Smart Stick for Blind using IoT

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***Abstract*- This paper describes cost-effective smart Stick using IoT (Internet of Things) for blind or visually impaired people. These people find difficulties in detecting obstacles near them, while they are out from their home all alone, which is very dangerous to them. This smart Stick comes as a proposed solution to enable them to identify the objects (water, fire, puddles, stairs, etc.). In this paper we propose a solution, represented in a smart Stick with ultrasonic sensors to detect stairs, walls and nearby objects in front of the user, within a maximum range of 3 meters. Moreover, another a water sensor is placed at the bottom of the Stick to detect water and puddles. Infrared fire sensor is attached, so that if the pole (stick) comes near to the fire, it will detect it and will produce a warning buzzer tone. A camera has been set with this Stick which enables the user's friends or family members to get the access where the person is going and can also track him/her using IP address of the camera. This proposed system uses the Arduino UNO board. This Stick gives a suitable message to the blind person as well as his/her family members or friends, empowering him/her to move twice the normal speed as he/she feels safe. It is cheap, fast in response, low power consumption and can be easily be operated by a battery or power bank.**

I. INTRODUCTION

Visually impaired people have acuity of 6/60 or the horizontal extent of the visual field with both eyes open less $\leq 20^{o}$, which means they cannot or face difficulty in identifying objects around them. From a research, it has been found that around 10% of blind people from the total world population have no usable eyesight at all to help them move around independently and safely. This electronic device is designed to solve this issue.

To record information about the obstacles presence in a road, active or passive sensors can be used. In case of a passive sensor, the sensor just receives a signal. It can detect the reflected , emitted or transmitted electro-magnetic radiation provided by natural energy sources. In case of using an active sensor, the sensor emits a signal and receives a distorted version of the reflected signal. It detects reflected responses from objects irradiated with artificially generated energy sources. These kind of active sensors are capable of sensing and detecting far and near obstacles. In addition to it, it can determine the accurate measurement of the distance between the blind and the obstacle. Overall, in the field of obstacle detection, four types of active sensors may be used: infrared, ultrasonic, laser, in addition to radar sensors.

Bat K Sonar, Smart Cane, Smart Vision, Guide Cane, use ultrasonic sensors or laser sensors to detect obstacles in front of blind by transmitting the wave and reception of reflected waves. It produces either an audio or vibration in response to detected obstacles to warn him/her about the near obstacle(s). Systems like VOICE, SoundView, SVETA and CASBLIP, use single camera or stereo video cameras mounted on a wearable device to capture images. These captured images are re-sized, processed further and converted to speech, audio, sounds or vibrations. In such systems, the frequency of warning sound signal is correlated with the orientation of pixels. Some advanced systems use GPS (Global Positioning System) integration with the main system. It's also noteworthy that GPS receiver is useful for understanding the current location of the subject and nearby landmarks. Some solutions are already available in the market such as: UltraCanne, Isonic, Telecat, etc. These products help blind people by collecting information through sensors and then transmitting recommendations through vibrations or sound message to the user.

These solutions still have many disadvantages for example:

They can't detect obstructions that are hidden but very dangerous for the blind such as downstairs, holes, etc. Usually, the feedback information comes out as either vibration or sound signals. Thus, these systems communicate their recommendations to the user through sound or frequency vibrations.

Consequently, training is then necessary to help the user understand the signals and to react to them in real time. However, such training is sometimes

more expensive than the product itself. Therefore, users can't afford it in most of the times. Otherwise, the information is transmitted as a sound it may be embarrassing for the blind person in public.

In our work we tried to overcome some of disadvantages:

• We designed stick to detect obstacles and is able to recognize and buzz loud accordingly, depending it is stair, hole, puddle or fire.

• The training of our project isn't as expensive as training in other products.

• An ultrasonic sensor is used to transmit information to the blind. A buzzer is attached with the Stick which acts as a warning tone in order to make it user friendly.

• A very fast response is achieved with a calculated time of 40 ms in average distance 20 cm before hitting the obstacles.

II. MATERIALS & METHODOLOGY

A. SYSTEM ARCHITECTURE

The proposed smart stick for blind system uses ultrasonic sensor, IR flame detecting sensor, water detecting sensor, a 2 megapixel camera, DC power supply source (9V). The schematic diagram of this system is shown in figure 1.

The sensors, i.e. the ultrasonic sensor, water level detecting sensor and IR flame detecting sensor is connected with one Arduino UNO board and the ESP32 camera Wrover module is connected with another board. Both the circuit board is connected to individual 9V external power source.

