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A BLIND STICK ASSISTING BLIND PERSON TO DETECT OBSTACLE AHEAD AND TO ALERT THE USER

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Abstract: In today's world where man has reached Mars, technology is helping them grow stronger with time. Normal persons get the most advantage but the disabled are also not left much behind. Today there are advancements for the disabled persons too. This study has dealt with making a blind stick which will assist a visually blind person to detect the possible obstacles ahead and to alert the user timely.The system consists of a micro-controller, a buzzer and four sensors, namely ultrasonic sensor, flame sensor, water sensor and LDR. All the sensors collect value and send it to the micro-controller. The ultrasonic sensor triggers a pulse for 10 micro seconds and then reads the sound wave travel time in microseconds to the Arduino-Nano. Using this time, it calculates the distance of any obstacle if present in front. When no obstacle is found within 1.4m range, it keeps on beeping normally, but as soon the obstacle crosses the limit and the user approaches close to it, it starts beeping faster. Similarly, the fire sensor reads of fire is present ahead. When encountered it reads the reading through the IR sensor and the value is then compared to a reference value set. If found more that means it can be dangerous and thus alerts the user. Similarly, the water sensor receives value from sensor and when senses danger comparing the value alerts the user.The developed prototype was made using simple things and turns out under the cost of Rs.300/- thus making it highly affordable.

Keywords: Blind Stick, Active sensor, Passive Sensor, Arduino-Nano, obstacle.

1. INTRODUCTION

The blind persons have trouble to interact and sense their surrounding and nature as common people do. Today there are many other advancements for the disabled persons too. These persons are soon to be benefited from the futuristic inventions. Among such inventions are eSight glasses. It has been designed to benefit people living with a variety of different eye conditions, like cataracts to complete blindness since birth. It helps people who struggle to see a much clearer and better view of the world. Aira is an advanced model of this which uses augmented reality to describe the live feed to the wearer. Dot Watch is yet another invention which is similar to smart watches which help them access to call and other notifications. Among some technologies

there is BrainPort V100 which captures the surroundings with the help of a camera and then converts it into electric signals.

According to WHO, in 1996 the number of blind were found out to be 45 million and in 2020 this value of number of blind is said to be 76 million with 47% of the cases due to cataract. So, the need of invention has brought together many to work in this matter. Mohod et al. [1] have proposed Blind Mate which is a system consisting of a smart stick and app connected together for better assistance of blind people in any location. When the stick detects an obstacle it vibrates, an equivalent signal is sent to the app which then gives voice command of the obstacle ahead. Shanmugam et al. [2] have given the solutions for the visually impaired persons by making Object Detection Module and Location tracking module. Gulati [3] came up with an idea of using GPS for assisting blind people. He designed a GPS based voice alert system for navigation purpose. Assistive Infrared Sensor Based Smart Stick [4] is a compact, foldable blind stick fitted with a IR sensor to detect obstacle ahead and then plays a speech of warning message which is heard by the user through earphone. Nada et al. [4] found out that it is highly essential to design a stick which is consumes less power thus ensuring longer battery life. The price is also a factor deciding the reach of the product. Sourab et al. [5] suggested a system in the form of a jacket consisting of sensors mounted on it. This system consisted of 5 sensors for the purpose of detecting potholes, staircase and obstacles and then according give instruction to microcontroller when then played pre-saved voice commands stored in SD-card. Lin et al. [6] recommended the most affordable system utilizing UN-hear able sensing component to detect barrier or obstacle ahead and thus warning the user. Anwar et al. [7] introduced a smart blind stick system for supporting blind people. Chaurasia and Kavitha [8] suggested a system made up of 2 ultrasonic sensors and 2 infrared sensors. It also had a button which on clicked sent an emergency notification to a saved mobile number. The Nottingham Obstacle Detector [9] is a secondary device using ultrasonic transducer to detect obstacle up to 7½ feet ahead of the user. This secondary type device required proper training for use and it was usually used with a long cane or dog guide. The NavBelt system [10] is a computerized ETA which consisted of a computer connected to different sensors. It worked on mainly two modes: Guidance Mode and Image Mode. The guidance mode used values from sensor to guide through path whereas the image mode utilized image processing technology to guide the user in a surrounding. The idea of Service Robots [11] also came into plan to guide blind. The idea was to create service robots that was acceptable socially and worked on three modes of assistance. Though this idea was later brought down to work, it was noticed that the service robots worked perfectly in indoors and specially in places where the layout of the working place is fed in its memory. Additional training was also necessary to use this system. Use of deep learning and machine learning techniques [12] for performing indoor navigation was already started in the year 1999. Though this system operated with an efficiency of 50%, but this was the first time a new path was seen on, for better indoor navigation using “data cooking” module which operated on raw data from

