SCBIoT: Smart Cane for Blinds using IoT

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***Abstract*—The old concept of the cane makes no sense in the current technological advancement, as the revolution of smart devices urges us to create a more reliable and more adaptive way to help disabled people. In this paper ; we developed intelligent cane that aims to make a more comfortable trip for the visually challenged people. Besides its ultra-sonic sensors, which help to detect obstacles from far away, we decided to make use of the new revolutionary IoT definition. The cane gets connected to the Wi-Fi hotspot of the android phone. It sends a periodic mail with the location of the cane holder using the equipped GPS module on the cane to inform the relatives of the person of his site in case of any emergency. Also, the vibrators beside the buzzer help more with sensing and adequately warn the holder of any obstacles. There is also a LED strip to light up the way and warn the people of the holder's instructions. The proposed solution prove the Superior and cheapest solution for blinds.**

***Index Terms*—Ultrasonic Range Finder; IoT; GPS; SMT.**

I. Introduction

When someone lacks to any of his organ function so he has a disability. The popular types and categories of disability are like sensory impairment, intellectual impairment, mental illness, and various types of chronic disease. This disability may effect on a person's participation in their life. Vision disability or blindness is defined as the state of being sightless. A blind person is unable to see. In a strict sense the word blindness denotes the condition of total blackness of vision with the inability of a person to distinguish darkness from bright light in either eye. In this paper, we are focused on visual impaired persons or blinds.

In Egypt, there are around 10.446 million impaired persons, i.e., 10.6% of the total population (99 Million nearly by 2018). Impaired persons can be classified depending on the type of impairment and its degree. This data is taken from a recent statistics study performed in the "Central Agency for Public Mobilization and Statistics," Egypt [1] . The number of visually impaired persons is 73 persons per 10,000 in towns and 162 persons per 10,000 in the countryside. This ratio is large, so it is a prominent figure to be interested in. The most important aspect that people look at is the quality value means how many features can be obtained for how much price. Disabled people, almost 90 percent of them suffer financial problems that make us look at the price optimization of the system as essential criteria. Also, one of the most things to be taken care of is making the device reliable, easy to use, and ask for the minimum intervention from the user. In this paper, we focus mostly on integrating the latest technological developments which is Internet of Things (IoT) in one complete mobile device that's portable, easy to use, and low in price smart cane. The cane will have the necessary standard features such as obstacles detection (moving/fixed types), alarming buzzer, and the vibrator that varies its speed according to how distant the obstacle is. Besides, it contains a GPS device, which is used to broadcast the site via e-mail every certain period, which integrates the concept of the Internet of Things (IoT), and this itself opens the way to many fantastic additions and full revelations.

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The main objective is making an efficient system that corrects the subjective questions. Rather than having the instructor correct each student's answer, we wish to create an automated system for addressing subjective questions. When it comes to final results, we are trying to reach the most possible to auto-correct the subjective questions with less error percentage accuracy that may occur.

The major contributions of this paper are as follows:

- Building Smart Cane for Blinds using IoT
- A novel Framework is proposed Blinds peoples based on IoT
- A novel combination of machine learning methods are developed and tested.
- The proposed method provides the cheapest solution for blinds

The remainder of the paper is structured as follows. We provide related work and background on IoT technology, including a discussion of the Role of IoT in Smart Cane for blinds and visually impaired persons in Section 2. System Development discussed in section 3, and In Section 4, we discuss the system implementation, is given. The paper concludes with a summary of the main findings of this research and some possible future lines of research to be explored in Section 5.

II. LITERATURE SURVEY

There are many studies and researches that are being done to plan an excellent instrument to help the client getting a superior strolling encounter.

One of them is Smart Vision [2]. It is a proficient plan which can identify way outskirts utilizing quick edge finder and an adjusted adaptation of Hough change. The gadget can distinguish stationary and also moving deterrents. The

previous is done through a camera connected on the client's chest, and the last is accomplished by multi-scale, commented on, and organically motivated vital points.

