ARDUINO BASED WALKING STICK FOR VISUALLY IMPAIRED

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***Abstract*- The paper presents a theoretical model and a system concept to provide a smart electronic aid for blind people. The system is intended to provide the visually challenged a better walking experience. The design is incorporated with Ultrasonic sensors for Obstacle detection, supported with heat and water detection. Ultrasonic sensors are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. This research work explains about the setup we used for the implementation, design details.**

Keywords*— *Arduino uno board, ultrasonic sensor, speaker, vibration motor.

I. INTRODUCTION

Moving through an unknown environment becomes a real challenge when we can't rely on our own eyes. Since dynamic obstacles usually produce noise while moving, blind people develop their sense of hearing to localize them. A white cane is the most common mobility aid for the visually challenged. However, it does not give information about the obstacles above knee level and those which are at a distance greater than 1m. Even though guide dogs were the initial companion of the blind, later on technologies played a vital role. Walking sticks with adjustable length, elbow canes, were developed in the market to guide the visually challenged. However, these attempts were not completely successful in assisting the user.

To alleviate these issues the Smart electronic aid is designed in such a way that it includes an Ultrasonic sensor for Obstacle detection, supported with heat and water detection. In this system, Vibratory motors are used to inform about the moving obstacles. The intensity of vibration depends on the speed of the moving obstacles.

II. RELATED WORKS

A lot of study is being done to design a fine instrument that provides the user a better walking experience. One of them is Smart Vision. The device can detect stationary as well as moving obstacles. The device can detect specific landmarks and will inform the user the distance from the obstacle .HALO is another device that can be mounted on the existing white cane and can detect low hanging obstacles such as branches of trees. It consists of ultrasonic range sensor with an eccentric-mass vibrating motor which vibrates distinctly for ground obstacle and low hanging obstacle. An intelligent guide stick detects obstacles using ultrasonic sensors but it is unable to tell whether the obstacle is in motion or not.

III. SYSTEM ARCHITECTURE

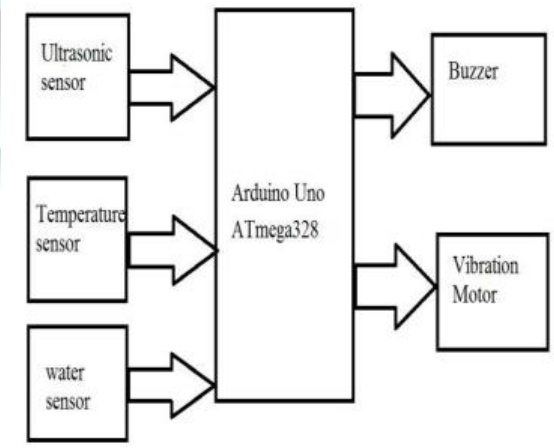

Fig.1 Overall System

The Smart electronic aid consists of 3 modules namely Heat Detection, Obstacle Detection and Water Detection. The presence of an obstacle in front of the user is identified by using an Ultrasonic Sensor. The distance is measured in centimeters and corresponding to the distance, the vibration alerts the blind. If the obstacle is in motion, the vibration motor attached vibrates. The intensity of vibration would be high for fast moving obstacles. The presence of hot objects (above 70 deg. Celsius) is informed to the user by the sound of a buzzer. The temperature is measured using an LM35 temperature sensor. Also the presence of water is informed through buzzer sound.

IV. IMPLEMENTATION

A. Hardware tasks:

The hardware tasks can be divided into three namely motor vibration, heat detection and water detection

1) Obstacle Detection Module:

The stick is designed in such a way that each time the obstacle moves, a motor vibrates. The intensity of vibration depends on the speed of the moving obstacle. The obstacle detection is carried out using dual transducer Ultrasonic Sensor.

Fig 2. HC-SR04 Ultrasonic Sensor.

Once triggered, the ranger produces an eight cycle sonic burst at 40 kHz frequency.

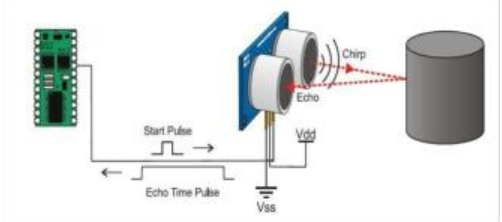

Fig 3

Simultaneously the echo pulse is raised high until the last sonic pulse sends back the reflected wave. Once the duration of this echo pulse is found, distance can be easily calculated using this time and the speed of sound. The module is also incorporated with motor vibration intended for moving objects. As the obstacle approaches the user and reaches close proximity, the intensity of vibration increases.

2) Heat Detection:

The heat detection is carried out using LM-35 Temperature Sensor. It helps in detecting the surrounding hot objects within the range -55 to 150 degree Celsius.

