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Smart Electronic Mobility Aid for the Blind

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ABSTRACT: Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual center of the eye, and total blindness is the full absence of the visual light perception. In this work, a simple, cheap, friendly user, smart blind guidance system is designed and implemented to improve the mobility of both blind and visually impaired people in a specific area. The white cane, due to its primitive design, is unable to offer the blind and visually impaired a level of independence that is achievable with modern technology. The Smart Cane looks to upgrade the white cane by increasing security and usability of the cane while ensuring an affordable price for an older and lower income demographic. This was done by including an ultrasonic sensor to detect potential obstacles at an extended distance from the user, vibrating motors to alert the user of these obstacles. Observations and basic testing confirm the effectiveness of the vibrations in the handle.

KEYWORDS: Physiological factors, White cane, Smart Cane

I. INTRODUCTION

The Smart Cane project examines how canes can be technologically equipped to improve their functionality in a way that is also economically accessible. The goal for the Smart Cane project is to eliminate this problem by designing, building, and testing a cane for the blind that utilizes computer and sensory technology to provide object detection capabilities and freedom of physical range. Once the project is completed, the cane design will be quantitatively and qualitatively examined to determine its success as a product. The high-end technological solutions have been introduced recently to help blind persons navigate independently. While such systems are suitable for outdoor navigation, due to the need for line of sight access to satellites, they still need additional components to improve on the resolution and proximity detection to prevent collision of the blind persons with other objects and hence subject their life to danger in comparison to other technologies many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is that the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuitry. The project is based on a theoretical model and a system concept to provide a smart electronic aid for blind people. Apart from the conventional navigation systems, blind aid systems can be used with depth measuring circuitry which will be helpful to measure the depth in case of dealing with the stairs and on stick vibration circuitry to inform the obstacle alert. These different units are discussed to implement the design of a smart cane.

II. BLOCK DIAGRAM

A. Smart cane – Arduino Uno

Smart cane is made using an Arduino Uno board. According to Fig 1, the ultrasonic sensor, infrared sensor, water level sensor and the flame sensor is interfaced with the Arduino board [9]. The buzzers and the vibrators are used on the other side to indicate it as the output, which helps the blind know that there is a danger in front of them. A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic or piezoelectric audio signaling device. A piezoelectric buzzer can be driven by an oscillating electronic circuit or other audio signal source. A beep or a ring can indicate that an object has been indicated. A vibrator is used to vibrate when something is found in order to alert the person. The Arduino IDE is used to compile and run the program. Once the compilation is successful, the code is transferred to the board. This code is then tested.

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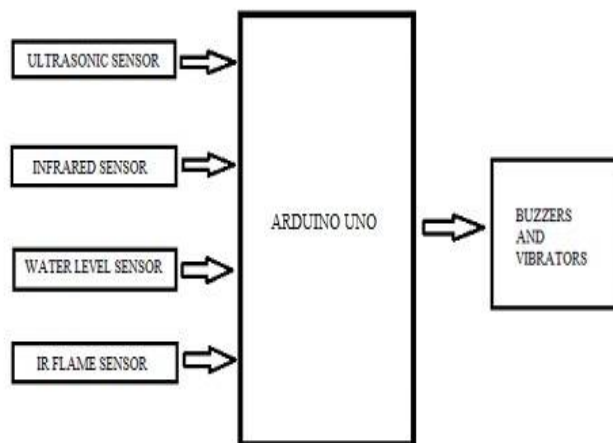


Figure 1. Smart cane-Block Diagram

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 quartz crystal, a USB connection, a power jack and a reset button. It contains everything needed to support the microcontroller. The ultrasonic sensor, infrared sensor, water sensor and the fire sensor is interfaced with the Uno to detect obstacles, water, and sensor respectively. The buzzers and the vibrators are used as the source to indicate the user when an obstacle comes through.

