of this coordinates."https://maps.google.com/maps? q=loc, “for instance[16-17]. The URL is then modified with the necessary information before being transmitted via the

GSM module to the user's careers, for example, "I'm in danger, please find me here."Additionally, the program continuously searches for RF signals from a Transmitter located on a basic remote controller using the RF receiver linked to the stick. This remote control includes a simple push button in addition to an RF transmitter [18-20].

TABLE 2. OBSTACLES ARE CLASSIFIED BASED UPON SENSOR READINGS

Types of obstacles	Types of alert	Sensors (Proximity & Readings)		
		IR sensor	Ultra Sonic 1 (cm)	Ultra Sonic 2 (cm)
Stairs	Voice1	HIGH	<20	>50&<100
Small obstacles	Voice2	HIGH/ LOW	<100	>400
Large obstacles	Voice3	HIGH/ LOW	<100	>150&<200

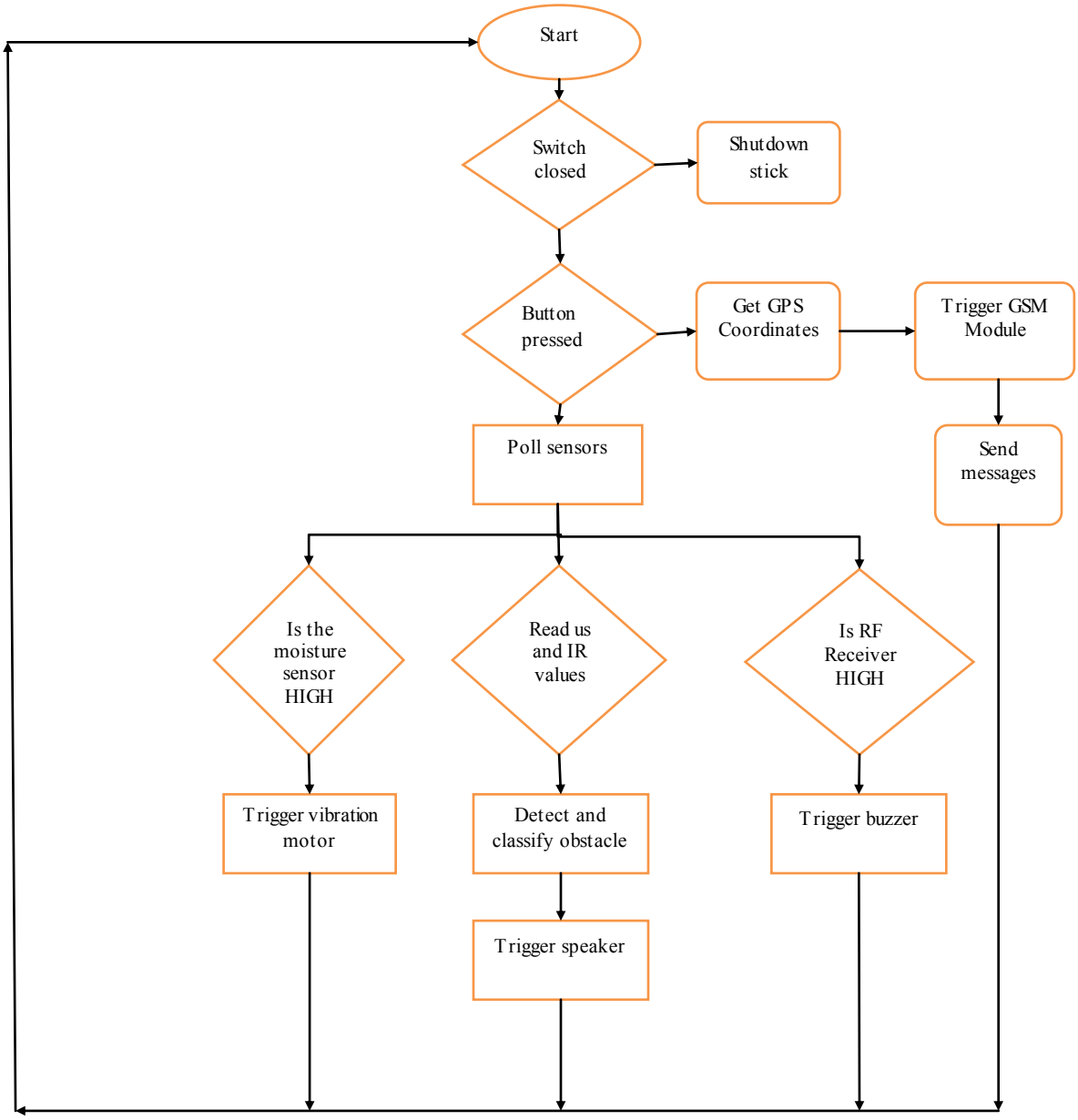

Fig.11.Flow chart of the Proposed Method

The proposed system consists of all the above-mentioned components. These components are connected to the Arduino digital and analog pins via jumper wires. The proposed system operates on the 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 Arduino polls for input from each of the sensors and follows flow as depicted in the above flow chart (see Fig. 11).

VI. RESULTS

Existing systems like canes can guide blind people by helping them detect the obstacles in their path through touching/poking. Alternative to the above method some other aids include smart belts, smart rings, smart canes, etc, which can assist them by detecting obstacles using ultrasonic or laser sensors. These systems produce either an audio or vibration in response with respective to the detected obstacles to warn

them. The limitations of existing systems are expensive, not very effective and reliable, very limited features and usability.

