A Project Presentation on Black Box for Vehicles

under the guidance of:
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Abstract

The project focuses on implementing a reliable Black Box system for accident analysis. Similar to black box systems in airplanes, the technology is used to analyze the cause of vehicular accidents and prevent the loss of life and and property arising from such accidents. Successful analysis is done by tracking sensor data and making the data available in IoT cloud servers such as Thinkspeak for the general public or specific users to access. An ESP32 board which uses the Tensilica Xtensa LX6 microprocessor is at the core of the system and is interfaced with temperature, ultrasonic, vibration and alcohol sensors to achieve the desired analysis. The inbuilt WiFi connectivity of the ESP32 is made to use to push data via HTTP protocol to a reliable IoT cloud from where it is accessed.

Hardware Components

- ESP32 Board
- HC-SR04 Ultrasonic Sensor
- SW-420 Vibration Sensor
- AHT10 Temperature and Humidity Sensor
- MQ3 Alcohol Sensor

Controller

- ESP32-WROOM32

- Proccessor: Tensilica Xtensa LX6

- Cores: 2 or 1 (depending on variation)

- Clock upto 240MHz

- Wi-Fi: 802.11 b/g/n/e/i (802.11n @ 2.4 GHz up to 150 Mbit/s)
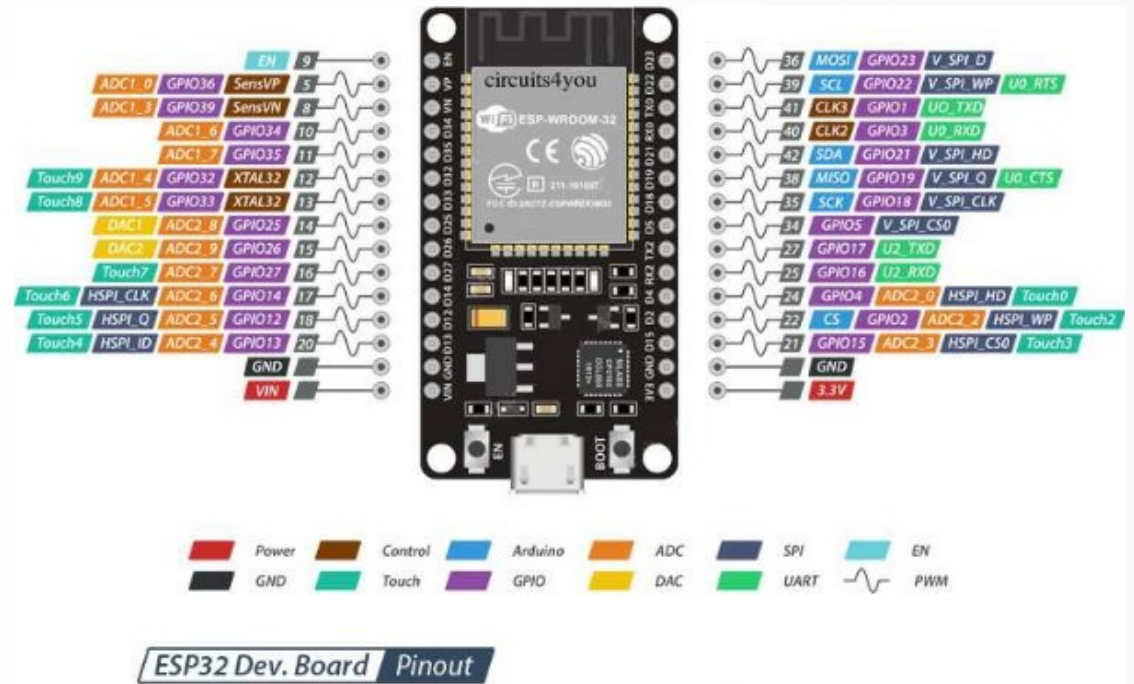
Sensors -HC SR04

- VCC – 5V

- TRIG – receives trigger from ESP32 to start high state for 10uS which sends 8 cycles of sonic bursts. Any object which gets hit reflects back the signal

- ECHO – Produces a pulse which is proportional to the time it took for the transmitted signal to be detected.

