Intelligent Vehicle Black Box Using IoT

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in Electronics and Communication Engineering

By

RUTHVIKA THUMMALA (38130189)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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www.sathyabama.ac.in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of RUTHVIKA THUMMALA (Reg.No: 38130189), who carried out the project entitled **"**INTELLIGENT VEHICLE BLACK BOX USING IoT**"** under my supervision from December 2021 to April 2022

Internal Guide

Mr. K.T ILAYARAJAA, M.E., (Ph. D)

Head of the Department

Dr.T. RAVI, M.E., Ph. D

Submitted for Viva voice Examination held on ________________________

Internal Examiner **External Examiner**

DECLARATION

I, RUTHVIKA THUMMALA (Reg.No: 38130189) hereby declare that the Project Report entitled **INTELLIGENT VEHICLE BLACK BOX USING IoT** is done by me under the guidance of **Mr. K.T. ILAYARAJAA, M.E., (Ph. D)** and at **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication
Engineering.

DATE: 1.

PLACE:

SIGNATURE OF THE CANDIDATE

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ABSTRACT

Nowadays automobiles technologies are rapidly increase each and every year and also every second accident count also increase. So, while using some technologies like black box placed in the automobile means creating a new level of data service in vehicle. The automobile black box has functions similar to an airplane black box. It is highly useful to analyse the cause of vehicular accidents and prevent the loss of life and property arising from vehicle accident these paper presents the prototype automobile black box system it is having the group of sensor and also gives the black box sends an alert message to pre stored mobile number in the way of way2sms in the case of an accident

Millions of people die due to accidents. The vehicle accident is a major public problem in many countries. This problem is still increasing due to rider's rash driving and drunk and drive. This problem can be solved by using Black Box system analysis. Automobiles and computer technologies are creating a new level of data service in vehicles. The automatic Black Box has functions similar to an airplane Black Box. It is used to analyse the cause of vehicular accident and prevent the loss of life and property arising from the vehicle accidents. This paper proposes a prototype of an automatic Black Box.

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INTRODUCTION

- A car is the consequence of joined work of various frameworks. Every framework, however essentially free, be impacted by the impact of different frameworks connecting with it.
- Before talking about the cooperation of different frameworks, let us initially specify the different frameworks that are available in a vehicle. It is utilized to examine the reason for vehicular mishaps and forestall the death toll and property emerging from vehicle mishaps.
- The Motor Vehicles (Amendment) Bill, 2016 have been recorded for thought and entry in the present Budget Session of Parliament. It looks to deliver issues identified with street mishaps, outsider protection, and street well-being measures.
- Right now, present a few information on street mishaps, reasons for mishaps, and engine vehicle outsider protection.

According to the World Health Organization, more than a million people in the world die each year because of transportation-related accidents. Now, a day's many accidents are happening because of the alcohol consumption of the driver or person. Hence drunk driving is a major reason of accidents in almost all countries all over the world. The project is developed to record informational data, such as: speed of car temperature of engine, etc. to revolutionize the field of motor vehicle accidents investigation. It can also use for vehicle mapping and accident alert with the help of GPS and GMS technology. In order to react to this situation, the black box system draws the first step to solve this problem that crosses national boundaries and threatens the safety and health of people worldwide. As we know current accident ratio. There are different reasons behind the accident. Considering the practical aspects after accident we need to prepare for all insurance, Policy Claims. There are several clauses in policies, to satisfy each and every clause we need proper documentation. To get, that black box will help us. Black box will help you and insurance company too in order to conclude claims. In addition to that we will have accident tracking system.

Whenever the vehicle meet with an accident an Alert Message will be sent to home contact number including current GPS location of vehicle. This system will help to save life of people. Technically black box is used as a safe to store system safely. At any Environmental condition it will remain as it is. Black box is used to store different parameter of vehicle in memory card.

BACKGROUND:

Due to the increasing incidences of air crashes in the year 1953-54, it was thought that a system could be created that could provide data on the causes for the plane accident and could also help to save planes from accidents. So, the black box is invented and it is also known as 'Flight Data Recorder'. An airplane's Black Box or Flight Data Recorder is a tool that records all of the airplane's activities during its flight. For safety reasons, Black Box is usually kept at the rear of the airplane. This box is made from titanium steel and is included in a titanium container that allows it to withstand shocks if it falls into the sea or from the height. The black box is composed of two different aircraft boxes that are Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR). The FDR is a tool used to monitor specific aircraft output parameters. An FDR has the function of capturing and storing data from several aircraft sensors on a platform designed to survive a crash. The CVR is used to record audio in the deck to investigate injuries and incidents. The CVR monitors and maintains the audio signals of the microphones and earphones and the area mounted in the cockpit of the pilot headsets

Each year, 1.35 million people are killed on roadways around the world [4275]. Some of these accidents can be prevented by just being more cautious while driving. Also, these accidents cause various roadblocks in the way of insurance companies legalizing the case and deciding whose fault the accident actually was. Police investigation also sometimes takes a while in finding the root cause of the problem.

The system proposed in this research paper solves majority of these problems. As automobiles aren't as complicated as airplanes, detecting flaws in automobiles is much easier than finding flaws in an airplane crash. The system proposed doesn't only act as an event data recorder but also as a live feedback information system providing information regarding various stats of the car provided by the OBD (On-

Board Diagnostics) port. As OBD port is a built-in feature in cars, this system is much more widely approachable as it can be used in already existing cars as well as newer models. The police as well as the insurance companies can use the black box as potential evidence for the investigation of crashes.

1.1. PROJECT OBJECTIVE

Millions of people die due to accidents. The vehicle accident is a major public problem in many countries. This problem is still increasing due to rider's rash driving and drunk and drive. This problem can be solved by using Black Box system analysis. Automobiles and computer technologies are creating a new level of data service in vehicles. The automatic Black Box has functions similar to an airplane Black Box. It is used to analyse the cause of vehicular accident and prevent the loss of life and property arising from the vehicle accidents. This paper proposes a prototype of an automatic Black Box

1.2. OVERVIEW

The black box concept is derived from the aviation industry, a flight recorder, colloquially known as black box. Although it is now orange coloured for easy search, is an electronic recording device laced in an aircraft for the purpose of the investigating aviation accidents and incidents. With the advancement in technology and cost coming down, in our project we attempt to build similar device for our cars, not only this device will help us in post-crash analysis but also it helps us in post-crash analysis but also it will help us in quicker emergency rescue operation. research has been targeted towards building an integrated systems for emergency rescue services in the event of a road accident.