Another work is finished by Fernandes, Costa, Filipe, Hadjileontiadis, what's more, Barroso [1]. The gadget (proposed tool) can distinguish particular historical points. What's more, it will educate the client about the separation and variety between the obstructions types. Profundities are recognized utilizing two cameras, which produce pictures appropriate to remove both the position and separation of objects as per their relative brilliance. Radiance is another gadget that can be mounted on the current white cane and can detect low hanging obstructions, for example, branches of trees.

In work by Amir Hossein Tamjidi, Cang Ye, and Soonhac Hong, a compact indoor confinement help for 6 Levels of Freedom gadget post-estimation is proposed [3]. This strategy is utilized as an indoor GPS framework for position estimation of the outwardly weakened. It likewise bolsters deterrent location and causes the outwardly disabled to move around freely. In another work, by C. Ye and X. Qian, a RANSAC based plane location technique is proposed wherein the complex geometry of the 3D information guarantees accuracy [4]. An automated navigational gadget would utilize this technique for helping the outwardly to be tested, but the accuracy is the significant judging factor.

Mohd Helmy, A. Talib, A. Kadir [5] In this study they produced a prototype to detect obstacles or objects in front of users and feed them with voice messages and vibration warning back. The developed prototype, which is named Smart Cane, had achieved its objectives by the carried out tests on its function. The proposed model used a power supply meter reading to monitor its power status, an alarm system to be used in congested areas, and a buzzer timer that was activated at a specific duration.

Jayant Sakhardande, Pratik Pattanayak [6] they have implemented an Obstruction Detection System for Visually Impaired persons using ultrasound sensor. It is inexpensive to develop and build a smart cane for the visually impaired to detect obstacles. Other sensors do not equip the designed prototype. In the future, they will improve the performance of the prototype model. Initial experiments had been utilized in real-life scenarios with the target group. Users detected raised obstacles like the edge of a table, side of a truck, and horizontal bar before contacting them.

G. Hapsari, G. Andriana, D. Tiara [7] In this paper, They proposed a prototype to a tool to aid blind to detect an area, especially in Telkom University, by using the portable cane. The deviation area accuracy is less than 8 meters for each area. The prototype is categorized into the "fair" category based on the results of user testing, so their prototype is friendly enough to use by the blind. This prototype still needs improvement as involving more users in the testing process. In this study, they offered a location detection method for blind people without using a gadget. In the future, they need to enhance the accuracy and connect it to the map system so the blind can use it simply.

P. Bhavishya [8] In this research, they have used a pedometer to calculate the number of steps to help the blind the ability to walk independently and to assist the blind in walking. The system consists of three ultrasonic sensors (attached to a cane) to detect the obstacles and direct them in the needed direction (front/right/left), which has no obstructions when a barrier blocks the other two paths. When there is an obstacle in one direction, then the Distance of the other two routes was calculated, and he/she will be directed to go in a direction with longer Distance.

Ayat A. Nada [9] proposed a tool to aid blind people with a safe moving. The offered smart to stick to improve the mobility of both visually impaired and blind people. Their proposed stick uses different technologies like laser, ultrasonic, and infrared, but they still have drawbacks. The rod was based on infrared technology, and its weight is light, cheap, user-friendly, fast response, and low power consumption. It can detect staircases and other obstacles presence by using a pair of infrared sensors but with a distance of a range of two meters. Their experimental results achieved acceptable accuracy.

Shwetali P. Talele, Shivani V. Vadnere [10] In this paper, they have developed a smart guide cane for blind people to walk with the help of a single stick without any sophisticated software or hardware embedded with it. The designed cane is used to detect obstacles, alert the person, give the optimum direction (by detecting obstacles) by the distance calculation, and traces the live location of the person using the GPS module. It uses one buzzer for every direction that makes different sounds for left, right, and front. This cane can indicate the person if he/she is blocked on three sides.