- Operating frequency: 40KHz

- Range: 2cm- 4m

- Distance = (0.034 x pulse_duration)/2

Sensors - MQ3

- Chemiresistor : sensing is based on the change of resistance of the sensing material when exposed to alcohol

- Works on 3.3-5V

- Alcohol detection range:25 to 500ppm

- Heater driven sensor

- The tubular sensing element is made up of Aluminum Oxide (AL2O3) based ceramic and has a coating of Tin Dioxide (SnO2)

Sensor – SW 420

- VCC – 3.3V-5V

- Dout – Logic High during vibration else low
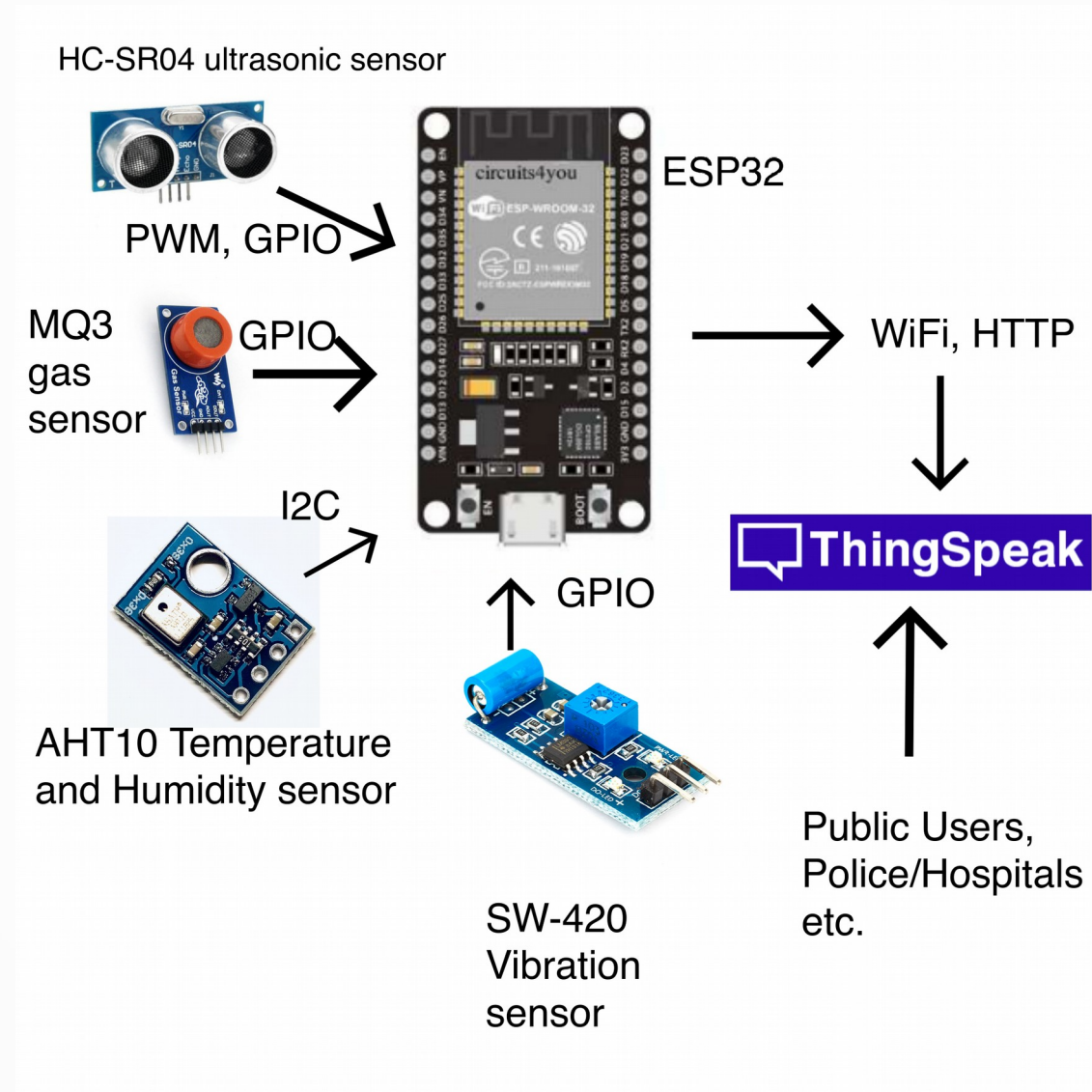
- Onboard potentiometer for vibration sensitivity adjustment.
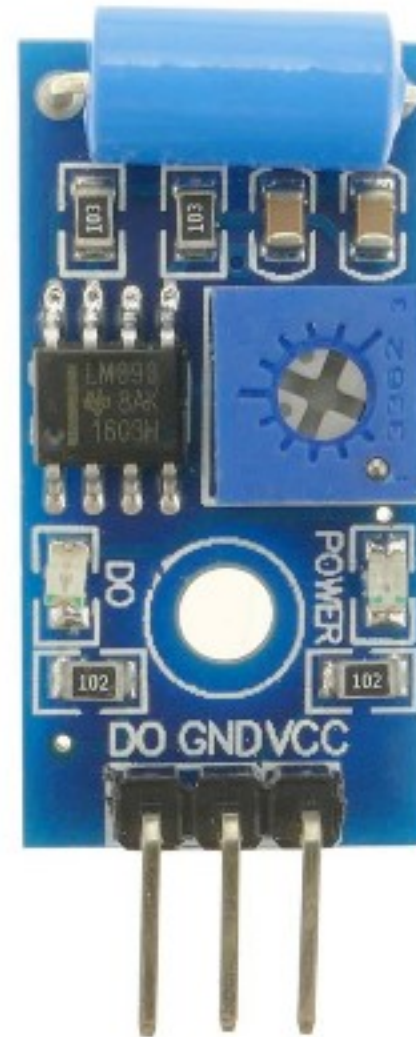
Sensors-AHT10