1.3. AIM OF THE PROJECT

The project aims to find the occurrence of any incident and to report the position of Incident with the previously fed contact number so that immediate assistance can be provided by ambulance to patient. Nowadays automobiles technologies are rapidly increasing each and every year and also each and every second accident count also increase. So, while using some technologies like black box placed in the automobile means creating a new level of data service in vehicle. The vehicle black package has occupation comparable to an aircraft black package. It is highly useful to analyse the cause of vehicular accidents and prevent the loss of life and property arising from vehicle accident. In today's world as the population increases day by day the numbers of vehicle also increases on the road and highways. These results in accident that leads to the traffic jams and people do not get the help instantaneously. Road accidents constitute the major part of the accident deaths all over the world. This takes a toll on the property as well as causes human life loss because of unavailability of immediate safety facilities. During 2008, Road Traffic Injuries ranked fourth among the leading causes of death in the world. Nearly 1.3 million people die every year on the world's roads and 20 to 50 million people suffer non-fatal injuries, with many sustaining a disability as a result of their injury. Road traffic injuries are the leading cause of death among young people aged 15-29 years. If no action is taken, road traffic crashes are predicted to result in the deaths of around 1.9 million People annually by 2020. Those who live, has a high chance of incurring a disability as a result of the impact. 91% of the fatalities on the roads occur in middle- and low-income countries. Many campaigns have been conducted by the people for the awareness, but this problem is still increasing due to rider's poor behavior such as speed driving, drunk driving, riding without sufficient sleep, etc. The numbers of death and disability are very high because of late assistance to people who got the accident. These cause huge social and economic burdens to people involved. Therefore, several research group and major motorcycle manufacturers have developed safety devices to protect riders from accidental injuries. However, good safety device for vehicles is difficult to implement and very expensive. Complete accident prevention is unavoidable but at least repercussions can be reduced. In highly populated Countries like India, everyday people lose their lives because of accidents and poor emergency facilities. These lives could have been saved if medical facilities are provided at the right time. In many situations the family members or the ambulance and police authority is not informed in time. This result in delaying the help reached to the person suffered due to accident. In order to give treatment for injured people, first we need to know where the accident happened through location tracking and then send a message to your related one or to the emergency services. Many cases remain pending due to unknown reason of an accident. In order to react to this situation, the black box system draws the first step to solve problem. It is referred as electronic data recorder. It records main driving data such as Engine Temperature, Distance from obstacle, Speed of vehicle, Brake status, CO2 Content, Alcohol content, Accident Direction, trip Time and Date. The recorded data will be analysed to find out reason for the accident easily and to settle many disputes related to accident such as crash litigation, insurance settlements. It can be used to not only reconstruct what happened before an accident by Insurance agents and police but improve vehicle design, roadway design and emergency medical service by automakers, government and hospital.

1.4. LITERATURE SURVEY

Accident Detection System using Black Box System Tushar shelke1 , NilimaRaut2 , Swati Sayare3 , Shital Bhade4 ,Shital Manmode5 ,Rajashri Sadawarti 6 Assistant Professor1 , Student2, 3,4,5,6 Department of Electronics and Telecommunication Engineering NIT, Nagpur, India

The main purpose of this paper is to develop a prototype of the Accident detection system using black box. In the event of accident, if any injury happened to the car driver or passengers so maybe there will be loss of lives due to delay in medical help. This prototype can be designed with minimum number of circuits. The VBBS can contribute to constructing safer vehicles, improving the treatment of crash victims, helping insurance companies with their vehicle crash investigations and enhancing road status in order to decrease the death rate. This project aims at finding the occurrence of any accident and reporting the location of accident to the previously coded number so that immediate help can be provided by ambulance or the relative earned. GPS which is a navigational system using a network of satellites orbiting the earth. Keywords: Accident Detection System using VBBS, GSM and GPS.

The ARDUINO ATMEGA-328 microcontroller consists of 14 input and output Analog and Digital pins(from these 6 pins are considered to be a PWM pins), 6 Analog inputs and remaining digital inputs. Power jack cable is used to connect ARDUINO board with the computer. Externally battery is connected with the ARDUINO microcontroller for the power supply ARDUINO is an open microcontroller for which there is no feedback present in the microcontroller. The operating volt ranges from 5v

The length of the ARDUINO board is nearly about 68.64mm and the width of the microcontroller is about 53.4mmThe weight of the ARDUINO microcontroller is about 20g.and finally display it to the user in a clear and simple.

This project uses IC LM35 as a sensor for detecting accurate centigrade temperature linearity defines how well over a range of temperature sensors output consistently changes. The LM35 is rated to operate over a -55 to +1500 c temperature range. It draws only 60uA from its supply. It has very low self-heating, less than 0.10 c in still air. LM35 operates from 4 to 30 volts.

Methodology

In this proposed work, a novel method of accident detection system used to track the vehicle using GSM and GPS technology. In this system we used temperature sensor, alcohol sensor, speed sensor, microcontroller, LCD and GPS module GSM module whenever the car will be start, at this time the entire sensor will be in active mode and then start to read the parameter.in this way the entire sensor will monitor the car performance. Since the control unit is receive all the data from the sensor. And then show all the parameter value on LCD at a time. In this system the heart of proposed system is microcontroller. The entire peripheral sensor connected to the microcontroller. Ideally system will read the different parameters like temperature, speed, alcohol percentage present in the car and continuously display on LCD. In this system we also insert memory card which is connected to microcontroller of the system. Will save the data of every parameter. When the accident occurred, then the particular location of this incident will trace by using GPS technology. On detecting accident this system will get current location coordinate from GPS module. The GSM module will send the alert message to the victim relatives to predefine contact number at the same time memory card will have to store the resend data which could be recovered at service station for helping insurance companies with their vehicle crash investigation. at service center memory card will be connected to PC to read all the data stored in it.