Many other researchers who are recognized in the literature on IoT applications such as [11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24] studied the importance of IoT applications in our life.

III. PROPOSED SMART CAN SYSTEM

The iris-based authentication system is an identity recognition technique that uses statistically unique iris forms, which are mainly used to identify individuals. In this study, the IRS is developed based on FLC. The proposed system consists of four stages, namely, pre-processing, segmentation using PFCM, normalization using DRS, model, and iris recognition using FLC. The overall structure of the proposed methodology is shown in figure 1

A. System Architecture

the system architecture as shown in figure 1

B. The most important hardware components embedded in the system

The Raspberry Pi is a progression of small single-board PCs created in the United Kingdom by the Raspberry Pi Foundation to advance the educating of essential software engineering in schools and producing countries [21]. The first model wound up noticeably significantly more prominent than anticipated, offering outside its objective market for utilization, for example, apply autonomy. It does exclude peripherals (for

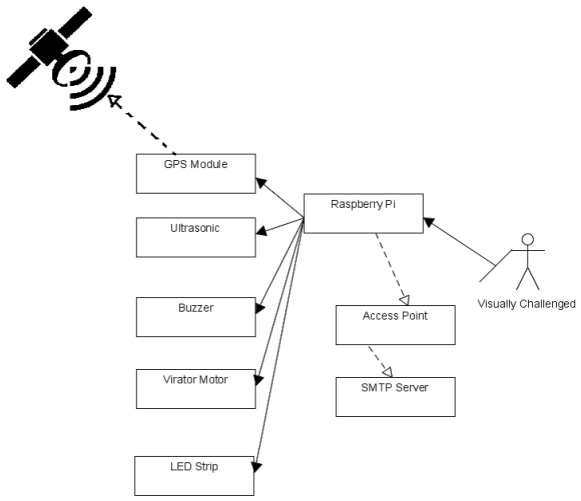

Figure 1. The Block diagram of the proposed system.

example, consoles, mice, and cases). Notwithstanding, a few frills have been incorporated into a few official and informal packs. The Raspberry Pi, as we see in figure 2, is a charge card measured PC that fittings into your TV and a console. It is a fit little PC which can be utilized as a part of gadgets ventures, and for a significant number of the things that your work area PC does, similar to spreadsheets, word handling, surfing the web and playing recreations. It likewise plays a top-quality video. In our research, we used it as the central controller; it is a full computer as it has the software to run and also processes the data then produces the output as opposed. It enables us to provide high-quality applications. We were equipped to be integrating network and internet into our project, besides the ease of use of other modules like Ultrasonic and GPS.

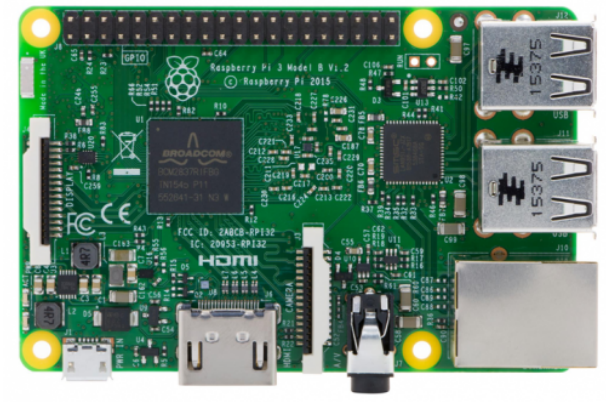

Figure 2. Raspberry Pi 3.