sensors like accelerometers, magnetometers, and temperature and light sensors. Image processing is yet another path chosen by many to find a solution.

With one such idea, Smart Glasses for the Visually Impaired People [13] came into action. This system used Raspberry pie for processing and camera for image capturing. This prototype was able to recognize texts from hardcopy materials. Rodriguez et al. [14] introduced Obstacle avoidance system for assisting visually impaired people. Innet and Ritnoom [15] have given an idea of an application of Infrared Sensors for Electronic White Stick. The advanced controllers developed by Dasmahapatra et al. [16-20] can be implemented in such system to make it as robust system. These inventions additionally lack in some options or the opposite. They cannot observe potholes, stairs or hazards like fireplace.

This study has forbidden creating a blind stick that will assist a visually blind man to observe the doable obstacles ahead and to alert the user timely. The details of the materials and methods have been mentioned in the next section followed by the logical flow diagram and the physical prototype.

2. MATERIALS AND METHODS

The materials used to make the blind stick are mainly different types of sensors to receive signal. Microcontroller has been used here to process the signal and to make the necessary output which is helpful for the blind people.

2.1 Sensors

In general, to record data concerning any obstacle, 2 varieties of sensors will be used primarily, active and passive sensors. For passive device, the task is simply to receive a symbol of the mirrored, emitted or transmitted electro- magnetic radiation from completely different energy sources. On the contrary, active sensor emits the signal and additionally receives the mirrored signal. It then checks the changes within the distorted version of received signal. These inventions do bring tons of changes and betterment to our society however there's no good solution and therefore without stopping to invention. Different kinds of active and passive sensors are mentioned next.

a) Ultrasonic sensor: It works well for shut obstacles in contrast to optical maser one, when associate degree object is thus shut the optical maser device (less than fifteen cm) can't get associate degree accurate reading. Moreover, it ought to be noted that measuring device sensors will easily observe close to and much obstacles with equal perform once, but their medium accuracy does not enable them detective work tiny obstacles. The speed at that sound travels depends on the medium through that it passes. The speed of sound waves changes with the atmospherical conditions. All obstacles replicate some a part of the wave back to the receiver. The amplitude of the wave mirrored is found proportional to the existing surface present on the obstacle. The extent, form and orientation of the obstacle contribute to the worth of the mirrored signal. The ultrasonic device

connected to the circuit has been given in Fig.1(a).

b) LDR-Light Dependent Resistor: This can be created from semiconductor materials therefore facultative it to possess photo-sensitive properties. LDR works on the principle that whenever lightweight falls on its surface the electrical current increases and therefore the value of resistance decreases. For this case a voltage divider circuit is employed wherever the voltage amendments with the change in resistance of the LDR. The amendment of this value in voltage is fed to the ARDUINO through analog pin. Therefore, serving to the blind to decide concerning light and dark within the encompassing. Thus, throughout day once light falls on LDR, the resistance value decreases and therefore value of voltage is magnified or HIGH. During night or dark, the resistance in resistor circuit is additional and the voltage is a smaller value or LOW.

c) Water Sensor: It is a simple to use, light weight, comparatively low-cost device which works on an awfully simple principle. The device consists of a series of traces of that some square measure exposed wires connected to ground and interrelated between these traces square measure device lines that consist of a low resistance value of 1MΩ. On presence of water the circuit gets short circuited wherever the device line gets connected to grounding wires, thus changing the worth of device. The Fig.1(b) represents the water device.

d) Fire Sensor: This is a sensor which works on the principle of receiving IR wave-lengths that are emitted by a flame. The microcontroller receives the amount of IR and gives an analog value. Then the values are compared to give the signal of the fire hazard ahead. This sensor has been depicted in Fig.1(c).