AUTOMOBILES BASED BLACK-BOX SYSTEM USING IoT **S.Monika1, S.Miruthulasri2, R.Mano Priya3, D.Murugesan4. 1-3Student, Dept. of ECE, SRM Valliammai Engineering College, Tamil Nadu, India. 4Professor, Dept. of ECE, SRM Valliammai Engineering College, Tamil Nadu, India.**

The proposed system is designed such that, the device itself sends a data to the IOT and this process is done by ESP8266 chip with sensors when an accident is met. Proposed system uses Arduino board that provides an easy access to input/output and analog pins and easy burning/uploading of a program. To monitor the various sensors such as alcohol sensor, temperature sensor, light sensor, accelerometer, ultrasonic sensor, GPS are connected to Arduino board. Arduino board is connected to cloud. The output of the sensors is read from Arduino and output values are displayed in LCD. The data is stored in the cloud the given system is proposed in IoT

Consider a car had an accident the sensor will activated automatically and start its surveillance mode. If user is not in critical condition and can help himself then he will for every 30 seconds GPS will receive the information from the satellite and fed to the microcontroller. Control the form of longitude and latitude. Then it records car details will read information and display it on the LCD display. A memory card is solid-state electronic flash memory data storage device capable of digital contents. Black Box system that can be installed into vehicles. The system aims to achieve accident analysis by objectively tracking the vehicle. The system also involves enhancement of security by preventing tampering of the Black Box data .This system consists of Alcohol sensor, Speed measurement sensor, Ultrasonic sensor, MEMS sensor and Mobile GPS. Whenever an abnormal value is detected, it will be created in the form of log and send to the cloud it contains location and image.

stop surveillance mode. Once the system started in assistance mode first of all system will gather the car location using GPS device Power supply is a supply of electrical power, that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The Global Positioning System (GPS) is a burgeoning technology, which provides flexibility of positioning for navigation, surveying. The GPS provides continuous three-dimensional positioning

24 hrs a day throughout the world. Once the user's position has been determined, GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination. One of the most common devices attached to a micro controller is an LCD display. 16x2 display is used in this project. This means 16 characters per line by 2 lines.

Black Box for Automobiles Vandan Shah1, Vatsal Sheth2, Narendra Sharma3, Ami Munshi4 1,2,3Student, Department of EXTC, MPSTME, NMIMS University, India 4Assistant Professor, Department of EXTC, MPSTME, NMIMS University, India

Vehicular accidents are on the surge in a developing country such as ours. Majority of these accidents happen due to carelessness of the driver while checking the car statistics, or not checking them entirely. Also, a lot of accident cases are open ended, as the justice architecture can't find the root cause of the accident. The system proposed here acts as a black box for automobiles. Black box is a device commonly used in airplanes for accident analysis and safety measure purposes. The black box prototyped in this research paper is a modified version of the tradition black box. It doesn't only store event data in the light of a fatality or an accident but also provides with live statistics of the car details through an application interface on a mobile phone. A traditional black box system requires a box with all the sensors physically connected to car, but by using the OBD-II technology, we overcome the problem of fitting every car with new sensors and can directly use the technology present in one's car. Outcome of this research is a physical box which can store data up to 10 minutes before an accident to analyze what went wrong as well as an application which provides live updates to the driver if there's any issue with the automobile which in case can avoid any fatal accidents with live GPS tracking. Key Words: Automobiles, Black Box, Live Tracking, Application interface, OBD- II

2. HARDWARE RESOURCES This section shows the various hardware components used in the system. The block diagram shows all the system flow of various components, to the center microcontroller which is Arduino mega. The various components used are as follows: 2.1 Microcontroller (Arduino Mega) The Arduino mega is the bigger version of Arduino UNO. It is a microcontroller based on At Mega 2560. It is designed for projects requiring more I/O lines, more RAM and

more sketch memory. This microcontroller is used as the central hub in the system as it interacts with every component of the system. To describe the system circuit, the GPS module uses 4 lines, the Bluetooth chip uses 5 lines, the SD card reader uses 6 lines and the Wi-Fi module uses 8 lines. 2.2 ELM327 OBD Bluetooth Adapter ELM327 is a Bluetooth device, which uses the OBD port present in the car as the input device and scans all the present data of the given automobile. The ELM327 adapter connects with the microcontroller with help of Bluetooth and transmits the given data to the microcontroller, which further works on the data. This Bluetooth adapter converts the known OBD-2 protocols into a serial data communication, which communicates with the Arduino. 2.3 SD Card Module the SD card module interacts with the Arduino to receive data and store the data in the SD card. It allows the Arduino to communicate with the SD card, as it is an important part of the system as it is crucial for the system to act as an event data recorder. 2.4 Bluetooth Module The module HC-05 is used for the Bluetooth communication of the system as required by the ELM connector to transfer the signals via Bluetooth to the microcontroller. HC-05 supports full duplex communication to the system and add much functionality to the system. It has a 2.4 GHz radio transceiver and baseband. 2.5 GPS Module the NEO-6M GPS module used in the system is a global position system module, which provides accurate location of the system it is installed in. The GPS module in our system is interfaced with the Arduino microcontroller and provides real time location tracking to the board. Our system also has an antenna extender used in conjunction with the module to extend its signal.

