Voice based assistance for blind with Image Recognition

Making life easier for the Blind with the power of Technology (IoT)

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Abstract: Blindness is a condition in which an individual loses the ocular perception. Mobility and self-reliability for the visually impaired and blind people has always been a problem. In this paper a smart Electronic Traveling Aid (ETA) has been proposed. This smart guiding ETA ameliorates the life of blind as it is well equipped with Internet of Things (IoT) and is meant to aid the visually impaired and blind to walk without constraint in close as well as open environments. This ETA is a highly efficient, reliable, fast responding, light weight, low power consuming and cost-effective device for the blind. Ultrasonic sensors have been used to detect the obstacle and potholes within a range of 2m. GPS and ESP8266 Wi-Fi module has been used for sharing the location with the cloud and do the work of image processing on the cloud itself. A RF Tx/Rx module for finding the stick when it is misplaced. Arduino Mega2560 is the microcontroller used, which has 54 digital I/O pins which makes the interfacing of components easy

Keywords— IoT, Embedded System, Blind-Stick, Image Recognition, Cloud Computing, GPS, visually impaired people, Obstacles Detector.

I. INTRODUCTION

According to the report from World Health Organization, (WHO) in 2014 there were 285 Million people who were visually impaired and out of those 39 million were blind and 246 Million were low blind [1]. With the advancement in the modern technologies, different types of devices are available for the mobility of visually impaired and blind. These devices are known as Electronic Travel Aid (ETAs) [7]. The ETAs have sensors which alert the blind in advance about the danger with sounds or vibrations. With the introduction of such Electronic Traveling Aids (ETAs), there is an increase in blind's safety and self-confidence. Some of the visual aid devices include UltraCane [2], Computer based image processing [3], Infrared based smart stick [4], BlinDar [6]. These devices are not so user friendly and easy to handle. Laser canes and Virtual Eye Aids are very costly and not so user friendly. This paper proposes the device which is a user friendly and easy to use ETA. It aims at improving the life of blind and helps them to self-navigate without depending on someone.

Unlike before, blind people will now be able to lead life as normal people. Apart from that the family members of the blind person will also be able to track him at any moment and will be able to get the exact location of him from anywhere. This stick is IoT based and is very cost effective, efficient and user friendly. The device mainly consists of an Advanced Blind Stick with Arduino Mega2560 microcontroller.

It also has different sensors and modules attached to it which are interfaced with the microcontroller

The proposed system provides the following features:-

- Inexpensive navigation smart stick with total cost not exceeding more than 100$.
- Fast response of the obstacle sensors in near range up to 4m.
- Light weight components integrated on sticks which makes it user friendly with low power consumption.
- Overall circuit is not complex and uses basics of C/C++/Java to program microcontroller.
- RF Tx/Rx module is attached for finding the stick in close premises such as home. If the stick is misplaced, a key on the wrist band which on pressing will activate the buzzer on the stick which helps the person to locate the stick depending on the intensity of sound.
- A GPS module attached for location sharing to the cloud. Location is updated every 20ms.
- The concept of image processing is implemented where the camera module will be used to capture the image and detect the obstacle in the path of the user.