- Vcc : 3.3V-3.6V

- Interface: I2C

- Temperature range: -40 to 80 (degrees C)

- Humidity range: 0 to 100%

Block Diagram

HC-SR04 ultrasonic sensor

PWM, GPIO

ESP32

MQ3 gas sensor

GPIO

I2C

AHT10 Temperature and Humidity sensor

GPIO

WiFi, HTTP

ThingSpeak

SW-420 Vibration sensor

Public Users, Police/Hospitals etc.

Working

- Driver enters the vehicle and the driver may or may not be drunk. If drunk, then the MQ3 gas sensor detects and sends data to Thingspeak cloud via HTTP

- During collision/accident , both vibration sensor goes high and ultrasonic sensor causes the distance calculation to a lower value. This condition in turn forces a write of all sensor data to the Thingspeak cloud.

- If there is extreme high temperature say above 50 degrees celcius, it is causes all the sensor data to be sent to the cloud.

- To be able to achieve communication with the cloud, the ESP32 board must be able to connect to an active WiFi connection within the car which has internet connectivity. This is a feature seen in several modern cars.

- Once WiFi connectivity is established, the ThingSpeak client is initialized and HTTP request is made to the ThingSpeak cloud.

- All sensor data are kept in individual fields and are sent together at once.

- The sensor data then can be viewed in the ThingSpeak public channel.

- To avoid wastage of power and storage space ,sensor data is not always being sent. Data is only sent when the following condition is met

  if(driver_drunk || (US_distance==2)&&(vibration_detected) || temperature>=50)

Software Used

- Arduino IDE
- Board Manager: ESP32DevModule

Libraries Used

- AHT10.h
- WiFi.h
- ThingSpeak.h

Result

Black Box for Vehicles

Channel ID: **1303618** | Sensor Data for Analysis

Author: mwa0000021485736

Access: Private

Private View   Public View   Channel Settings   Sharing   API Keys   Data Import / Export