2.6 Wi-Fi Module the ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. This Wi-Fi module is used in our system so that the microcontroller can interact with the servers, which sends the data to the host application. 3. SOFTWARE RESOURCES 3.1 Arduino IDE Arduino IDE is an open-source IDE that is primarily used for writing and uploading codes on any Arduino certified board and can be used in various environments. We used this IDE to upload the final code on the Arduino mega microcontroller. 3.2 Android Studio Android studio is the platform used here to develop an application for the live updates of the car sent by the microcontroller via Wi-Fi Module. Android studio is an open-source platform and can be used by anyone to create an android application. 3.3 Firebase Database the Firebase Real-time Database is a cloud-hosted NoSQL Database that lets you store and sync data between your users in real-time. This database is being used by us to store the data coming from the car, which is then extracted by the android application

Blackbox for on-road vehicles Saket Joshi, Vedant Gadewar, Shourya Goswami, Shubham Pal, Pratik Nikhare Guided by : PROF. S.S CHIWANDE Department of Electronics and Telecommunication Engineering, Yeshwantrao Chavan College of Engineering, Nagpur, India

This paper presents the study of wireless device Black box used for detecting crashes of on-road vehicles. Blackbox will send and store the important information. It is constructed in such a way that when a crash happens, the device sends a particular location to the registered mobile no, so that the help could reach on time. Mainly used in all the automobiles industries as their Safety feature. The master component we use is Arduino UNO that controls all the other modules and sensors. The GPS and GSM modules are used to obtain location data and send that data to a registered mobile number. Some of the sensors we use are, Temperature sensor (DTH11), a switch etc. Keywords: Safety, Road accidents, Sensors, Global positioning system, Used in automobiles.

The project is regarding ‘Black-Box for On-Road Vehicles’. From this project we hope to achieve a wireless device that can be installed in any vehicle all over the world. This device will contain a range of small circuits. Wireless Black-Box is basically a device that will collect all the parameters regarding vehicular accidents, which will also be stored and sent to concerned authorities over a text message. The parameters include Latitude, Longitude, temperature etc. For collecting the information, we use various types of sensors like temperature, GPS. This information will be stored in a SD card for further information regarding the crash. After the crash is detected by the switch the built-in system will send an emergency message to the registered numbers. The GPS module will take the exact latitude and longitude of the crash and the GSM module will send the information via a text message. All the parameters which are sensed by the system will send the signal to Arduino UNO.

1.1 Power Supply :A power supply is used in electrical devices to supply electric power to an electrical load. The power supply converts electric current from a source to the required value of voltage, current, and frequency by the load. 1.2 GPS : The Global Positioning System (GPS) is a satellite-based navigation system that gives location and time information in all conditions irrespective of the weather, it can give accurate location of objects anywhere on or near the Earth where there is a clear line of sight to four or more GPS satellites. 1.3 Arduino UNO : The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller which is developed by Arduino.cc. The board is equipped with the sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. 1.4 Temperature Sensor (DHT11) : DHT11 is a low-cost digital sensor which is used for sensing the temperature and humidity. This sensor can be easily interfaced with any microcontroller such as Arduino, Raspberry pi,etc.DHT11 sensor is used to measure the temperature and humidity instantaneously. 1.5 GSM : The Global System for Mobile Communication is a standard which is developed by European Telecommunications Standard Institute to describe the protocols for second-generation digital cellular networks used by mobile devices such as mobiles phones and tablets. 1.6 Collision Sensor : Collision Sensor is also called an impact sensor. It is a piece of electronic safety equipment that detects an impact through vibrations. Collision sensors are used in industrial settings, in cars for the collision detection purpose.

1.2 The device is used to reduce the number of deaths caused due to medical services not reaching on time after the accidents so to overcome this situation this wireless device is made. It will also be useful for the concerned authorities to know the cause of accidents. This wireless device has been used in Aero planes for recording purposes before an accident, we try to bring this technology to ON-Road Vehicles. It will have a number of sensors attached to Arduino UNO which will store the data and send information to registered mobile numbers. After Collision is detected, sensors will get activated which in turn triggers all the other modules to store and send information. When we power on the system Arduino and other attached components get turned on. First, we get the location by the GPS module, and the Temp of the inside of the vehicle. Then we use Accident detector to check whether the accident has occurred or not. If YES then we send the message to the respective authority and save the data in the local SD card. If NO then we save the DATA in the SD card and then we check the location and temp again and the loop continues.

Nowadays, the number of accidents is rapidly increasing in the crowded cities as well as on the highways. So, we have constructed a wireless device which can track the vehicle and send the location on the registered number. The functions of this automobile Black Box are much similar to an aero plane Black Box. It is used to analyze the cause of vehicular accidents and prevent the loss of life and property due to vehicle accidents. This paper proposes a model of an Automobile Black Box system that can be implemented into vehicles. The system also involves the improvement of the security by preventing the damage by the Black Box data. An Event Data Recorder(EDR) is the device which is used to record the movement parameter of a vehicle mainly used for the accidents analysis purposes and for the safety measures. In some vehicles Video Event Data Recorder(VEDR) is used. A Video Events Data Recorder(VEDR) is a device that records the video in a vehicle to create the records of accidents. This research will be continued in the near future by researching new features such as data compression, security, low energy and more safety measures

