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IoT based route assistance for visually challenged

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Abstract - *The intelligent devices have taken us to a convenient and fashionable era, however while we use a pedometer to calculate the number of steps, the blind even do not have the ability to walk independently. There is no doubt that they are eager for convenience and freedom based on this, we propose an intelligent system that assists the blind in walking. The system consists of three ultrasonic sensors (attached to a cane) which are not used to just detect the obstacles but the visually challenged will be directed in the direction (front/right/left) which has no obstacles, when other two directions are blocked by an obstacle. Or when there is an obstacle in only one direction then the distance of other two directions will be calculated and he/she will be directed to go in a direction at which the distance is longer. The Mq2 gas sensor is also appended to the system to warn the user in case he/she is too drunk and make them wary.*

Key Words: blind, visually challenged, HC Sr04 ultrasonic, Mq2 gas sensor.

1. INTRODUCTION

According to the statistics of the survey that has been conducted by World Health Organization 39 million people are blind, 285 million people are visually impaired [1]. The cardinal challenges faced by them are mobility and navigation. The development and popularization of smart devices are bringing us to a convenient and fashion epoch, we should be aware that while many people enjoy the convenience of technology services and use the step-counting software to show off their steps, many blind people can't walk freely. At present, the cane and wheelchair do not bring convenience to them. They need the help of the chaperone to walk by contraries.. The utility model is matched with a multifunctional walking stick with alcoholic and Ultrasonic sensors. This system can assist the blind to walk, help them avoid the obstacles and lead them in a direction that doesn't have obstacles with the help of a buzzer tone from single buzzer having sounds unique in each direction i.e., for each direction left, right and straight three different buzzer tones are programmed instead of using three different buzzers. Therefore it is more reliable and system has less hardware.

2. THE PROPOSED SYSTEM

2.1 A System Overview

In our proposed system, the system consists of three ultrasonic sensors (unlike the models that have been depicted in [2] and [3] which have only one ultrasonic sensor which cannot recognize any terrain changes)by which the direction of the blind people can be easily directed to the correct path by detecting the obstacles present around them. In this system, there is also use of alcoholic sensor so that we can find whether he/she has drunken or not. To differentiate the direction in which the person needs to travel to avoid obstacles, we have the buzzer with different frequency tones using tone function. So for each different direction that the arduino programming calculates based on the distance between obstacle and the cane, the blind person will hear different tones. For instance, if the stick calculates the direction to travel is right, then a tone unique to that direction will ring from the buzzer.

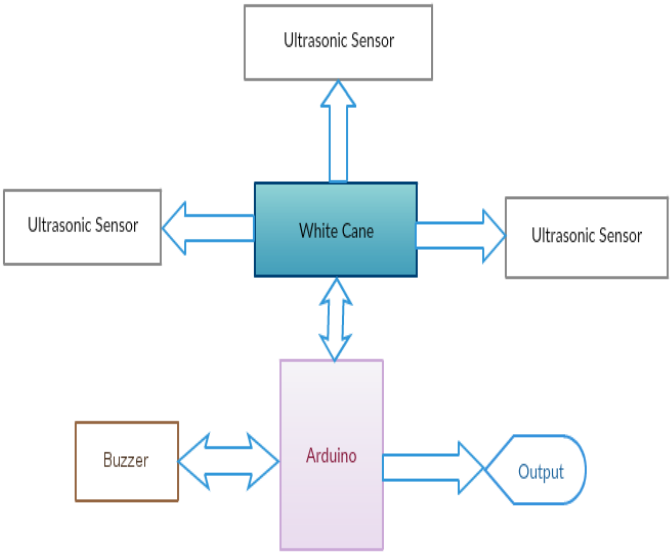

Fig1: the cane with ultrasonic sensors and buzzer attached

The following are the components involved in the proposed visually challenged route assistance.

1. Arduino Uno: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. Arduino can send and receive the data to most devices, and can also command electronic devices through internet. The software program used to program the Arduino UNO board is simplified C++ [4].

2. Ultrasonic Sensor: Ultrasonic sensor is a sensor that works on principle that is akin to sonar or radar. It generates high frequency sound and calculates the time interval between the sending of signal and the receiving of echo. For this reason, ultrasonic sensors can be employed for measuring the distance. Ultrasonic sensors have been used due to their high precision within a shorter distance and resistance to external disturbances such as vibration and electromagnetic interference [5]. HC-SR04 ultrasonic sensor consists of a control module, transmitter and a receiver. [6]The primary reasons to use Ultrasonic sensors are that they are light weight and compact, give high amount of sensitivity and accuracy in detecting objects compared to other sensors popular like the IR sensors which fail in certain cases like surfaces, light changes etc. as stated in [7].