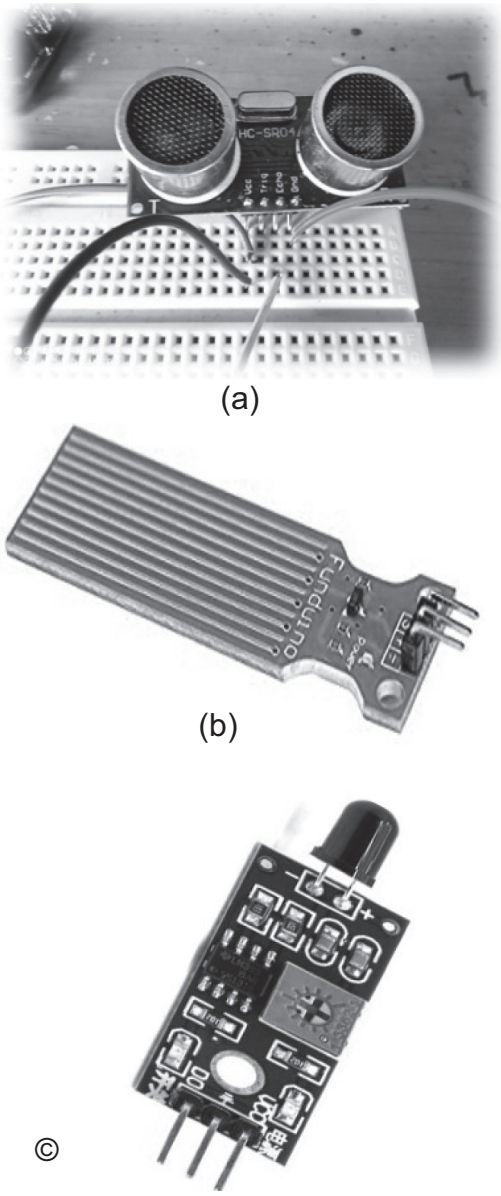

Fig.1. (a) Ultrasonic sensor, (b) Water sensor, (c) Fire sensor

2.2 Microcontroller (Arduinonano)

The Microcontroller employed in this work is Arduino Nano that is analogous to Arduino Uno however works with a Mini-B USB cable rather than a customary one. Arduino Nano is a compact, cheap yet powerful microcontroller which can be easily fitted inside the frame of the stick thus owing to less weight of the system. The microcontroller, Arduino NANO has been depicted in the Fig. 2. The specification of the Microcontroller has been mentioned in the Table 1.