Abhirup Das et.al, have demonstrated how to effectively prevent accidents and monitor the location information obtained from the vehicle. Step1: If the subject becomes excessively asleep, an IR sensor receives an excessive blindness rate and a warning to wake the person is activated. Step 2: The driver’s intoxicated state is measured by an alcohol tracker, which is typically used to measure the amount of alcohol in the blood. Step3: If the neighboring distance dropped below the threshold point, the motor control circuit would be excited by the sensor, which would in effect restrict the speed of the car. Step4: If there is a sudden accident, the transmitter stops working and the receiver station receives no signal. Using a GSM (Global System for Mobile) module, a help message would be sent to the nearest station. So, the location of the accident between two stations can be predicted and medical assistance can be provided. Manish Bhelande et al have discussed the functions and the configuration of the BB system. This system focuses on uploading real-time driving monitored data to cloud applications for further investigation in the case of an accident. The steps are as follows, Step1: Car black box is an android app that can be installed on your android phone. Before the system begins, it requires user authentication, you have to enter your login credentials issued by the admin, and then check your login credentials. Step2: Once you are allowed to record your video and begin speed tracking straight away. Video recording is rendered from the android phone's rear camera. Step3: The video is separated and saved on the android phone's storage so that it can upload more cloud video at a faster pace with each 2- minutes video. Step4: The length of two locations taken between the same times to measure the car's average speed (approximately 2 minutes). The car speed is determined and submitted to the database along with its position (latitude, longitude). Step5: The emergency / alert notification will be sent to user-specified contacts when the user clicks on the alarm button in the program. Kumar et al. They mentioned the vehicle security solution which alerts the driver automatically by continuously monitoring the output of the vehicle with sensors and driver activity using IoT technology. The work process is given as steps, Step1: Submit it to the cloud once the car starts position. Step2: Get the accelerometer, ultrasonic sensor, and alcohol sensor values. Step3: When the driver exceeds his alcohol consumption level. The owner or the automobile authority will automatically receive a message. Step4: The ultrasonic sensor tracks the distance from the driver when it collides with the surrounding vehicle. Step5: The accelerometer learns the tilt values immediately after the collision and sends the message to the position using GSM and GPS. Step6: Press the button to call for management support, and use the panic button to call emergency response assistance. Step7: For monitoring purposes, the sensor values and position are forwarded to the cloud. Kingshuk Mukherjee has discussed the functions of the anti-theft configuration of the vehicle. This system focuses on tracking and immobilized in the case of a theft. The steps are as follows, Step1: Whenever the consumer deems it necessary, text messages can be sent to the vehicle's GSM modem via his / her mobile, and the vehicle's text message is answered within seconds. Step2: This module senses a location, and sends the user's coordinates via an additional text message via the GSM modem when the Arduino is alerted through GSM by the user with ' TRACK. ' Step3If a vehicle robbery is suspected; the car is sent by text messages remotely. Step4: The Arduino activates a relay which disconnects the fuel injection system, and thus stops the car when an "IMMOBILITY" message is received. Step5: The recipient should collect the

“VEHICLE IMMOBILIZED” Step6: Upon completion of the injection cycle and encouraging the engine to operate again, the recipient of a REVERSE message will reverse the immobilization. Step7: Once the immobilize reverse is completed, the owner will receive the “IMMOBILIZATION REVERSED” message. Step8: If the user sends any other texts to the Arduino, Arduino will send "INVALID MESSAGE, TRY AGAIN" Message to the cellphone's recipient. Z. Liu et al have discussed the vehicle anti-theft. In this system, it starts working when the owner leaves the truck. The noise sensors are triggered if the vehicle is abnormal intruded by offenders. They often mount pyroelectric infrared sensors to ensure it is triggered by anthropogenic causes. The GSM module sends data from the GPS module every 10 seconds via SMS to the mobile phone of the owner. Upon receiving messages, the owner will open the app by clicking on "Vehicle location," to test the vehicle's position. G. S. Prasanth Ganesh et al. Proposed anti-theft tracking work. In this paper, a mobile phone system connected by another device and GPS, connected via an internet connection and then a user interface, only the location, and other essential details were displayed through an SMS. when a message is received from the user that is hijacked by a vehicle. In this way, the sensor is triggered when the motor is turned off. R Dimple and Nanda B S proposed a system for a smart black box for gathering information on vehicles. When the power is on, "START" and "GSM Enabled" appears on the LCD monitor. As the car encounters incident, a warning will be displayed on LCD as the incident, certain settings such as temperature, the seat belt, are constantly calculated by the corresponding sensors and shown on the LCD. In the event of a crash, a recorded GSM number will be issued to a message. Tushar shelke et.al, [8] have demonstrated how to effectively prevent accidents and monitor the location information obtained from the vehicle. The whole peripheral sensor is attached to a microcontroller. Ideally, the machine can interpret the numerous parameters, such as temperature, rpm, alcohol level, present in the car, and continuously displayed on the LCD. In this method, a memory card is attached to the system's microcontroller. The data for each parameter is stored. If an incident has happened, the device can get the latest position coordinate from the GPS module. The GSM module would transmit a warning note to the victim's family so that the phone number may be predefined at the same moment as the memory card has to be processed. Priyanka S G et al have discussed the vehicle anti-theft. In this system parameters obtained are vehicle Id, pace, engine temperature, and injuries date and period. The program Smart Black Box allows accident researchers to submit GPS during ultrasound sensor sensed accidents through GSM. S. Shahzad et.al, have demonstrated how to effectively prevent accidents and monitor the location information obtained from the vehicle. The GPS decides the accident's precise location, GSM delivers the text alert to a registered mobile phone account. The GSM will transmit the alert to the stored numbers as soon as the voltage hits the level and store the alcohol rate, temperature, and sound, seatbelt, and break indicators. The black box utilizes the automotive battery power source. The pen camera is often used for transmitting video and audio signals. The RTC tracks the incident in real-time. Article takes the shape of a model definition. Such articles led to inspiring research. According to the report, details could not come before or after the incident if the vehicle was destroyed or missing. When someone robs the vehicle, they can’t figure out who robs the car.so Link to mail by creating a black box for the transmission of the data and picture captures via the internet and using the sensor to find out where and when the accident took place to save the lives for rescue teams and have a separate mobile application connection for finding the vehicle speed and direction coordinates

‘

CHAPTER 2

EXISTING SYSTEM

- Normally black box cost is high so no one prefer to install in the vehicle and normally black box is just store the data
- In existing system black box is done by using the sensors with gsm if any of the parameter reach above the threshold level it sends only the message
- In an existing system circuit looks bulky not in compact
- In this system use GSM & GPS communication.

2.1 DRAWBACKS

Only speed can be monitored

Accident can’t be noted

2.2 PROPOSED SSYTEM:

- To monitor the various sensors such as alcohol sensor, temperature sensor, Gas sensor, Touch sensor, Crash sensor, Vibration sensor and GPS are connected to Arduino board
- The output of the sensors is read from Arduino and communicated to single board computer. These data are uploaded into the node mcu board.

- The data is stored on the SD card and also in the cloud the given system is proposed in IOT
- We can get the live update through the gps and IOT Technology.

ADVANTAGES:

The proposed system is designed such that, the device itself sends a message to the concerned person when an accident is met. Proposed system uses Node MCU Arduino board that provides an easy access to input/output and analog pins and easy burning/uploading of a program. The system uses GPS to find the location of the accident and to send that location in the form of SMS to the previously coded number. It also includes the feature to detect the presence of alcohol. To monitor the various sensors, GPS are connected to Arduino board which is Node MCU. Arduino board is connected to Ubidots (open-source cloud). The output of the sensors is read from Arduino and communicated to single board computer. The data is stored in the cloud the given system is proposed in IOT.