- **GPS Module** The GP-002 [22] is a whole GPS module that has many features like super influence capacity, ultra-low power, and little shape factor. The GPS signal, as shown in figure 3, is associated with the radio wire contribution of the Module and an aggregate serial data message with position, speed, and time information is presented at the serial interface with NMEA pattern or with a custom pattern. GP- 002 expands upon MT3337 superior, low-control chipset, - 165dBm is ultra-high affectability. It has TTFF at a low flag level to a great degree quickly. Savvy strolling stick helps the outwardly tested en route in addition to the identification of the current area, and it refreshes the area to cloud. It is of extreme significance to think about the current position of a man. In a request to unravel this test Global Positioning System (GPS) is utilized. The present location alongside current time can be discovered using GPS, which triangulates the GPS information obtained from at least three satellites. A microcontroller and voice data handle the information given by GPS is educated to the client. The present outwardly tested area isn't as it was critical for them yet in addition to their partnerships. They ought to know about the superficially tested individual's immediate area since there is a plausibility that an outwardly tested wanders into an obscure situation. It is the obligation of the partnerships to discover the superficially tested if they are lost. So it is fundamental to monitor their way. Wi-Fi module is utilized to transfer the present position of the client of the Smart strolling stick to SMTP. The kindred mates, the association of daze individuals, can get to the page with the login ID given to them. Isolate login ID will be accommodated each client of the stick. So, whenever the partnerships can track the position of the outwardly tested [24].

Figure 3. WeePee GPS Module.

- **Ultrasonic** An Ultrasonic sensor is a gadget that can gauge the Distance to a protest by utilizing sound waves [24] . It apportions remove by sending a sound wave at a particular recurrence and tuning in for that sound wave to bob back. Sound comprises of swaying waves through a medium (for example, air) with the pitch being

dictated by the closeness of those waves to each other, characterized as the recurrence. Just a portion of the sound range (the scope of sound wave frequencies) is capable of being heard to the human ear, characterized as the "Acoustic" range. Low recurrence sound underneath Acoustic is described as" Infrasound," with high recurrence sounds above, called" Ultrasound." Ultrasonic sensors are intended to detect question vicinity or range utilizing ultrasound reflection, like radar, to ascertain the time it takes to reflect ultrasound waves between the sensor and a strong protest. Ultrasound is used because it's undetectable to the human ear and is generally exact inside short separations. You could utilize Acoustic sound. For this reason, you would have a boisterous robot, beeping at regular intervals. Ultrasonic going module HC - SR04 gives 2cm 400cm non-contact estimation work, the going precision can reach to 3mm. The Module incorporates ultrasonic transmitters, recipients and control circuits. It works at a supply of 5V and 15 mA, as we see in figure 4 . The IO trigger of the sensor is set high for no fewer than10s. The Module naturally sends eight 40 kHz and sits tight for the beat flag to be gotten back to the point that the flag is gotten back; it keeps up its abnormal state. If the flag is gotten back, it changes to a low level. The time of being an abnormal state is called irregular state time. We use it simply as that we calculate the time that elapsed since the sound is out until it returns. As we know, the speed of sound, which is 343 m/s, then with the simple equation of Distance = Time x 17150, we divided the speed as we want only the Distance to the opposing object.

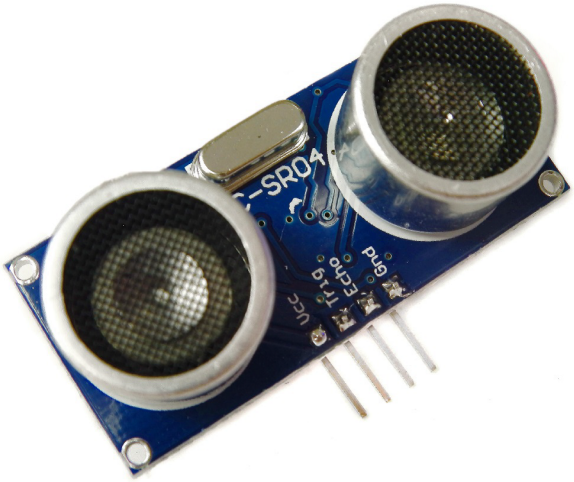

Figure 4. Ultrasonic Module.

