Design of Intelligent Stick - Guide for the Blind

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Abstract— To help the visually challenged humans to sense the obstacles in front of them while walking and provide navigation with additional features to make them independent in the society. This intelligent stick has features like obstacle detection, finding the stick if lost or misplaced, provides navigation using GPS (Global Positioning System) and GSM (Global System for Mobile). This system uses Arduino Nano AT-Mega 328, FONA feather 32u4, GPS feather wing, ultrasonic sensors HC-SR04, Bluetooth sensor HC-05.

Key words: Arduino Nano AT-Mega 328; Bluetooth Sensor HC-05; Fona Feather 32u4; Intelligent Blind Stick; Ultrasonic Sensors HC-SR04

I. INTRODUCTION

The aim of project is to serve the visually challenged people by improving their stick that ensures safety & security, better navigation and interactivity, making it an intelligent stick. The visually impaired people use only their natural senses and we enhance this using simple available technologies. The 2017 statistics by the World Health Organization (WHO) estimates that there are 253 billion people in world with visual impairment. 36 billion of which are blind and 217 with low vision. The traditional and oldest mobility aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information.

This project aims to design an intelligent stick by incorporating the advancement in Their transportation is made easier using blue tooth in the place of Infrared remote sensors for conveying bus arrival information. It also offers single click request availability for private transportation such as taxi that notifies the cab driver with the user location. Technologies such as obstacle detection using ultrasonic [1] and infrared sensors [2]. It also improves navigation with 3D voice commands, thereby reducing voice commands and improving their hearing sensitivity. In case the stick is lost or misplaced, it can be found with the help of a remote and buzzer through blue tooth technology.

II. METHODS

Pair of ultrasonic sensors HC-SR04 to detect obstacles in front of the blind from ground level height to head level in the range of 400 cm. The microcontroller processes the data from the sensors and provides vibration or alarm whose intensity depends on the closeness to the obstacle.[3]

Two HC-05 Bluetooth[10] modules are used, one configured as master and other as slave. When the stick is lost, which has the slave is identified through the remote that has the master that can both send and receive signals which in turn connected with a buzzer. Adafruit Feather 32u4 FONA is Arduino-compatible with features like audio/sms/data capable cellular with built in USB (Universal Serial Bus) and battery charging with sim800H module.

An Ultimate GPS Feather Wing plug s right into your Feather board and gives it a precise, sensitive, and low power GPS module [6], [7] for location identification anywhere in the world. the GPS can also keep track of time once it is synced with the satellites.

A. Obstacle detection using Ultrasonic sensor HC-SR04

It consists of a pair of ultrasonic sensors[3] to detect obstacles in front of the blind from ground level height to head level in the range till 400cm. The microcontroller processes the data from the sensors and provides vibration or alarm whose intensity depends on the closeness to the obstacle.

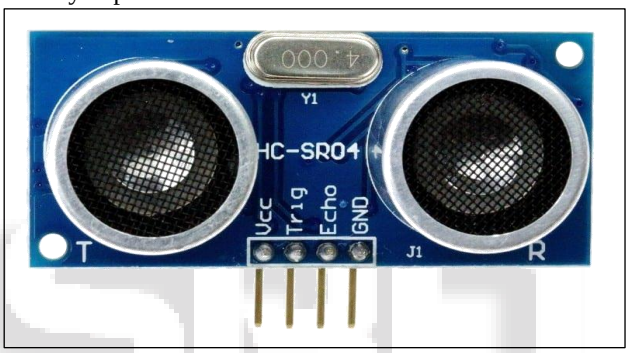

Fig. 1: Ultrasonic sensor (HC-SR04)

B. Locating stick using two Bluetooth module HC-05

Two Bluetooth modules [11] are paired with one and another, where one is the master and other is slave. The master in independent whereas the slave is connected with the stick which consist of a buzzer. When the master send a high signal to the slave, the slave receives it and the buzzer gets ON till the signal is transferred.

Fig. 2: Bluetooth sensor (HC-05)

C. GSM and GPS location using Adafruit Feather 32u4 FONA

Adafruit Feather 32u4 FONA is Arduino-compatible with features like audio/sms/data capable cellular with built in USB and battery charging with sim800H module. It can make and receive voice calls using an external 8Ω speaker + electret microphone, Pair-able Bluetooth client interface with SPP(Serial Port Profile) (for controlling the module) as well as audio. It can send and receive SMS messages, send and receive GPRS(General Packet Radio Services) data (TCP/IP, HTTP, etc.) and AT(ATtention) command interface with "auto baud" detection.