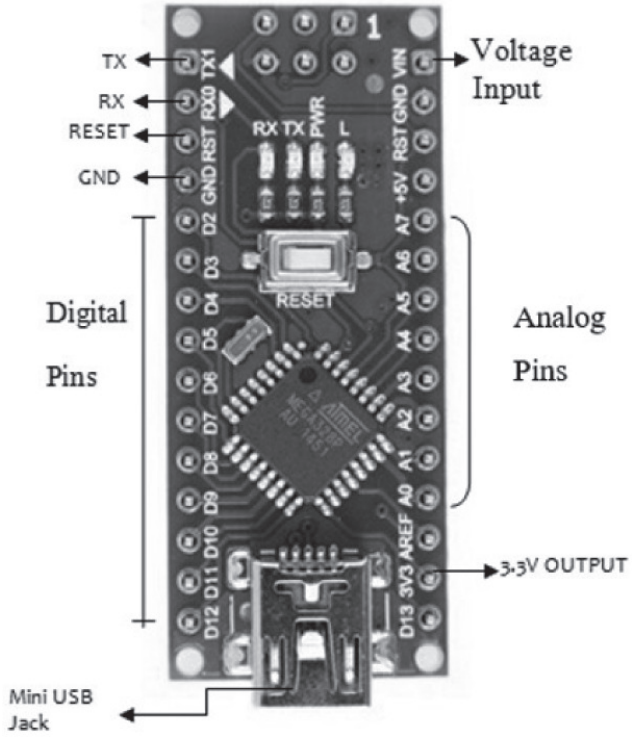

Fig. 2. Microcontroller (Arduino Nano)

2.3 Connection of the Sensor and Microcontroller

The connections of sensors and microcontroller have been described in this section with help of Fig. 3 and Fig. 4. The water sensor, fire sensor and LDR are connected to the analog pins of Microcontroller. Only the ultrasonic sensor and the buzzer is connected to the digital pin. The sensors are used to detect alert the obstacle ahead to the users. The Trig and Echo pins are connected to digital pins 10 and 9 which are PWM (Pulse Width Modulation) enabled. The VCC pin is connected to 5V power source in Arduino Nano and the ground pin is connected to ground. The LDR is connected the analog pin 3 which feeds Arduino with analog values with changing intensity of light. Similarly the fire sensor is connected to analog pin 0 and the water sensor is connected to analog pin 1. All the other pins of the sensors are connected to GND terminal. A 9V battery is connected to the Arduino as a power source.

Parameter	Specification
Operating Voltage	5V
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
Flash Memory	32 KB (A Tmega328)
Dimensions	0.73” x 1.70”

Table 1: Specification of microcontroller (Arduino Nano)