B. Working Principle

Ultrasonic Sensor:

Ultrasonic sensor works on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. The Arduino is programmed in such a way that on switching 'ON' the Arduino, it sends a LOW to HIGH signal on the TRIG pin of all the three Ultrasonic sensors. As depicted in Fig 2 ultrasonic sensors will send an Ultrasonic wave using the ultrasonic transmitter of the sensor. These ultrasonic waves travel through air and on colliding with an obstacle, get reflected back. Programming is done in such a manner, that when this obstacle is in the range of 1.4 m of the sensor. the Arduino will play the buzzer with different delay for obstacles located on the sides, and no delay for the straight ones. To further enhance its performance, if the obstacle is too close then the vibrating motor is also activated. This response is the time taken by the wave for a round journey from sensors to obstacle and back to the sensors. Each ultrasonic sensor detects the obstacles in a range of about 200 - 400 cm. The distance of the obstacle is determined based on the delay between the emission of sound and the arrival of an echo.

The distance of the obstacle can be measured as:

$$\text{Distance} = (\text{time} * \text{speed of sound in air}) / 2$$

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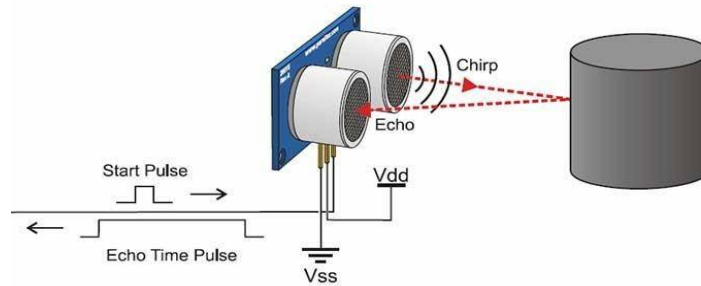


Figure 2. Working of Ultrasonic Sensor

Infrared Sensor:

Photo diode is connected in reverse bias; inverting end of LM358 is connected to the variable resistor, to adjust the sensitivity of the sensor. As in the Fig 3, the non-inverting end is connected to the junction of photodiode and a resistor. When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR Falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 which is connected to the non-inverting end of comparator gets higher than the voltage at inverting end, then the output becomes HIGH and LED turns ON. Voltage at inverting end, which is also called Threshold Voltage, can be set by rotating the variable resistor's knob. Higher the voltage at inverting end (-), less sensitive the sensor and Lower the voltage at inverting end (-), more sensitive the sensor.

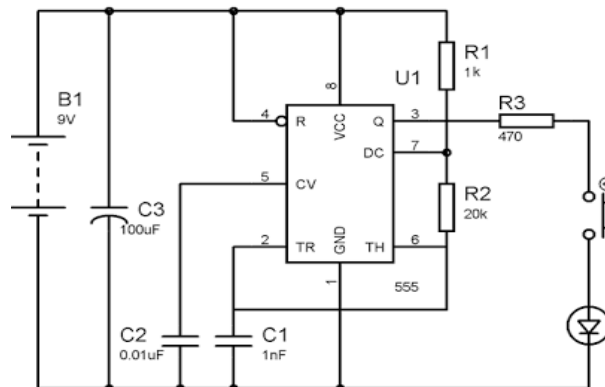


Figure 3. Circuit of Infrared Sensor

Water Sensor:

Water sensors available are used to detect water levels inside tanks and very expensive. As depicted in Fig 4, the objective is to detect water existence regardless its level. So a costless alternative is used, where three wire probes fit at the bottom of the stick to sense obstacle like water pits, puddles and water spread. Two wires are used to complete the circuit and another one wire is used to short circuit. Once wires touch water, the circuit is shorted, this interrupts the microcontroller, and beep sound is produced by the speaker to warn the blind person about the puddle. The water sensor is useful in a normally occupied area near any appliance that has the potential to leak water. Water sensors are of several types that include ultrasonic sensors, pressure transducers, bubblers, and float sensors. The sensor measures the time interval between the transmitted and received signals, which is then converted into distance measurement with the help of electronic circuits within the sensor thereby

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measuring the level of the liquid. Float sensors work based on the change in resistance of a potentiometer within the sensor by the turning of a pulley or a spring-loaded shaft.