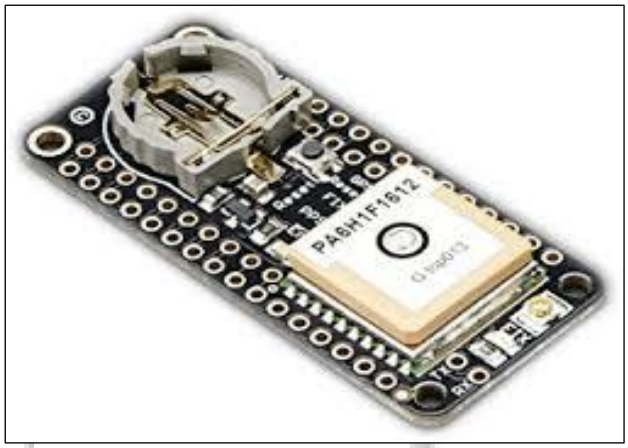

Fig. 3(a): GPS wing of FONA feather

Fig. 3(b): FONA Feather 32u4

NOTE: The main components that is used, is the Arduino Nano that is interfaced with ultrasonic sensor and Bluetooth module whereas Fona feather 32u4 is independent.

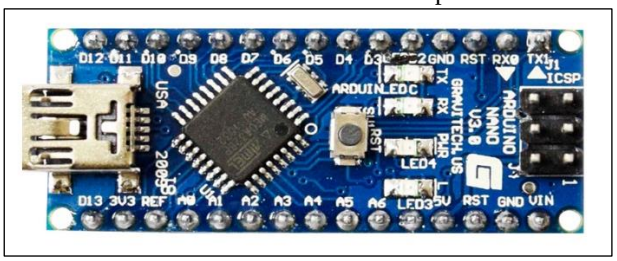

Fig. 4: Arduino NANO (ATMega 328)

III. DISCUSSION

A. System performance of Ultrasonic Sensor

Ultrasonic sensor has operating voltage of 5V and current of 15mA with an operating frequency of 40 KHz. The range of the ultrasonic varies from 5cm-400cm.The connections of two ultrasonic sensors with arduino nano is given below

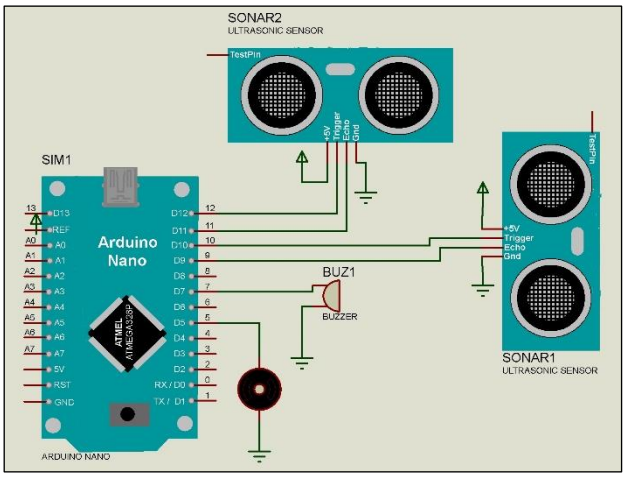

Fig. 5: Two Ultrasonic sensors with Arduino nano-ATmega328

When the object is placed in front of the ultrasonic sensor[4] the frequency transmitted(trigger) from the sensor is returned back to the receiver (echo) the time delay is then calculated which gives the distance between them where time delay is varied with the respective distance.[5]

Theoretical Calculation - Time taken by pulse is actually for to and from travel of ultrasonic signals, while we need only half of this. Therefore time is taken as time/2. Distance = Speed * Time/2; Speed of sound at sea level = 343 m/s or 34300 cm/s.