- **Buzzer** Piezoelectric materials are either ordinarily available or engineered. Piezoceramic is a class of manufactured equipment, which stances the piezoelectric effect and is comprehensively used to make a plate, the center of the piezo ringer. Right when subjected to the trading electric field, they broaden or pack, according to the repeat of the banner along these lines, making a sound as shown in figure 5

Figure 5. Buzzer Module.

- **Vibration Motor** It is a small motor (see figure 6), as we see in figure 6, works on DC 3V, it can be up to 1100RPM as a current of 0.2A High-Speed Mini Vibration Motor is proposed to be used as an awareness tool for the person when there is a something close at a certain distance.

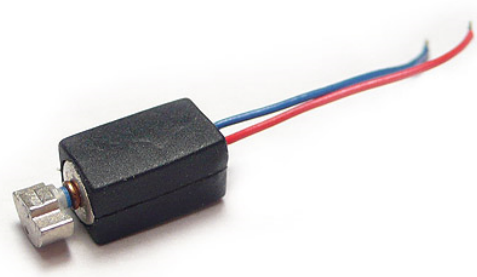

Figure 6. Mini Vibrator Moto.

- **The Whole System Implementation** First of all, we had to add the script file or, in our case, the python code to the boot-up data for it to work as soon as the system is powered on and without any interference from the user himself. When the system is on, it connects to the nearest access point in the area as instructed, which in turn, we specified it for the system, then begins the work. The ultrasonic is initialized along with the GPS module, and then the GPS starts to bind with and download the data

needed for the acquisition of the location. Also, in that stage, we initialize some variables to be used in the SMTP code for sending an e-mail. In the following figure, the system for initialization and definition stages.

After the initialization process is the main program, first, the ultrasonic starts to send a wave, and the timer begins counting for the time elapsed until we receive it back, as mentioned before. Through calculations, we get the Distance displayed in centimeters. Also, it adapts the buzzer sound and the vibration intensity to the Distance accordingly; it manipulates the PWM of the pins connected to them both.

Then after the GPS gets connected to one of the satellites, it takes about 5 minutes at maximum to join, we provide that the slow connection is due to the internal antenna of the Module. After the relationship it retains the data (longitude and latitude) through parsing the NMEA pattern, we then connect to the SMTP server to connect through the mail and send a message containing the location,

We implemented the proposed system as shown in Fig (7) that shows the final smart system for visually impaired

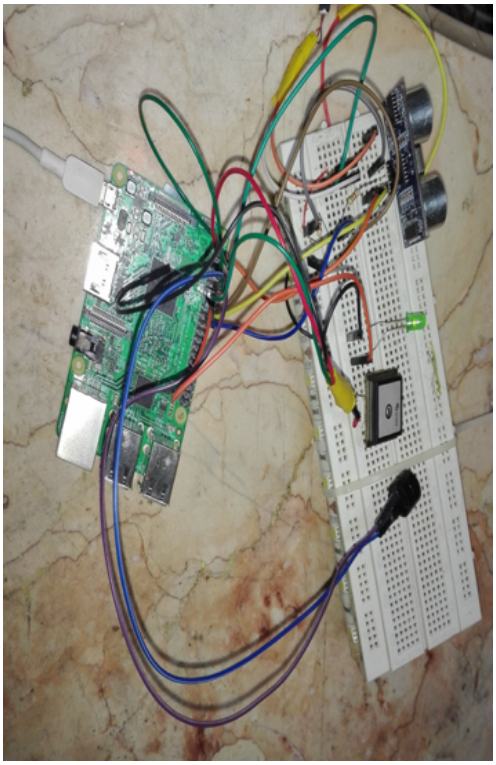

Figure 7. The Final Smart System For Visually Impaired..