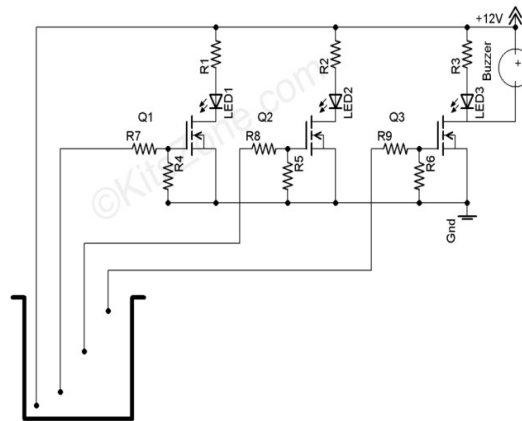


Figure 4. Circuit of Water Sensor

Flame Sensor:

Radiant intensity signals of the flame sent by a muffle burner change into relevant voltage strength signals by the photoelectric sensor. The voltages are so low that they need to be turned into standard analog signals, which would be processed in the single chip microcomputer and change into relevant controlling signals to be output. The flashlight reflector is integrated as depicted. The Flame sensor available in the market with two categories one is having three pin and second one having four pins both can be easily interfaced with Arduino. The flame detector has functions of collecting, processing input signals and output control signals [8]. Working voltage is between 3.3v and 5.2v DC, with a digital output to indicate the presence of a signal.

RF Module:

The term RF module can be applied to many different types, shapes and sizes of small electronic sub assembly circuit board. It can also be applied to modules across a huge variation of functionality and capability. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. It is incorporated with arduino as depicted in Fig 5. RF modules typically incorporate a printed circuit board, transmit or receive circuit, antenna, and serial interface for communication to the host processor.

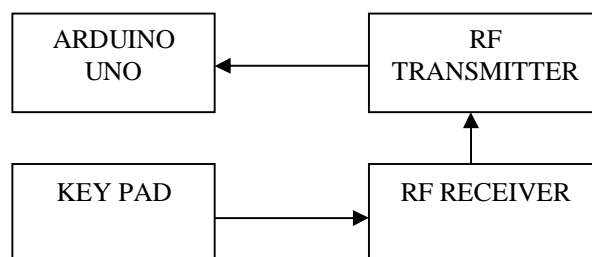


Figure 5. RF Module

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Transmitter Module:

An RF transmitter module is a small PCB sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which can be transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics, and band edge requirements. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

Receiver Module:

An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: super heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Super heterodyne receivers have a performance advantage over super-regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in the past tended to mean a comparatively more expensive product. However, advances in receiver chip design now mean that currently there is little price difference between super heterodyne and super-regenerative receiver modules.

III. EXPERIMENT AND RESULT

Smart cane helps the blind in preventing themselves from getting into danger such as fire and water, which is detected using the fire sensor and the water sensor respectively. The obstacles are detected with much ease using the ultrasonic sensors even if they are moving objects or people. It is an easy wearable and compact device. The consumption of power is less with such functions in it. The efficacy of this device is high. The cost of the smart cane will be less in comparison to the wooden cane. The distance measured will be accurate in this device. This device also makes sure that the blind and the visually impaired don't slip or fall due to an obstacle while they walk. The buzzer and the vibrator serves as an alert system in the smart cane to make sure they are safe. The sound and vibration allow the blind have enough time to change their path in case of trouble.

Ultrasonic sensor is used for obstacle avoidance. The vibrator vibrates when an obstacle is encountered which helps in alerting the blind person and allows enough time to change their path. IR sensor is used for pit and staircase detection. Water sensor is used to detect the presence of water and provide an alert in time for path change so as to avoid slipping. Fire sensor is used for avoiding fire.

The Smart Cane has been finally made into a prototype which can be used to guide the blind. The various results regarding the sensors used in the smart cane is as follows:

A. Obstacle Detection:

It majorly uses an ultrasonic sensor, as in Fig 6, to detect the front obstacles, an infra-red sensor to detect the obstacles underneath, fire sensor to detect any kind of fire hazard and water sensors that sense any kind water allowing the safe walk of the blind people. It has buzzers incorporated into itself that gives different sounds from different sensors making navigation very easy. The vibration motor is also used for the convenience of the visually impaired.