Thus, Distance = 17150 * Time (unit cm)

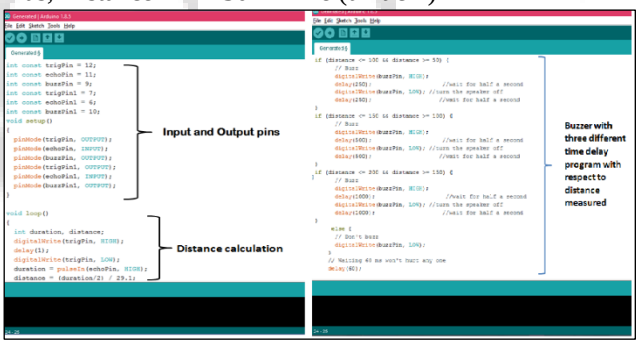

Fig. 6: Sample coding for ultrasonic sensor

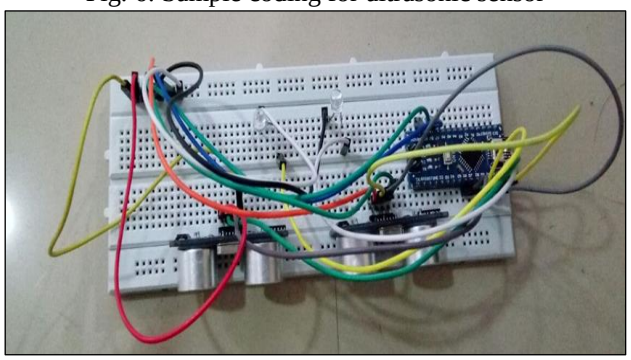

Fig. 7: Practical working with ultrasonic sensor

B. System performance of Bluetooth Module

Bluetooth module (HC-05) has an operating voltage of 1.8V to 3.6V I/O. It has programmable baud rate with integrated antenna (9600,19200,38400,57600). The main advantage of this Bluetooth [10]module is that it can be made as the master or a slave using AT command.

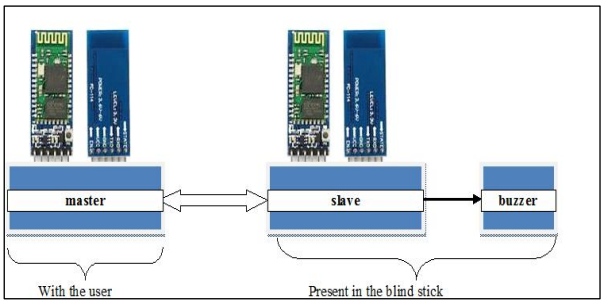

Fig. 8: Block diagram of Bluetooth connection

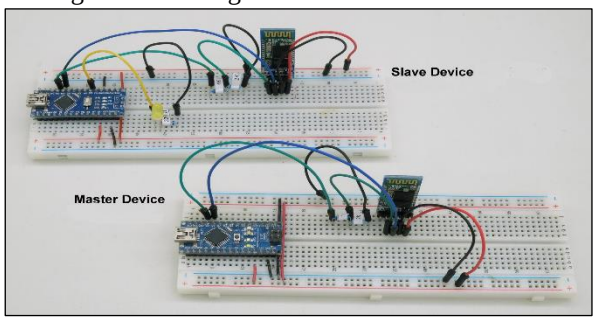

Fig. 9: Practical working with Bluetooth module

C. System performance of Fona feather 32u4

Adafruit Feather 32u4 FONA is Arduino-compatible with features like audio/sms/data capable cellular with built in USB and battery charging with sim800H module.

An Ultimate GPS Feather Wing plugs right into your Feather board and gives it a precise, sensitive, and low power GPS module for location identifcation anywhere in the world. the GPS[8], [9] can also keep track of time once it is synced with the satellites. This is programmed to send the location to cab driver or emergency numbers depending on the situation through sms and also provides options for making calls.