Ultrasonic sensor (HC-SR04) have 4 pins, namely Vcc, Trig, Echo, Gnd. The Vcc is fed with a 5V DC supply voltage. The Trig (Trigger) pin is used to transmit ultrasonic wave and the wave is reflected back to the receiver and the data is read via the Echo pin. Gnd stands for ground.

This sensor works well for close obstacles unlike laser one, when an object is so close (less than 15 cm) cannot get an accurate reading. Moreover, it should be noted that radar sensors can easily detect near and far obstacles with equal performance, but their medium accuracy does not allow them detecting small obstacles.

Water level sensor is an easy to use, cost-effective high level recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets or water volume in order to determine the water level. Easy to complete water to analog signal conversion and output analog values can be directly read Arduino development board to achieve the level alarm effect.

The IR flame sensor module consists of a IR (Infrared receiver), resistor, capacitor, potentiometer and comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700 nm to 1000 nm. The far infrared flame probe converts the light detected in the form of infrared light into current changes. Sensitivity is adjusted through the onboard variable resistor with a detection angle of 60º. It works between 3.3 V and 5.2 V DC, with a digital output to indicate the presence of a signal. Sensing is conditioned by an LM393 comparator.

The ESP32 camera has a very competitive small size camera module that can operate independently as a minimum system. It can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications. It is packaged in DIP and can be directly plugged into the backplane for quick production. It provides customers with a highly reliable connection method and is convenient for use in various IoT hardware terminals.

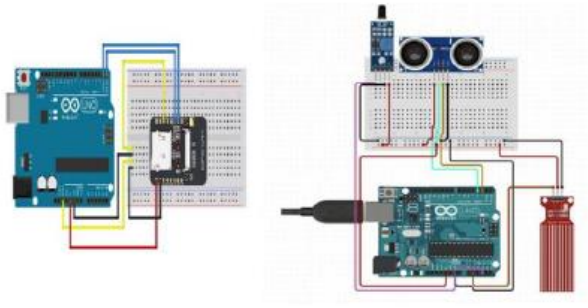

Fig. 1: Connection diagram of Smart Stick for Blind

B. WORKING PRINCIPLE

The smart stick, as shown in Fig. 2, is basically an embedded system integrating the ultrasonic sensor to detect obstacles in front of the blind from ground level height to head level height in the

range of 400 cm a head, infrared flame sensor to fire near the blind person. Ultrasonic sensors, water level sensor and infrared flame sensor collect real time data and send it to microcontroller. After processing this data, the microcontroller actives the buzzer to buzz and invokes a warning message to the user. The water sensor to detect water spreads and puddles. A rechargeable battery is used to power the circuits with 9V (DC).

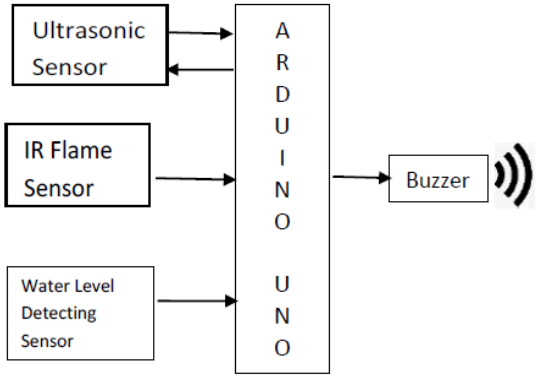

Fig 2: Working flow diagram of the proposed smart stick for blind system

III. RESULT

The proposed circuit is designed and tested and shown in the figure 4. The smart stick for blind system was tested in a classroom. The result showed proper functioning of the system.

Fig 3: Model of Smart Stick

Fig 4: Demonstration of the working of camera

IV. CONCLUSION

The Smart Stick for blind acts as a basic domain for the forthcoming generation of more aiding devices to help the visually challenged people to be more safe. It is effective and affordable. It leads to good results in detecting the obstacles lying ahead of the user in a range of 4 meters, detecting stairs, water pits, puddles, fire, etc.

this system offers a cheap, reliable, low power consumption and robust solution for navigation with obvious short response time. Though the system is hard-wired with sensors and other components, it is light in weight.

Further aspects of this system can be improved via wireless connectivity between the system components thus increasing the range of the sensors and implementing a technology for determining the speed of approaching obstacles. While developing such a massive solution, visually impaired and blind people will be more relieved in all developing countries across the globe.

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