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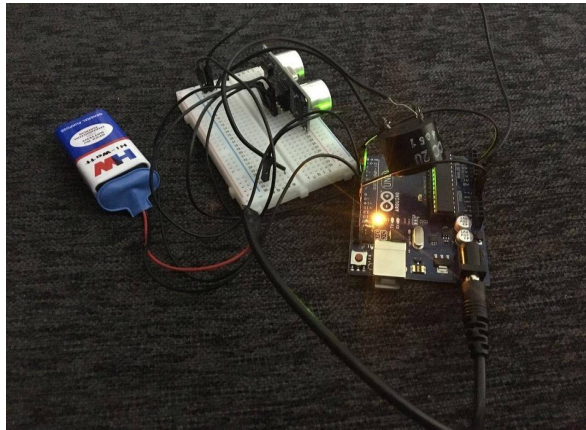


Figure 6. Obstacle Detection Results

B. Water Detection:

In the water detection module, we use water to test if the code and the sensor are working. The Fig 7, shows the working of the sensor, i.e., when the tip of the sensor touches the surface of the water, it automatically produces a sound using the beep and vibrates using the vibrator. When the sound is not produced, it means that either the sensor has not touched the water surface or the code consists of an error in it. In the simulation, if the water is detected, it displays a message saying that the water is detected and when it doesn't touch the water, it displays a message informing the water is not detected.

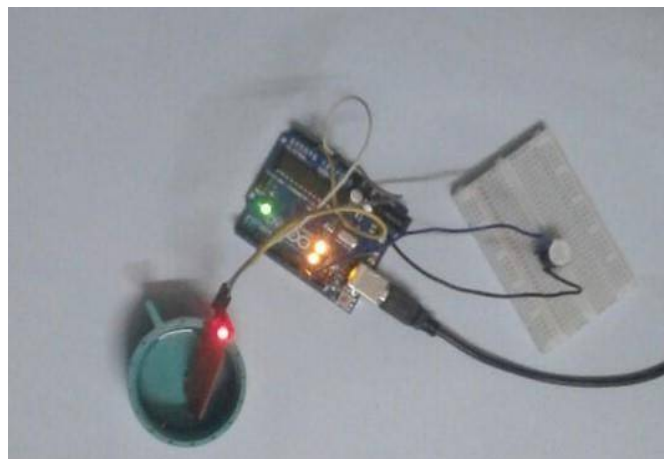


Figure 7. Water Detection Results

C. Fire Detection:

For the fire detection, we use the Flame sensor. Referring to Fig 8, the working of the flame sensor can be well understood. Once the flame is brought next to the Flame sensor, it uses a buzzer to produce sound which alerts the blind about their next step. It also vibrates in case the buzzer does not work or can be used as an extra alert system for the blind. In simulation, it has the same working as the water sensor. If the fire is being detected, it displays a message saying the fire has been detected and if not it displays a message saying that the fire is not detected.

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Figure 8. Fire Detection Results

IV. SIMULATION RESULTS

A. Simulation of Obstacle Detection:

Simulation is done mainly in order to check if the code is proper and to also check if the sensor is working. The projected window, in Fig 9, lets us know about the object being detected or not. It can also be used to print the distance of the detected object. But in this case, the simulation is only used to check if the sensor is in a working condition or not. So, the data or the message being displayed is not really necessary for the smart cane as it does not help the blind in knowing the displayed distance of the object being detected.