3. Gas sensor: The Grove - Gas Sensor (MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

4. Buzzer: The buzzer is used to give alerts to the user by producing noises that differ from each other in frequencies.

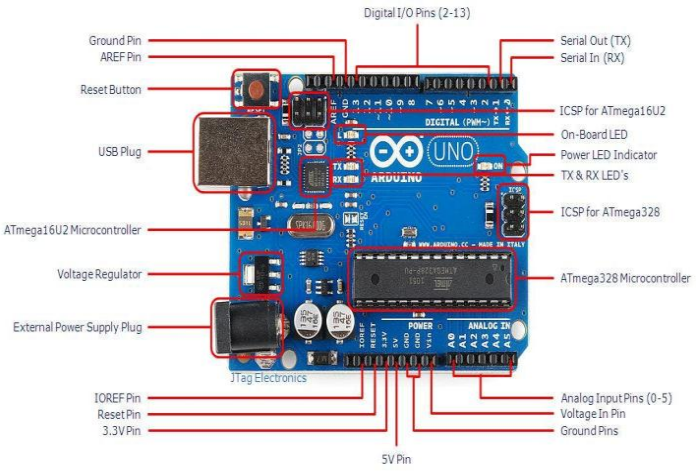

Fig2: Labeled diagram of Arduino Uno

Fig3: Ultrasonic sensor HC-SR04 [8]

3. DISTANCE AND DURATION CALCULATION

Each US sensor consists of four pins, as seen in fig3.

- VCC: +5V supply
- Trig: Trigger input to the sensor. Microcontroller will apply a trigger pulse of 10 ms [microsecond] to the HC SR04 module.
- Echo: The echo output of the sensor. The microcontroller reads this pin either to find the distance or detect obstacle
- Gnd: ground

The following is the working principle of HC-SR04 sensor

A trigger pulse of at least 10ms should be transmitted to the Trig pin of sensor to start the ranging (pulse input). The input given to the trigger pin is the pulse generated after detecting the obstacle. Then the sensor will send out eight 40 kHz automatically and waits for the rising edge output to be generated at the Echo pin. The time gap between the raising edge and the falling edge is the duration. This duration is the time taken by the pulse from the sensor to hit the obstacle and reach back the sensor. This pulse travels at a constant baud rate of 9600. The time for which the echo pulse remains low gives the time taken by the ultrasonic pulse to travel twice the distance [9].

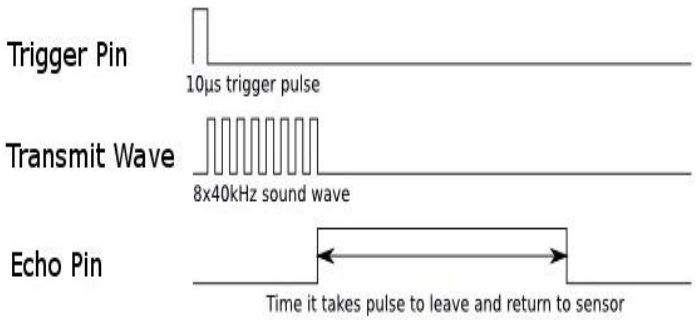

Fig4: Timing diagram of HC SR04 US sensor

The output of the echo pin eventually gives us the final output i.e., the buzzer tone, after calculating the duration and distance.

After the duration in ms is obtained, then the distance will be calculated using the below formula

Distance=time * Sound speed/2 (1)

Here, total distance is divided by 2 because signal travels from HC-SR04 to object and returns to the module HC-SR04 and sound speed is calculated using baud rate.

The speed of the sound is approximately 340m/s or 0.034 cm/ms

Now the equation (1) becomes,

Distance = time * 0.034/2 (2)

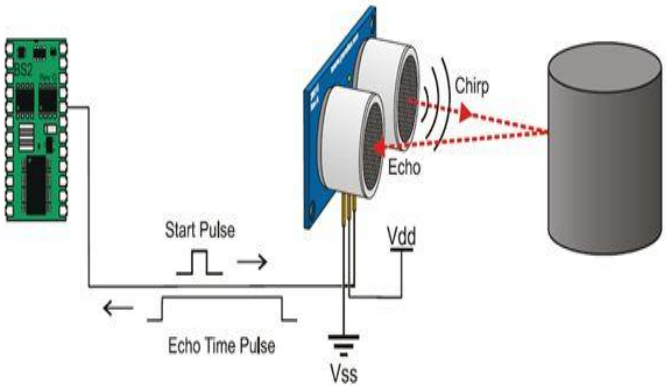

Fig5. Using HC SR04 in arduino [10]

3.1 Working of buzzer alert

- The ultrasonic sensor can be programmed to detect the obstacles up to 400cm. If left and right sensors are blocked then buzzer will alert with frequency tone of 1000 Hz, indicating that the person needs to travel in the forward direction.
- If left and front sensors are blocked then buzzer will alert with frequency tone of 5000 Hz. This signals the person to go in the right direction.
- If right and front sensors are blocked then buzzer will alert with frequency tone of 9000 Hz. So, the person now needs to in the left direction.
- If he/she has drunken over the limit buzzer will alert with a frequency of 6000 Hz with 500 ms delay.