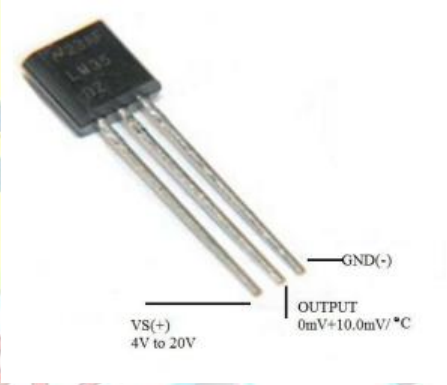

Fig 4. LM 35 Temperature Sensor

LM 35 absorbs thermal radiations around the hot objects and converts it into voltage.

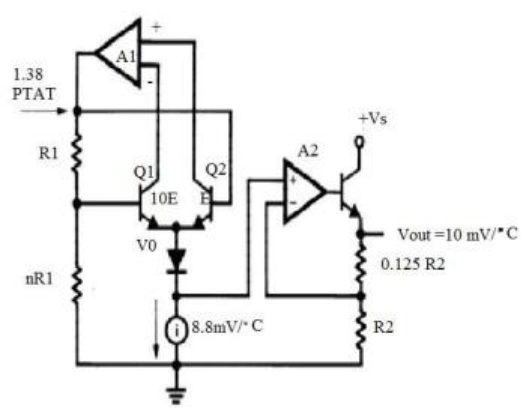

Fig 5. The circuit diagram of LM35 Temperature Sensor

The above is the circuit diagram of LM35 Temperature Sensor. Christo Ananth et al. [3] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The two resistors are calibrated to produce a highly accurate temperature sensor.

3) Water Detection:

Two electrodes are provided in circuit, which are fitted at the bottom of stick for sensing water pits in the travelling path. Information about water pits are indicated through buzzer. Indication to the blind people is conveyed through different sound intensities. This is used to indicate any liquid

B. Software Tasks:

1) Algorithm for obstacle detection

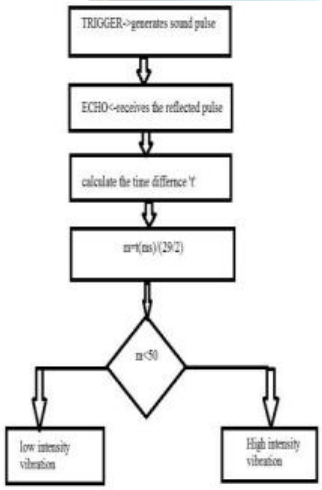

Fig. 6

A continuous stream of pulses is sent out through the Trigger terminal of the Ultra sonic Sensor. The pulses Reflected from the obstacle are received at the echo terminal. The time duration for which the echo pulse remains low gives the time takes by the ultrasonic pulse to travel twice the distance. Thus relating the time taken (t) and distance between the obstacle (d), 2d=s*t; where s=340 m/s (speed of sound).

(d=microseconds/29/2)

If the distance d is less than 50cm, low intensity vibration is provided. If the distance d is greater than 50cm, the intensity of vibration is high.

2) Algorithm to detect moving obstacle

The distance received from the Ultrasonic Sensor for that particular obstacle is measured 5 times. Each reading is subtracted from the previous reading and the absolute value is taken. If the measured value is within 55 cm which is equal to the average footstep of the user implies that the obstacle hasn't moved and vibration given to the motor is zero. If the difference increases and lies between 55 cm and 150 cm, it means that the obstacle is moving at a faster rate and medium vibration is given. Finally, if the difference measured is greater than 150 cm, it gives an idea that the obstacle is moving at a greater rate and maximum vibration is given.

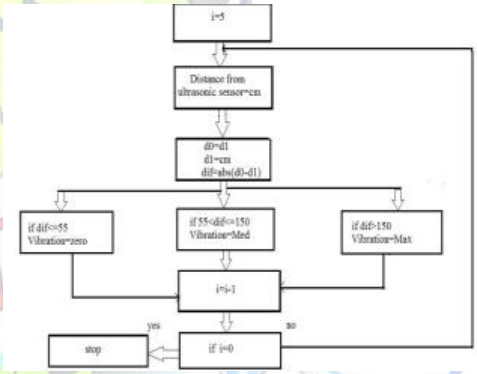

Fig.7. Flowchart for Moving Obstacle Detection

3) Algorithm to detect hot objects

The temperature of the obstacle is measured using LM35 temperature sensor. The voltage corresponding to the temperature is received at the Arduino pin. To get the temperature reading from the board, the conversion,

*(tempC = (5*Voltage*100)/1024)*

is used. The transistor gives 10mV for every degree rise in temperature. So the value measured by the analog pin needs to be multiplied by 100. To scale the voltage to 5V, again the value needs to be multiplied by 5 and divided by 1024 since analog reading will be in the range of 1024 (10 bit).

V. FUTURE WORK

It can be further enhanced by using VLSI technology to design the PCB unit. This makes the system further more compact. The use of active RFID tags will transmit the location information automatically to the PCB unit, when the intelligent stick is in its range. The RFID sensor doesn't have to read it explicitly.

VI. CONCLUSION

The paper proposed the design and architecture of a new concept of Smart Electronic Guiding Stick for blind people. The advantage of the system lies in the fact that it can prove to be very low cost solution to millions of blind person worldwide. The proposed combination of various working units makes a real-time system that provides feedback making navigation more safe and secure.

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