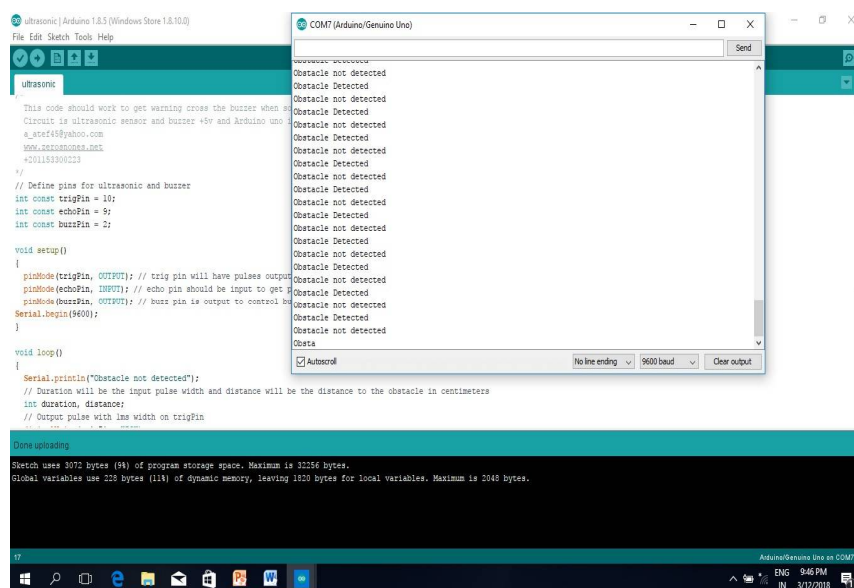


Figure 9. Simulation Results of Obstacle Detection

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B. Simulation of Water Detection:

In the case of water detection, the water sensor when touches the surface of the water, displays the message saying that the water is detected, as depicted in Fig 10. It also displays the water level, in case the data in necessary. But again, similar to object simulation, the data will not be necessary in this Smart Cane project. The water level sensor has the main purpose of detecting the level of water. The water Levels might be great help for certain projects but is not needed for the smart cane.