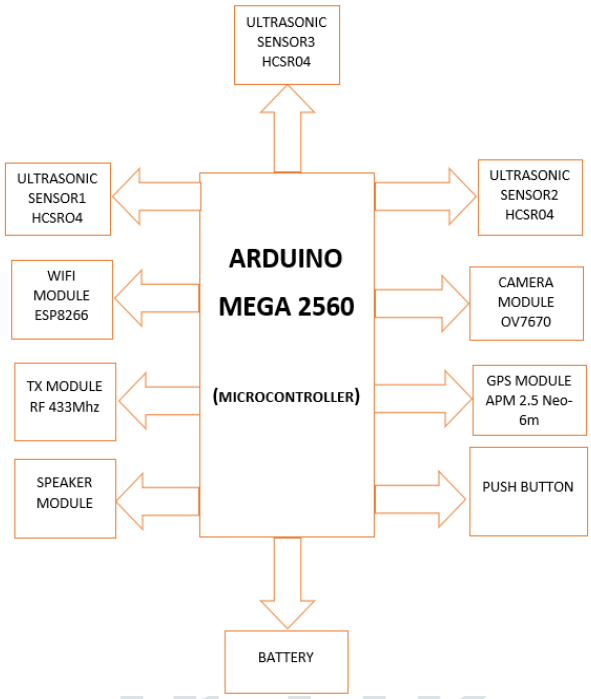

Fig 1. Block diagram of proposed system

II. COMPONENTS USED

A. Arduino Mega2560 Microcontroller (ATmega2560)

The Arduino Mega 2560 is a microcontroller board based on the AT mega 2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. 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. [10]

B. Ultrasonic Sensors

The system is installed with 3 ultrasonic sensors. One in the centre, one on the right and one on the left to detect obstacles coming from all the 3 sides of the user. These sensors will detect the object once it comes under the radius of 1.5 metre. [7]

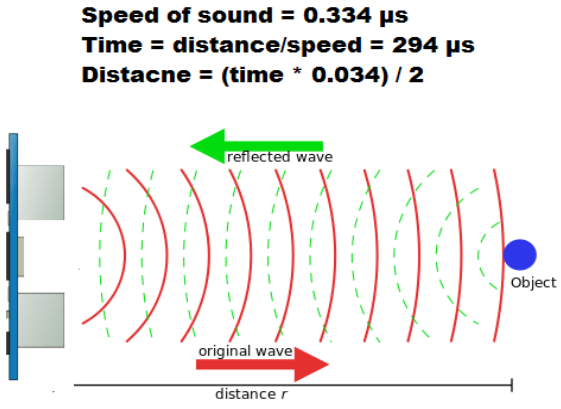

Fig 2. Object Detection using Ultrasonic Sensor

C. Camera Module (OV7670)

The stick will contain a camera mounted on it. The camera will be initiated after the user will press a button present on the stick. It will then capture the image of the environment in front of the user and will send it to the cloud where TensorFlow's object detection API (modified output) will be used to classify the objects present in the image. TenserFlow's object detection API uses COCO

(Common objects in context) dataset for training the model. COCO is a large-scale object detection, segmentation, and captioning dataset.

COCO has several features:

- Object segmentation
- Recognition in context
- Super pixel stuff segmentation
- 330K images (>200K labelled)
- 1.5 million object instances
- 80 object categories
- 91 stuff categories
- 5 captions per image
- 250,000 people with key points [8]

D. ESP8266 Wi-Fi module

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications. It is a 2.4 GHz Wi-Fi module supporting WPA and WPA2. It is a low cost standalone wireless transceiver that can be used for end-point IoT developments [11].

E. GPS module

A GPS module is also attached on the stick for location sharing to the cloud. This will help the blind person's family members to check the location whenever the ant to Location is updated once every 20ms.[9]

F. Tx/Rx module

This RF module comprises of an RF Transmitter and an RF Receiver. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna. The transmitter will be attached to a wristband on the user's hand and the receiver will be on the stick. When the user presses the transmitter button the receiver on the stick will start a buzzing sound which will help the blind person to find the misplaced stick. [12]