2.3 BLOCK DIAGRAM:

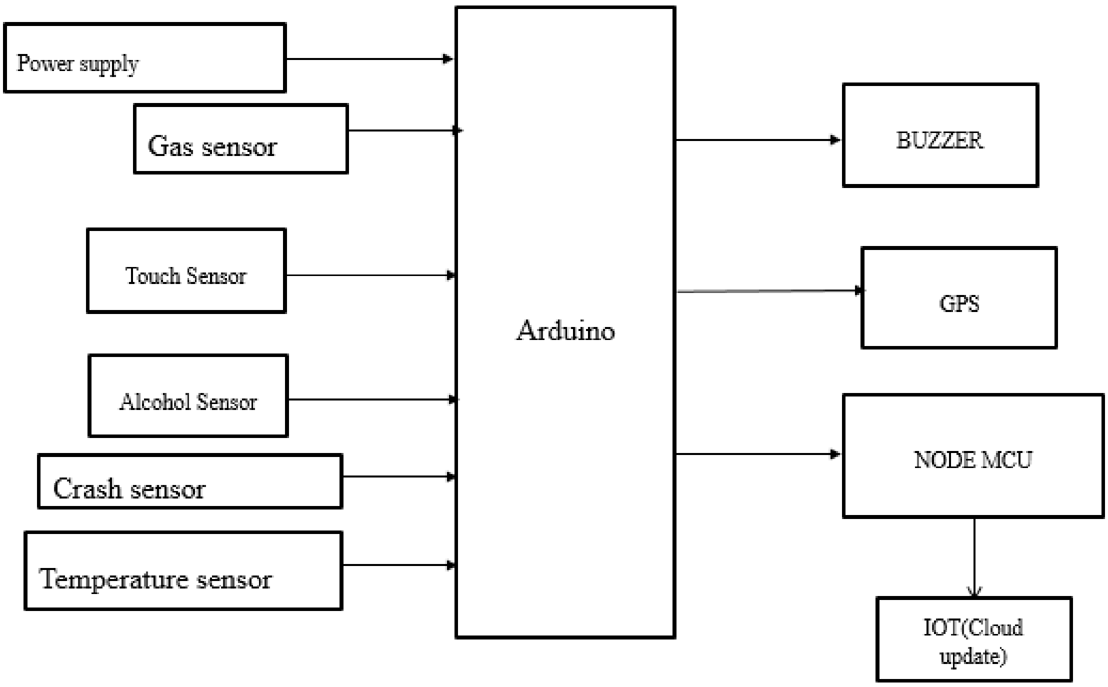

Fig 2.1: Block diagram of the project

2.4 HARDWARE REQUIREMENTS

- Arduino
- Node MCU
- Temperature sensor
- Vibration sensor
- Touch sensor
- Crash sensor
- Alcohol sensor
- Gas sensor

2.5 SOFTWARE REQUIREMENTS

- ARDUINO IDE
- Language: Embedded C

CHAPTER 3

HARDWARE DESIGN

3.1 ARDUINO NANO AND ITS PROGRAMMING

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Arduino Nano:

Fig 3.1 – Arduino Nano

3.2 Overview

Arduino Nano is one type of microcontroller board, and it is designed by Arduino.cc. It can be built with a microcontroller like Atmega328. This microcontroller is also used in Arduino UNO. It is a small size board and also flexible with a wide variety of applications. Other Arduino boards mainly include Arduino Mega, Arduino Pro Mini, Arduino UNO, Arduino YUN, Arduino Lilypad, Arduino Leonardo, and Arduino Due. And other development boards are AVR Development Board, PIC Development Board, Raspberry Pi, Intel Edison, MSP430 Launchpad, and ESP32 board.

This board has many functions and features like an Arduino Duemilanove board. However, this Nano board is different in packaging. It doesn't have any DC jack so that the power supply can be given using a small USB port otherwise straightly connected to the pins like VCC & GND. This board can be supplied with 6 to 20volts using a mini-USB port on the board.

3.3 Summary:

- ATmega328P Microcontroller is from 8-bit AVR family
- Operating voltage is 5V
- Input voltage (Vin) is 7V to 12V
- Input/Output Pins are 22
- Analog i/p pins are 6 from A0 to A5
- Digital pins are 14
- Power consumption is 19 mA
- I/O pins DC Current is 40 mA
- Flash memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK speed is 16 MHz
- Weight-7g
- Size of the printed circuit board is 18 X 45mm
- Supports three communications like SPI, IIC, & USART

3.4 Pin Configuration

Power Pin (Vin, 3.3V, 5V, GND): These pins are power pins

- Vin is the input voltage of the board, and it is used when an external power source is used from 7V to 12V.
- 5V is the regulated power supply voltage of the nano board and it is used to give the supply to the board as well as components.
- 3.3V is the minimum voltage which is generated from the voltage regulator on the board.
- GND is the ground pin of the board

RST Pin(Reset): This pin is used to reset the microcontroller

Analog Pins (A0-A7): These pins are used to calculate the analog voltage of the board within the range of 0V to 5V
I/O Pins (Digital Pins from D0 – D13): These pins are used as an i/p otherwise o/p pins. 0V & 5V

Serial Pins (Tx, Rx): These pins are used to transmit & receive TTL serial data.

External Interrupts (2, 3): These pins are used to activate an interrupt.

PWM (3, 5, 6, 9, 11): These pins are used to provide 8-bit of PWM output.

SPI (10, 11, 12, & 13): These pins are used for supporting SPI communication.

Inbuilt LED (13): This pin is used to activate the LED.

IIC (A4, A5): These pins are used for supporting TWI communication.