In the below figure, thr is the distance range that can be programmed into the ultrasonic sensor and the arduino Uno. This range can vary between 2 cm to 400 cm. The 3V in the Mq2 gas sensor is the maximum limit set to identify if the person is drunk or not. The sensor sensitivity can be adjusted by the built-in potentiometer. The sensor outputs the voltage that is proportional to the concentration of gas. This output generated by Mq2 sensor is an analog signal that can be read with the help of analog input of the Arduino Uno or a digital output that can be read using the input (digital) of the Arduino.

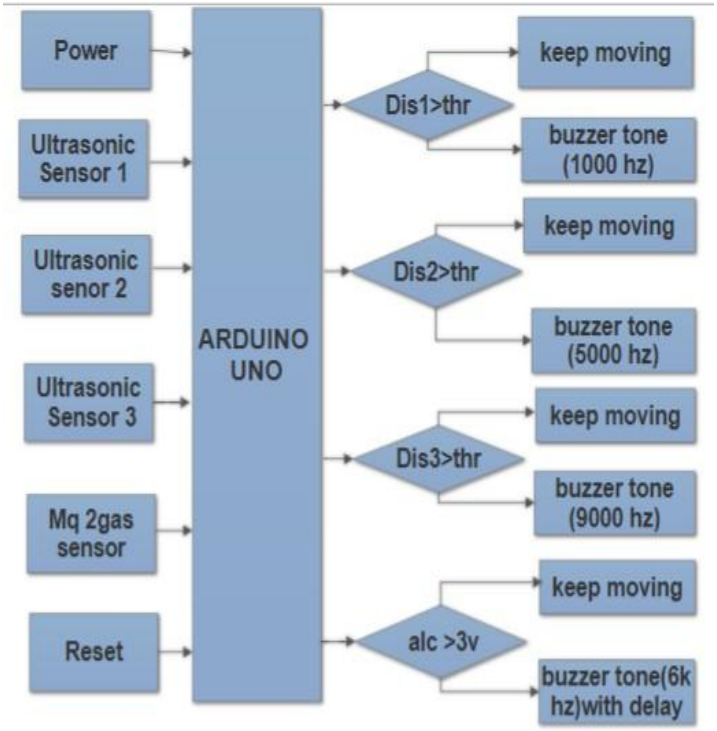

Fig6: Architecture of the proposed system

3.2 Positioning and guiding

The hardware consists of a cane, 3 ultrasonic sensors hcsr04, along with an arduino uno chip and Mq2 alcoholic sensor .The three sensors will be placed in the bottom of the cane each pointing in the direction front, left and right. The 4 pins of each sensor, alcoholic sensor will be connected to the arduino chip and it is programmed as follows.

When a person is walking and encounters obstacles from any two sides, then it calculates the duration of all the sides using three different sensors. From eq (1), the distance can be calculated. The cane directs the user to go in the direction that has long distance i.e., if the person is blocked from left and right sides by obstacles then it indicates the user to move in forward direction with the buzzer tone. And if the person gets blocked by three sides, then also he/she can get an indication

4. FURURE WORK

Modifications like giving the direction to the user through pre-recorded voice, instead of buzzer tones can be done. Further we are working on the other incorporations into the smart cane like Voice recognition and Global Positioning System, so that through voice the person can enter the destination where they wish to go and the cane will direct them, without the need of smart phone/device and at a low cost.

5. CONCLUSION

To sum up, this smart cane can act as a complete guide for blind people to walk with the help of a single stick without any complex hardware or software incorporated into it. This simple cane, is not used to just detect obstacles present in any direction and alert the person , but uses the distance calculation to give the optimum direction(by detecting obstacles) in which the person can proceed. There is only use of one buzzer for every direction that makes different sounds for left, right, front instead of using three different buzzers. A battery powers the cane. This cane not only shows the direction, but can also indicates the person if he/she is blocked on three sides. Its additional inclusion of alcohol sensor helps to warn the person if he is too drunk. It is also developed to be cost efficient and to be reachable to every visually impaired person.

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