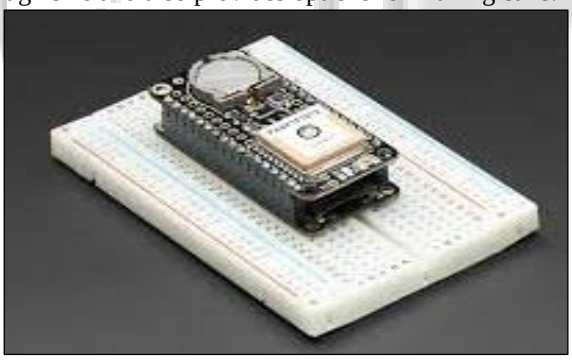

Fig. 10: GPS wing embedded in FONA feather

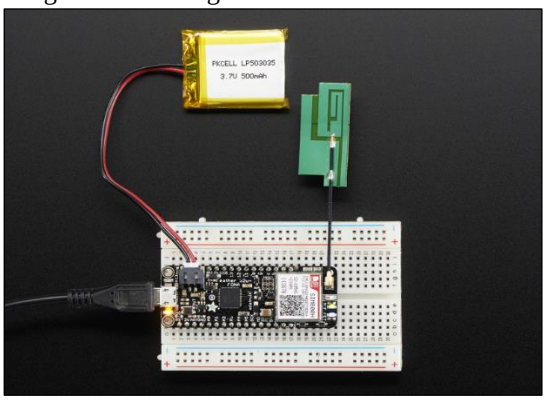

Fig. 11: Working with Fona feather 32u4

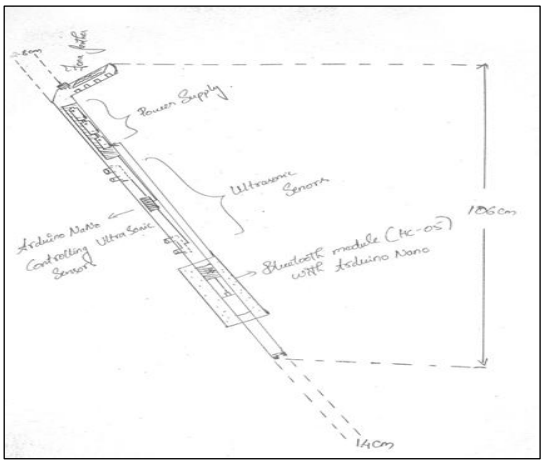

Fig. 12: Overall design of the stick

IV. GENERAL BLOCK DIAGRAM

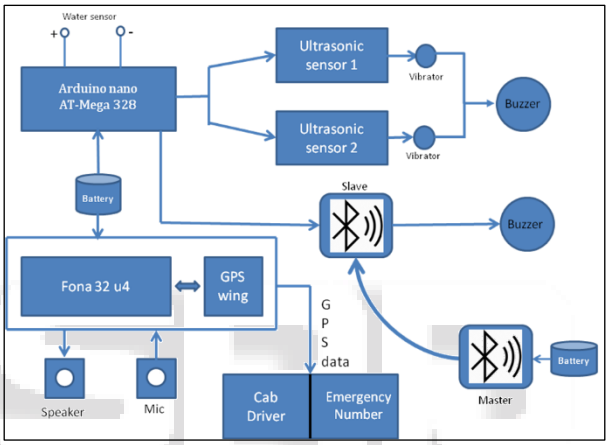

Fig. 13: General block diagram of intelligent stick

This block diagram shows the overall connection of the existing components. An Arduino nano board is connected with two ultrasonic sensors that provide obstacle detection at both knee and head level. It is also used to interface with the Bluetooth Module at stick and the other Bluetooth module is present with the user in the form of key. A feather fona component fitted with GPS feather wing is used to track location and send sms for cab services and emergency numbers.

The working in the form of flow chart is as follows:

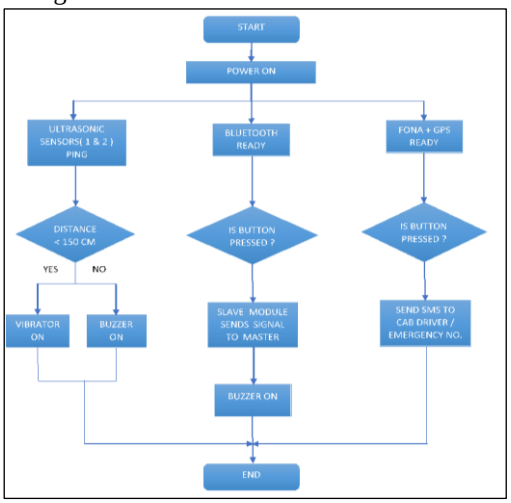

Fig. 14: Process flow of intelligent stick

V. CONCLUSION

The main conclusion of the work is that the stick is easy to use, small in size and more interactive. This product looks actually like a stick rather than an assembly of components as the size is made smaller by the use of Arduino Nano, Adafruit feather Fona and GPS feather wing. Since the visually impaired people use only their natural senses, we enhance this using simple available technologies like ultrasonic sensing, bluetooth, gps and gsm technology. Hence, we serve the visually challenged people by improving their stick that ensures safety & security, better navigation and interactivity, making it an intelligent stick.

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