IV. Experimental Results& Discussion

To run the device, we have to do the following steps:

- First, run the device through plugging the power
- The program script is set to run in the boot of the OS of the device
- If we want to monitor the Distance of Ultrasonic sensor or the coordinates of the GPS, we can log in through the Putty or VNC using the following IP address, user, and pass, respectively, as" 192.168.1.50"," pi, " raspberry."
- It is supposed that we can monitor the system through the buzzer and GPS coordinates mail, and it runs automatically.

Table I
THE AVERAGE TIME TAKEN THROUGH GPS TO SATELLITE CONNECTION OPERATION

Scenario	Average Time Taken
Out With View of Sky	2.7 minutes
On With No View of Sky	4.3 minutes
In a Closed Area	Never

Table II
THE INTENSITY OF VIBRATION DUE TO DISTANCE VARIATIONS RESULT

Obstruction Distance	Intensity of Vibration
>100 cm	No Vibration
100 _ 70 cm	Low
70 _ 40 cm	Medium
<40 cm	High

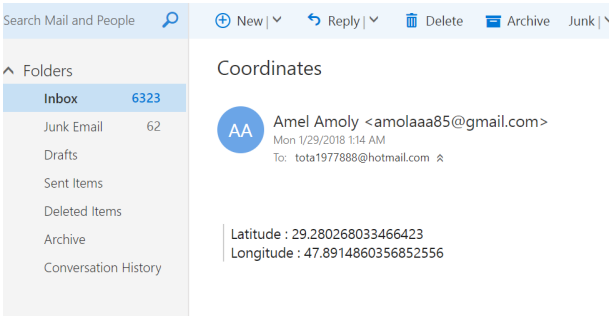

Figure 8. The e-mail message with the cane location.

By testing the GPS connection, we got that the delay of connecting to a satellite is approximately 2.7 minutes; that's also conditioned to providing a clear area and a comprehensive view of skies as tested, though, if there is no clear view of heavens or in a finished building, the connection may not happen at all. This happens because of the internal antenna; if it was external was to be more efficient(see Figure 8). In **Table I** below show the statistics, the calculations of each test state were captured after ten repetitions of the scenario; the timing was calculated by a stopwatch.

As we tested the intensity of the vibration and high validity, the separation measured by the ultrasonic sensor was checked utilizing a measuring device. The results of the strength and vibration are registered in table **Table II** . The identification of warning of obstruction was recreated with the assistance of a little car and also a solid wall. Three experiments were completed, and the following perceptions were checked.

Albeit certain restrictions like the failure to distinguish the obstructions hanging at a tallness of 150 cm from the beginning, this model turns out to be an incredible sparkle

to the mourned outwardly tested individuals. Its minimal effort of 2000 EGP, weight around 2 Kg, turns out to be an excellent luminance to the superficially examined with its extended highlights contrasted with as of now existing white stick and guided canine. In the future, the proposals that are obtained from the visually impaired individuals who made an exploratory utilization of the Smart strolling stick are to be refreshed in the Smart strolling stick. We are working on making the experience more convenient, by integrating more of the advanced concepts such as computer vision. That integration is not far beyond our hands, the GPU and the processing power enables us from doing that.

Further processing may be added coupled with a Bluetooth headphone to give the person a visual ability through hearing by describing the variants that he is met with. More and more can be expected as the concepts of deep learning, and reinforced training is getting brighter. We may invent a system that adapts to the variants and the type of life of the person with no further programming.

V. Conclusion

The purpose of this research is to design and work in the calculation of a gadget that outputs the way of an outwardly tested and cautions them in case of any risk. A Raspberry Pi-based calculation is built to warn about obstacles at a certain distance. The Raspberry Pi calculation joined with vibrator motor interfacing cautions the client of particular threats through a vibration intensity. Internet innovation is abused here to interface Raspberry Pi with SMTP service. In case of changing the location or for every five minutes, the device sends the site through the specified e-mail. Finally, at night which is determined by the raspberry clock, the LED strip turns on to notify the people of the challenged person visually.

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