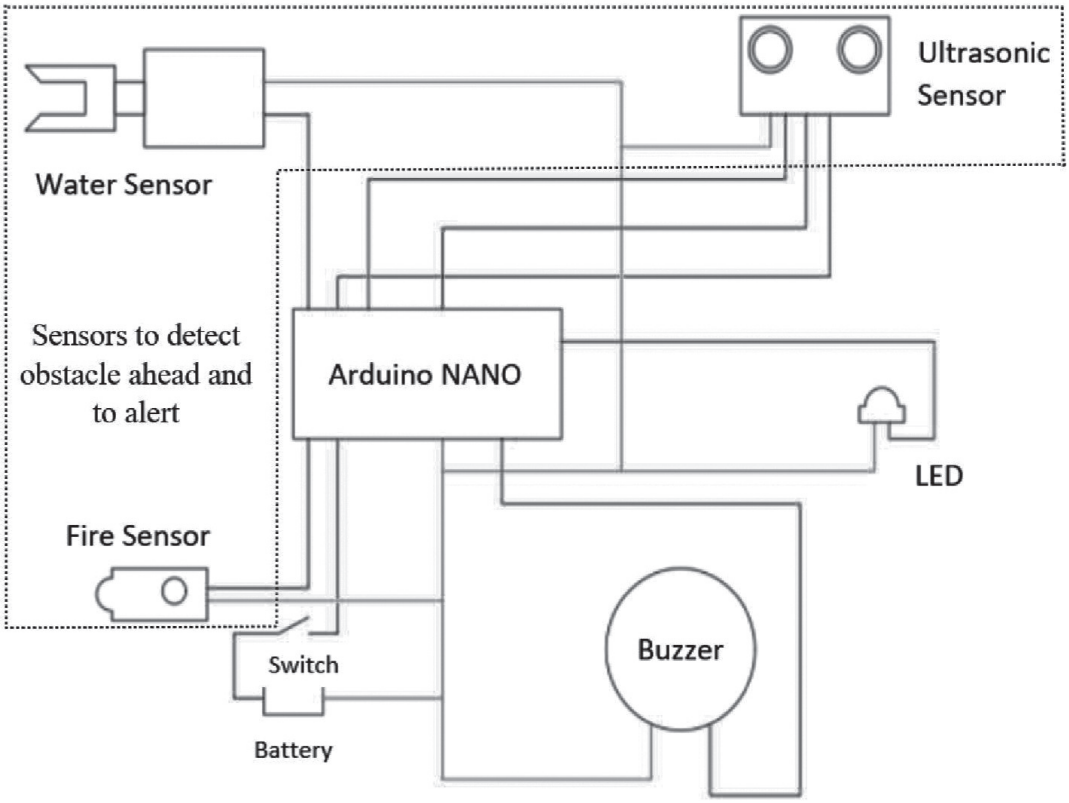

Fig. 3. Layout of connection to detect and alert obstacle ahead to the users

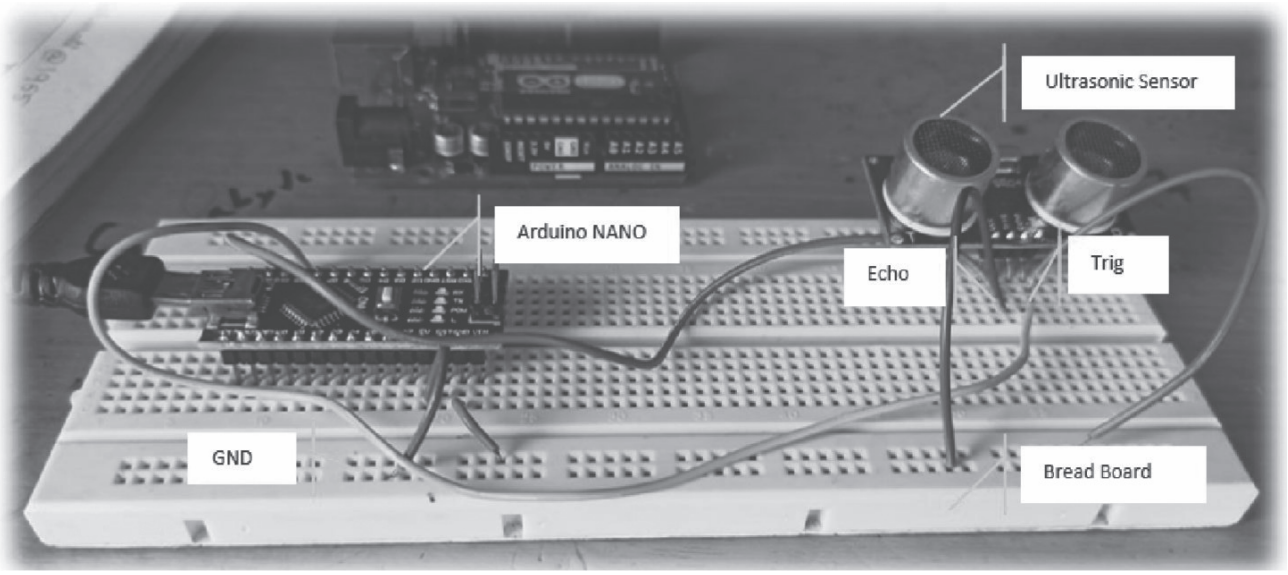

Fig. 4. Real time connection of sensors and microcontroller

3. LOGICAL FLOW TO DETECT OBSTACLE AHEAD AND TO ALERT USER

The logical flow of this system is very simple and it has been represented in Fig. 5 representing the flow diagram to detect obstacle ahead and to alert user. The system consists of a micro-controller, a buzzer and four sensors, namely ultrasonic sensor, flame sensor, water sensor and LDR. All the sensors collect value and send it to the micro-controller. The ultrasonic sensor triggers a pulse for 10 micro seconds and then reads the sound wave travel time in microseconds to the Arduino. Using this time, user calculates the distance of any obstacle if present in front. When no obstacle is found within 1.4m range it keeps on beeping normally but as soon the obstacle crosses the limit and user approaches close it starts beeping faster. Similarly, the fire sensor reads of fire is present ahead. When encountered it reads the reading through the IR sensor and the value is then compared to a reference value set. If found more that means it can be dangerous and thus alerts the user. Similarly, the water sensor receives value from sensor and when senses danger comparing the value alerts the user. The corresponding numerical values in the flow diagram have been given as set value of different sensors.The buzzer beeps faster for any type of obstacle, fire or water ahead to the user. The blind person continues to walk if there is normal beeping. The main objective of this device is to detect and alert any type of obstacle, fire or water ahead to the user.