The recommended prototype was able to send Text messages to the user's friends with his specific positions while reliably and precisely detecting several barriers of various sizes that were in his path. Additionally, when lost, it has been easily found using the RF remote control. Within a 100 m range, the RF module's transmitter and receiver may efficiently converse. The prototype, a 96 cm long PVC tube with a 2 cm diameter, is attached to the components (see Fig. 12).

The working GSM and GPS modules allow for the accurate position of the user (see Fig. 6). However, the first satellite lock-up time for the Neo-6M GPS module may be between 30 and 60 seconds. It is possible to determine with accuracy if a surface is damp with the help of a soil moisture sensor. By using a speaker device and vibration motor, the IR and ultrasonic sensors may finally be used to identify the impediments listed in Table I and provide the necessary alarms.

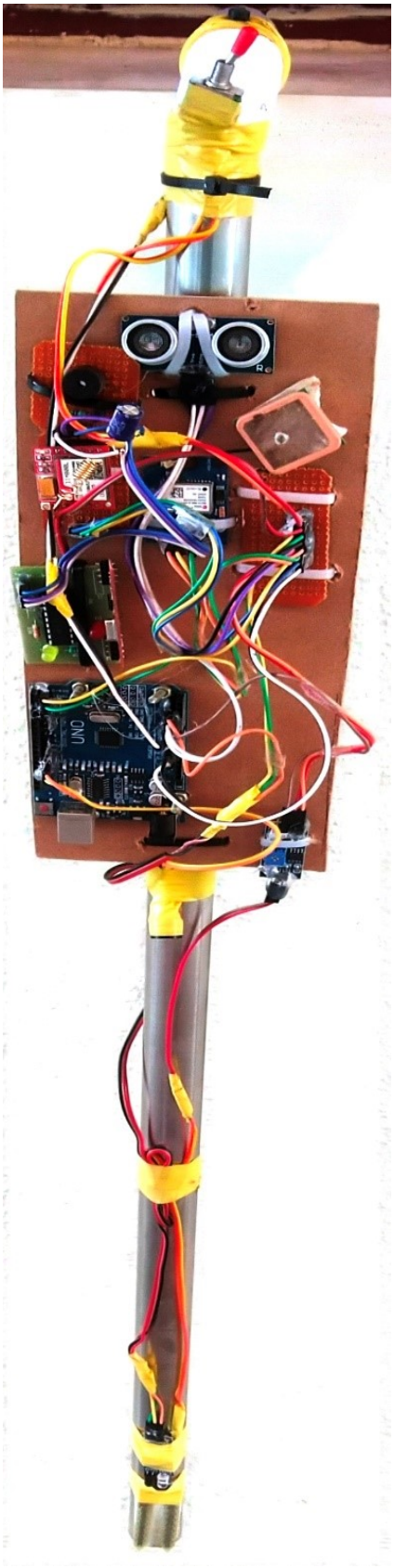

Fig.12. Arduino based Smart Blind Stick Prototype

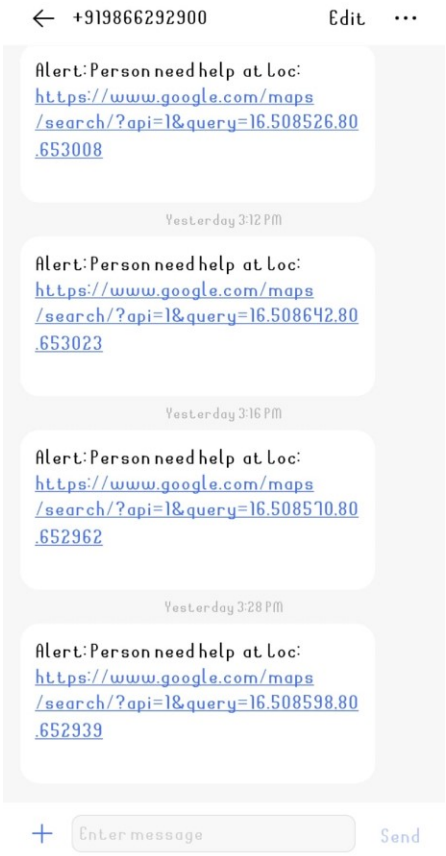

Fig.13 Message delivered to user

The straightforward sign-up-login-logout software programme (see Fig. 13) has been created to allow users to adjust the phone numbers that might get warning messages. a distinct stick ID It is possible for friends of users to utilize this software on their behalf. It identifies the blind stick of every user. The stick provider has the ability to modify the user count with administrative access. Conclusions and future scope by guiding the visually impaired user through a variety of surfaces and obstacles, the suggested blind stick in this research can assist the user. The stick may also be used to tell caregivers where the user is in an emergency or crisis. To find the stick, you may also utilize an RF remote control. Using small, powerful sensors would improve the design and free up more room on the stick, improving this even more. In order to better identify objects, the sensor angle positioning may be modified so that it may adjust to the stick's angular relationship to the ground. Instead of being placed at a fixed angle, they must constantly point straight forward. It may also be improved by employing a better material for the body, such as carbon fiber, in order to make the stick lighter and much more flexible.

VII. Conclusions And Future Scope

The Arduino based smart blind stick proposed in this paper could aid 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 a 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 with respect to the ground so that they always point straight instead of mounting them at a static angle.

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