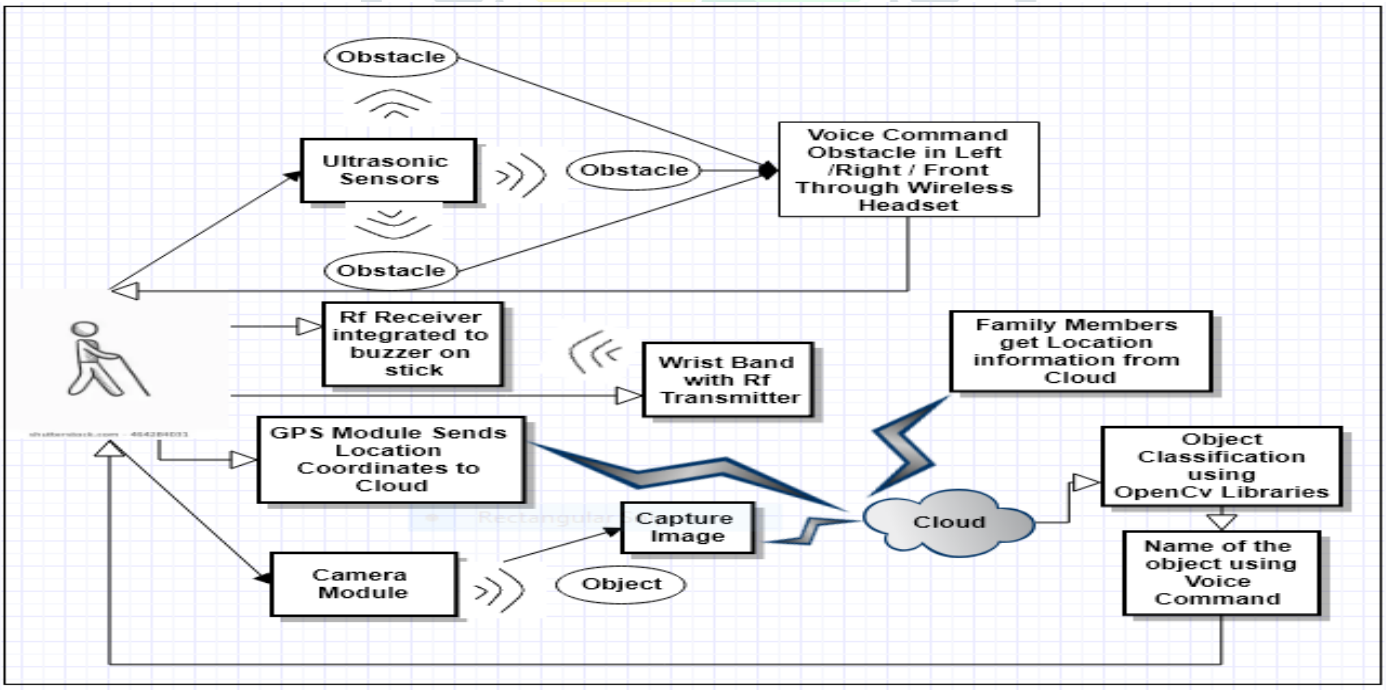

Fig. 3. Control Flow Diagram

III. FUTURE SCOPE

The Internet of Things (IoT) is a very promising technique. It is expounded as the network of Internet of Things (IoT) is a very promising technique. It is expounded as the network of real or virtual entities embedded with electronics, sensors and software's with network connectivity which enables these entities to collect and exchange data, thus providing connectivity at any time. As part of future work, we can implement a voice based GPS navigation system which could guide the blind with the directions to his/her destination by integrating the ETA with the Google maps API, we could also increase the size of the dataset used for training the Object recognition model so that it can detect almost every object in real life, we can also integrate face detection model so that along with objects it could also detect the person standing in front of the blind as and when needed. As the ETA would generate a lot of data on the cloud it could be used to make important decisions in the future using few AI and Machine Learning Algorithms.

IV. RESULT

The modules and sensors that were used are tested several times and the final design of the components is shown in figure 4. The ultrasonic sensors were coded on Arduino ID and then uploaded to the microcontroller board and were able to detect the objects in the range distance of 1.5m. The GPS module was able to detect the correct location of the stick with the output as the latitude and longitude.

Tensorflow's object detection API based on COCO dataset was modified according to our needs and deployed on a virtual machine on Google Cloud which can classify most of the objects captured by the Camera Mounted on the stick whenever the user triggers the button and will give out the result in voice.

Fig 4. The final look of the proposed smart stick

V. CONCLUSION

In this paper, a detailed explanation about the proposed smart stick has been given. With the introduction of this prototype, the life of the visually impaired will become much easier and independent. The main drawback of the visually impaired is that they deprive themselves of what they deserve. This stick helps them in giving confidence and independence. This product uses the technology of IoT, which is one of the most demanding topics in the current scenario. It is user-friendly, easily adaptable and has multipurpose functionality. We analyzed the current problems faced by the blind in India and came up with the solution of creating a smart stick. As described in section II, the components used enable the product to work in the desired field and hopefully help the blind.

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