AREF: This pin is used to give reference voltage to the input voltage

3.5 Communication

Microcontrollers depend on a host computer for developing and compiling programs. The software used on the host computer is known as an integrated development environment, or IDE. For the Arduino, the development environment is based on the open-source Processing platform (www.processing.org) which is described by its creators as a “programming language and environment for people who want to program images, animation, and interactions. “The Arduino programming language leverages an open-source project known as Wiring (wiring.org.co). The Arduino language is based on good old- fashioned C. If you are unfamiliar with this language, don’t worry; it’s not hard to learn, and the Arduino IDE provides some feedback when you make mistakes in your programs.

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

As you go through the list of programming statements available in the Arduino IDE (choose Help->Reference), you might think there isn’t much power for doing things like running servos, operating stepper motors, reading potentiometers, or displaying text on an LCD. Like most any language based on C, the Arduino supports the notion of “libraries” code

Repositories that extend core programming functionality. Libraries let you re- use code without having to physically copy and paste it into all your programs. The standard Arduino software installation comes with several libraries you may use, and you can download others from the Arduino support pages and from third-party websites that publish Arduino library code. A good example of a library you'll use with the Robot and likely many other robot projects is

Servo. This library allows you to connect one or more hobby R/C servos to the Arduino's digital I/O pins. The Servo library comes with the standard Arduino installation package Library->Servo. This adds the line
#include <Servo.h>

Which tells the Arduino IDE that you wish to include the Servo library in your sketch. With the functionality of the library now available to you, you can use its various functions to control one or more servos. For example, you can use the write function to rotate a servo to a specific position, from 0 to 180 degrees. The following code

myServo.write(90);

Moves a servo to its midpoint, or 90-degree position. Structurally, Arduino sketches are very straightforward and are pretty easy to read and understand. The Arduino program contains two main parts: setup () and loop (). These are programming functions that do what their names suggest: setup () sets up the Arduino hardware, such as specifying which I/O lines you plan to use, and whether

They are inputs or outputs. The loop () function is repeated endlessly when the Arduino is operating.

Arduino IDE (Integrated development environment) is used to write the program and dump into the Arduino board

NodeMCU is an open-source Lua based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module

Programming NodeMCU ESP8266 with Arduino IDE

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use.

Programming NodeMCU with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the NodeMCU board itself. You can check this Getting Started Tutorial for NodeMCU to prepare your Arduino IDE for NodeMCU.

NodeMCU is an open-source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.

Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications (see related projects).

History

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems began production of the ESP8266.[11] NodeMCU started on 13 Oct 2015, when Hong committed the first file of NodeMCU-firmware to GitHub.[12] Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the Gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform, and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib[15] to the NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In the summer of 2015, the original creators abandoned the firmware project and a group of independent contributors took over. By the summer of 2016 the NodeMCU included more than 40 different modules.

ESP8266 Arduino Core

As Arduino.cc began developing new MCU boards based on non-AVR processors like the ARM/SAM MCU and used in the Arduino Due, they needed to modify the Arduino IDE so that it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. They did this with the introduction of the Board Manager and the SAM Core. A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. Some ESP8266 enthusiasts developed an Arduino core for the ESP8266 Wi-Fi SoC, popularly called the "ESP8266 Core for the Arduino IDE".[17] This has become a leading software development platform for the various ESP8266-based modules and development boards, including NodeMCU’s.

NodeMCU is an open-source LUA based firmware developed for the ESP8266 Wi-Fi chip. By exploring functionality with the ESP8266 chip, NodeMCU firmware comes with the ESP8266 Development board/kit i.e., NodeMCU Development board.

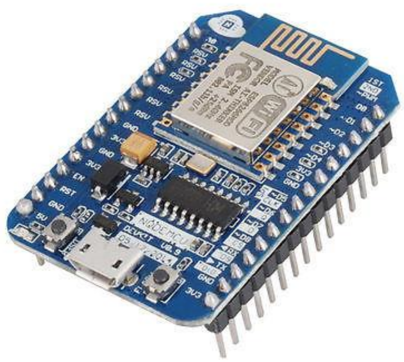

Fig 3.2 - NodeMCU Development Board (Version1)

NodeMCU Development Board/kit v0.9 (Version1)

Since NodeMCU is an open-source platform, its hardware design is open for edit/modify/build.

NodeMCU Dev Kit/board consist of ESP8266 Wi-Fi enabled chip. The **ESP8266** is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer to the ESP8266 Wi-Fi Module.

There is Version2 (V2) available for NodeMCU Dev Kit i.e., **NodeMCU Development Board v1.0 (Version2)**, which usually comes in black colored PCB.

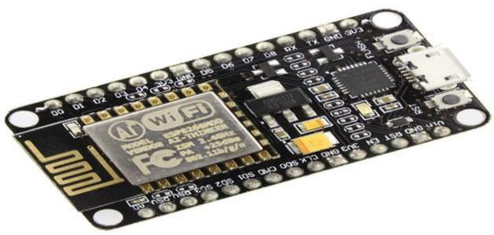

Fig 3.3 - NodeMCU Development Board (Version2)

NodeMCU Development Board/kit v1.0 (Version2):

For more information about NodeMCU Boards available in the market refer to NodeMCU Development Boards

NodeMCU Dev Kit has **Arduino like** Analog (i.e., A0) and Digital (D0-D8) pins on its board.

It supports serial communication protocols i.e., UART, SPI, I2C, etc.

Using such serial protocols, we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards, etc.

How to start with NodeMCU?

NodeMCU Development board is featured with Wi-Fi capability, analog pin, digital pins, and serial communication protocols.

To get started with using NodeMCU for IoT applications first we need to know about how to write/download NodeMCU firmware in NodeMCU Development Boards. And before that where this NodeMCU firmware will get as per our requirement.

There are online NodeMCU custom builds available using which we can easily get our custom NodeMCU firmware as per our requirement.

To know more about how to build custom NodeMCU firmware online and download it refer to Getting started with NodeMCU

How to write codes for NodeMCU?

After setting up ESP8266 with Node-MCU firmware, let's see the IDE (Integrated Development Environment) required for the development of NodeMCU.

NodeMCU with ESPlorer IDE

Lua scripts are generally used to code the NodeMCU. Lua is an open-source, lightweight, embeddable scripting language built on top of C programming language.