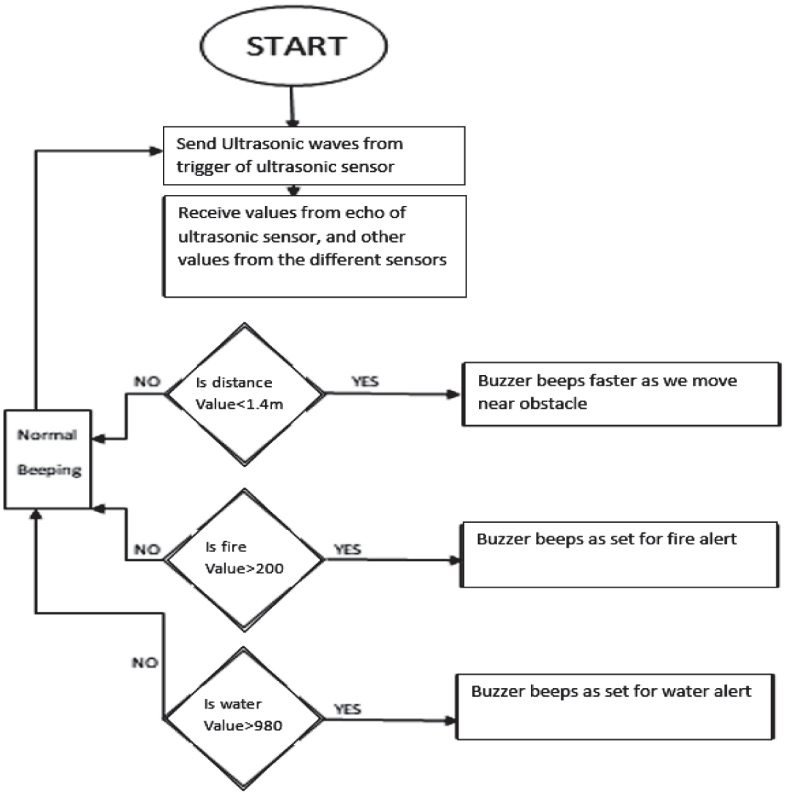

Fig. 5. Logical flow diagram to detect obstacle ahead and to alert the user

Being open-source hardware, Arduino shares the approach of free and open-source software too. The microcontroller cannot function by itself. It is fed with a code which then instructs the microcontroller to interact with the input and output devices. The software used by Arduino is ARDUINO IDE. The code can be uploaded and ready to run in just one single click.

4. PHYSICAL PROTOTYPE

The prototype depicted in Fig.6 has made using mainly three components, namely ultrasonic sensor, Arduino Nano and buzzer. The objective of this prototype is to detect obstacle ahead and to alert the user. The main focus of this project work is to make this device with low cost. The weight of components and their assembly is less weight to carry the system. This prototype has made using simple things and turns out under the cost of Rs.300/- thus making it highly cheap.

Connection inside prototype

Full Setup of prototype

Final look of prototype

Fig. 6. Physical prototype of blind stick to detect obstacle ahead and to alert

5. CONCLUSION

To evaluate the effectiveness of the developed stick, testing is needed to be performed in real world by blind and visually disabled person. This Blind stick can be added and improved more by the upcoming

technologies. This Blind Stick is a low costand easy to carry system, which can be improved adding features like GPS, Augmented Reality or Voice Commands. But even with this current prototype obstacles and hazards can be avoided at affordable price.The physical prototype of Blind Stick can be improved with high technology device in future.

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