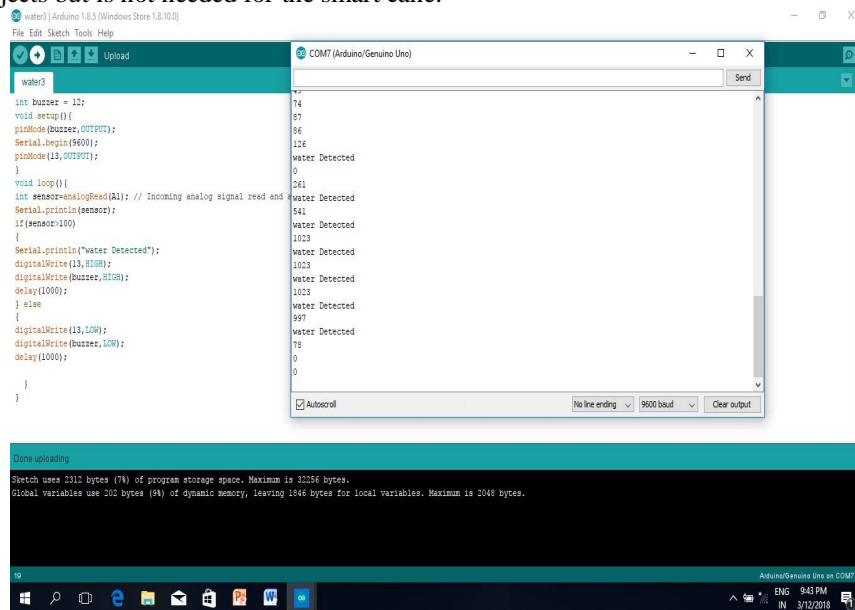


Figure 10. Simulation Results of Water Detection

C. Simulation of Fire Detection:

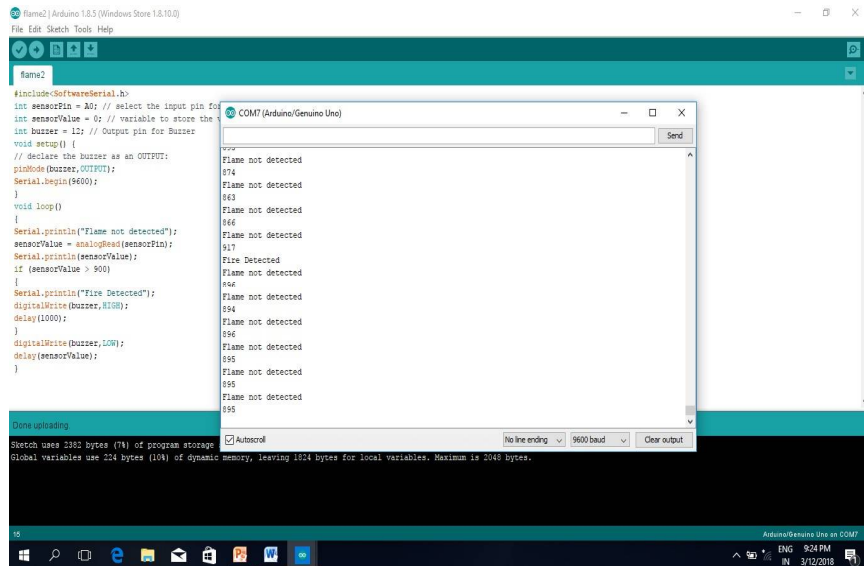
The Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. So, when the fire is being detected, it displays the message saying that the fire has been detected and also the range at which the fire was detected, as being depicted in Fig 11. Again, this is not really necessary for the Smart Cane. The only part that should be focused on is that if the fire is being detected or not by the sensor.

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```

#include <SoftwareSerial.h>
int sensorPin = A0; // select the input pin for
int sensorValue = 0; // variable to store the
int buzzer = 12; // Output pin for Buzzer
void setup() {
  // declare the buzzer as an OUTPUT:
  pinMode(buzzer, OUTPUT);
  Serial.begin(9600);
}
void loop() {
  Serial.println("Flame not detected");
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
  if (sensorValue > 900) {
    Serial.println("Fire Detected");
    digitalWrite(buzzer, HIGH);
    delay(1000);
  }
  digitalWrite(buzzer, LOW);
  delay(sensorValue);
}
  
```

```

Flame not detected
974
Flame not detected
963
Flame not detected
966
Flame not detected
917
Fire Detected
Flame not detected
948
Flame not detected
954
Flame not detected
956
Flame not detected
955
Flame not detected
955
Flame not detected
955
  
```

Sketch uses 3883 bytes (74% of program storage). Global variables use 224 bytes (194% of dynamic memory, leaving 1824 bytes for local variables. Maximum is 2048 bytes).

Figure 11. Simulation Results of Fire Detection

V. CONCLUSION

Smart Sensors are the wave of the future. As more people realize the value of these inventions the field will grow without bounds. This can be demonstrated by the design specified. It's practical, cost efficient and extremely useful. If all of these characteristics weren't enough to warrant investigation into this field of study, these inventions will also make the inventor very wealthy. This project is application based as it has an application for blind people. It can be further improved to have more decision taking capabilities by employing varied types of sensors and thus could be used for different applications. It aims to solve the problems faced by the blind people in their daily life. The system also takes measures to ensure their safety.

REFERENCES

- [1] Alejandro R. Garcia Ramirez and Renato Fonseca Livramento da Silva et al (2012), —Radio frequency identification walking stick (RFIWS): A device for the blind, in Proc. 5th Int. CSPA, Vol. 4, pp. 250–253
- [2] Benjamin J. M., Ali N. A., Schepis A. F., (2011) —A Laser Cane for the Blind, San Diego Biomedical Symposium, Vol.12, pp.53-57
- [3] Deepika S, Divya B.E, (2006) -Ultrasonic Blind Walking Stick, , Vol.5, pp.77-89
- [4] S.Gangwar and R. Damaschini, (2011) —Inventory of electronic mobility aids for persons with visual impairments: A literature review, J. Vis. Impairment Blindness, vol. 102, pp. 702–724
- [5] Johann B., Iwan U. (2008), —The Guide Cane — A Travel Aid for the blind, Proceedings of the IEEE International Conference on Robotics and Automation
- [6] Kher Chaitrali .S, Dabhade Yogita .A (2010) - An Intelligent Walking Stick for the Blind, International Journal of Engineering Research and General Science
- [7] Mohamad Helmyabd Wahab and Amirul A. Talib et al (2011), —An electronic approach to assist visually disabled persons, Vol.7, pp.345-389