Write API Key

Key   `YRNMHPL1VQ394LHX`

Generate New Write API Key

Help

API keys enable you to write data to a channe
keys are auto-generated when you create a n
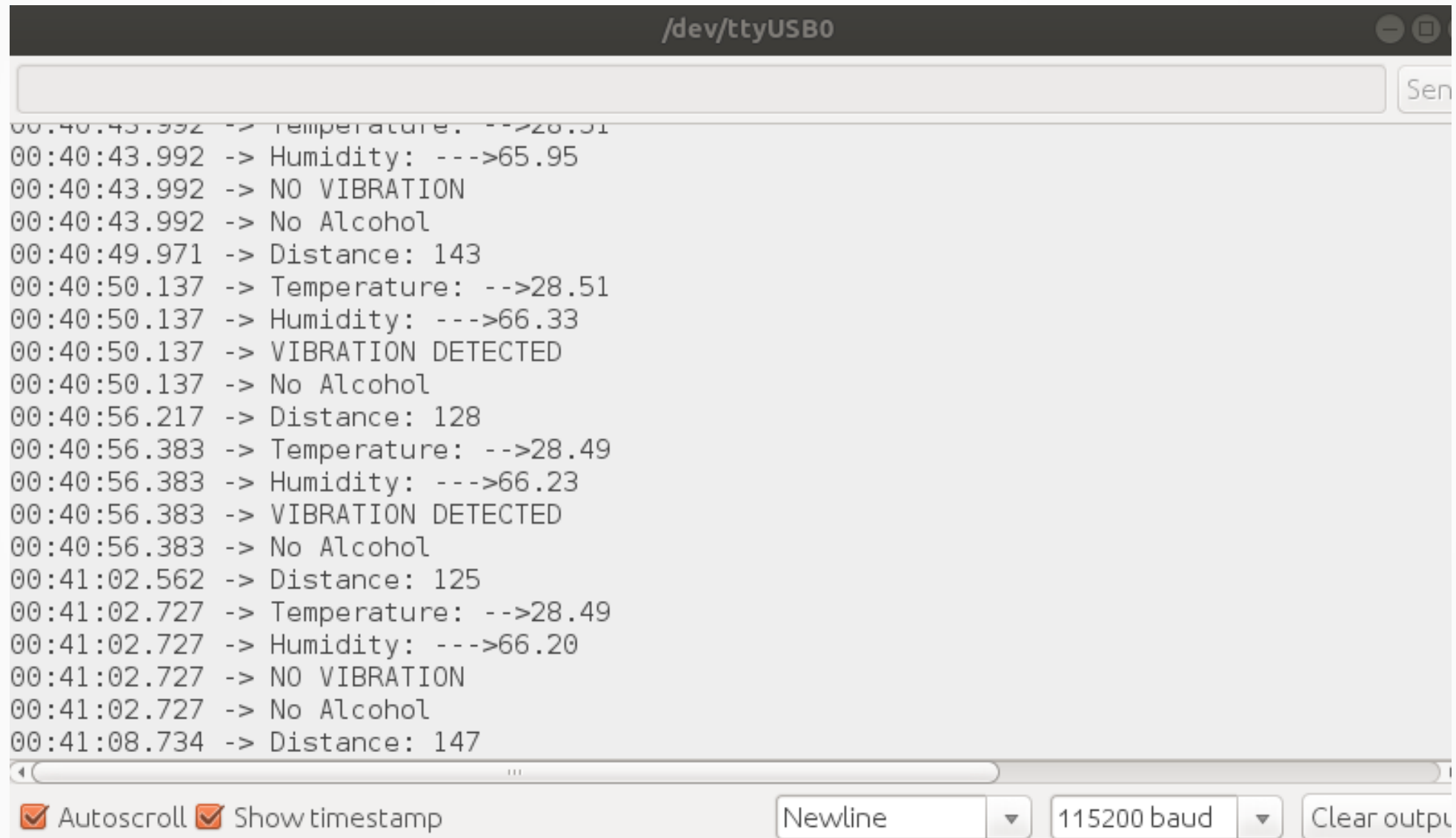
API Keys Settings

- **Write API Key**: Use this key to write da
  been compromised, click **Generate Ne**
- **Read API Keys**: Use this key to allow o
  feeds and charts. Click **Generate New**
  read key for the channel

Result

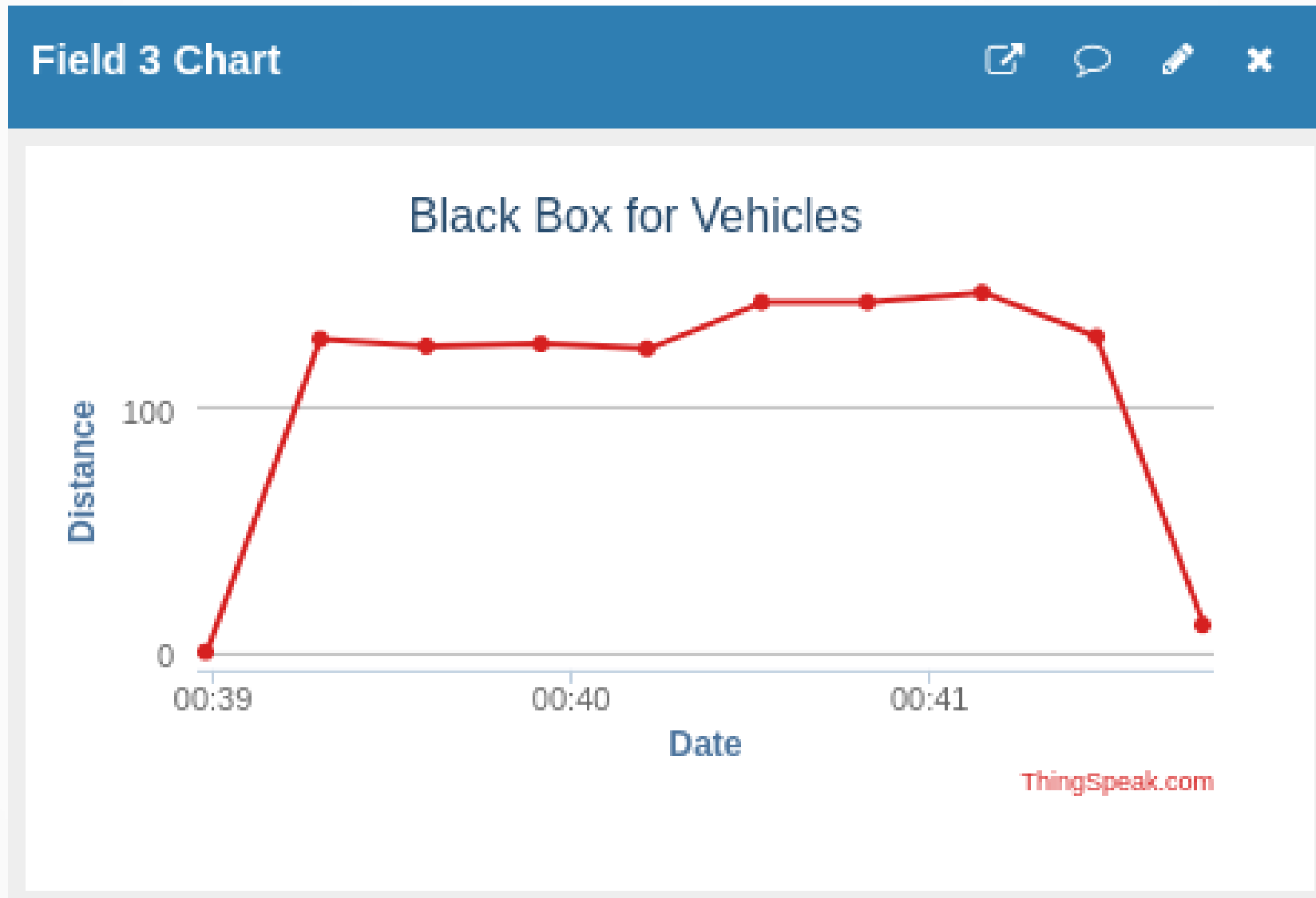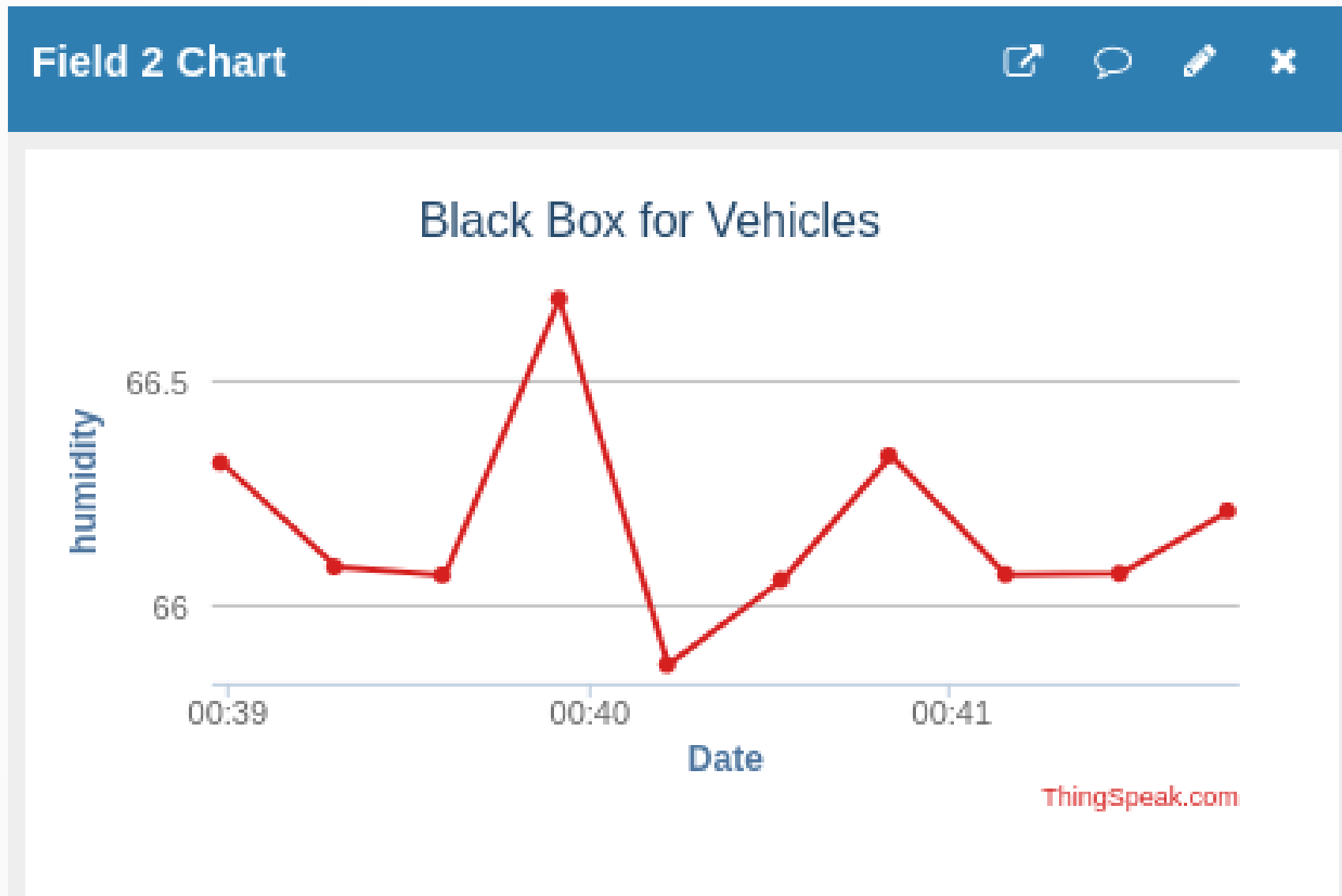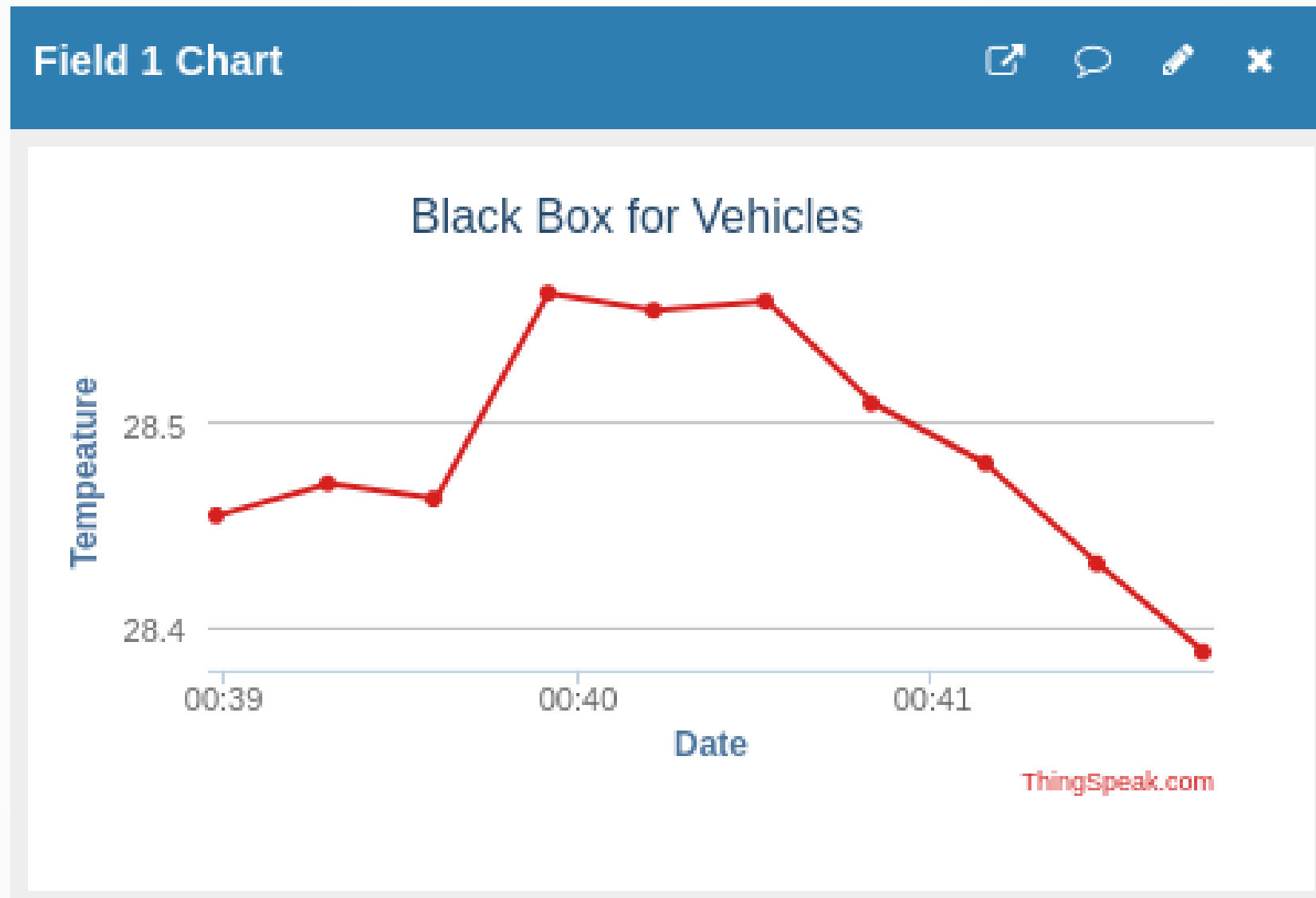|		
Description	Sensor Data for Analysis	
Field 1	Tempeature	☑
Field 2	humidity	☑
Field 3	Distance	☑
Field 4	Vibration	☑
Field 5	Alcohol	☑
Field 6		☐
Field 7		☐
Field 8		☐

Result

Result

Result

Result

Result

Result

Future Scope and Enhancements

- As the Autmotive Industry is vastly growing more sensory related data and tracking systems will be implemented in the future.

- Electric Cars are on the major rise and hence most will possess some sort of a Black Box implementation

- Future models will have accurate GPS systems which will track the location of the vehicle

- GSM/GPRS functionalities will be implemented so that the black box does not have to rely on a WiFi connection.

Work done by members

- Vatpal – Hardware
- Rachana – PPT, Report, Overall documentation
- Vinod - Software

Thank You