For more information about how to write Lua script for NodeMCU refer to Getting started with NodeMCU using ESPlorerIDE

NodeMCU with Arduino IDE

Here is another way of developing NodeMCU with a well-known IDE i.e., Arduino IDE. We can also develop applications on NodeMCU using the Arduino development environment. This makes it easy for Arduino developers than learning a new language and IDE for NodeMCU.

For more information about how to write Arduino sketch for NodeMCU refer to Getting started with NodeMCU using Arduino IDE

The difference in using ESPlorer and Arduino IDE

Well, there is a programming language difference we can say while developing an application for NodeMCU using ESPlorer IDE and Arduino IDE.

We need to code in C\C++ programming language if we are using Arduino IDE for developing NodeMCU applications and Lua language if we are using ESPlorer IDE.

Basically, NodeMCU is Lua Interpreter, so it can understand Lua script easily. When we write Lua scripts for NodeMCU and send/upload it to NodeMCU, then they will get executes sequentially. It will not build a binary firmware file of code for NodeMCU to write. It will send Lua script as it is to NodeMCU to get executed.

In Arduino IDE when we write and compile code, the ESP8266 toolchain in the background creates a binary firmware file of code we wrote. And when we upload it to NodeMCU then it will flash all NodeMCU firmware with newly generated binary firmware code. In fact, it writes the complete firmware.

That's the reason why NodeMCU not accept further Lua scripts/code after it is getting flashed by Arduino IDE. After getting flashed by Arduino sketch/code it will be no more Lua interpreter and we got an error if we try to upload Lua scripts. To again start with Lua script, we need to flash it with NodeMCU firmware.

Since Arduino IDE compiles and upload/writes complete firmware, it takes more time than ESPlorer IDE.

NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna

- Small Sized module to fit smartly inside your IoT projects

TEMPERATURE SENSOR (LM35)

FEATURES DESCRIPTION

- Calibrated Directly in ° Celsius (Centigrade)
- Linear + 10 mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at +25°C) LM35 has an advantage over linear temperature
- Rated for Full −55°C to +150°C Range
- Suitable for Remote Applications
- Low Cost Due to Wafer-Level Trimming
- Less than 60-μA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Nonlinearity Only ±¼°C Typical
- Low Impedance Output, 0.1 Ω for 1 mA Load

DESCRIPTION

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus, the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C, over a full −55°C to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 draws only 60 μA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 is rated to operate over a −55°C to +150°C temperature range, while the LM35C is rated for a −40°C to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35Dis also available in an 8-lead surface-mount small outline package and a plastic TO-220 package.

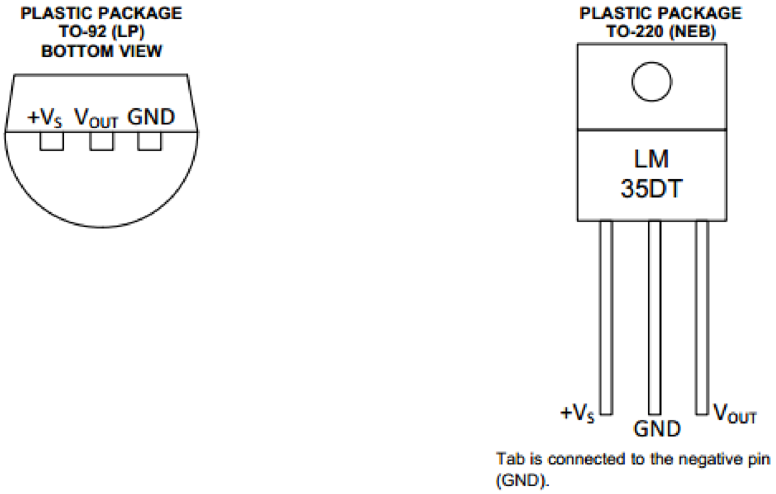

Fig3.4 - View of Temperature sensor

VIBRATION SENSORS

The piezoelectric sensor is used for flex, touch, vibration and shock measurement. Its basic principle, at the risk of oversimplification, is as follows: whenever a structure moves, it experiences acceleration. A piezoelectric shock sensor, in turn, can generate a charge when physically accelerated. This combination of properties is then used to modify response or reduce noise and vibration.

Why is that important? Because vibration and shock can shorten the life of any electronic and electromechanical system. Delicate leads and bond wires can be stressed, especially after exposure to long term vibration. Solder joints can break free and PCB traces can ever so slightly tear from impact and impulse shock, creating the hardest type of system failure to debug; an intermittent failure.

This article discusses piezoelectric shock and vibration sensors and sensor technology, focusing on available products (all parts mentioned here can be found on the Digi-Key website — links are provided), as well as design issues and design techniques.

How it works

The piezoelectric effect was discovered by Pierre and Jacques Curie in the latter part of the 19th century. They discovered that minerals such as tourmaline and quartz could transform mechanical energy into an electrical output. The voltage induced from pressure (Greek: piezo) is proportional to that applied pressure, and piezoelectric devices can be used to detect single-pressure events as well as repetitive events.

Still, the ability of certain crystals to exhibit electrical charges under mechanical loading was of no practical use until very-high-input impedance amplifiers enabled engineers to amplify the signals produced by these crystals. Several materials can be used to make piezoelectric sensors, including tourmaline, gallium phosphate, salts, and quartz. Most electronic applications use quartz since its growth technology is far along, thanks to development of the reverse application of the piezoelectric effect; the quartz oscillator.

Sensors based on the piezoelectric effect can operate from transverse, longitudinal, or shear forces, and are insensitive to electric fields and electromagnetic radiation. The response is also very linear over wide temperature ranges, making it an ideal sensor for rugged environments. For example, gallium phosphate and tourmaline sensors can have a working temperature range of 1,000°C. The physical design of the piezoelectric sensor depends on the type of sensor you wish to create. For example, the configuration of a pressure sensor, or a shock (impulse) sensor, would arrange a smaller, but well-known mass of the crystal in a transverse configuration, with the loading deformation along the longest tracks to a more massive base (Figure 1). This assures that the applied pressure will load the base from only one direction.

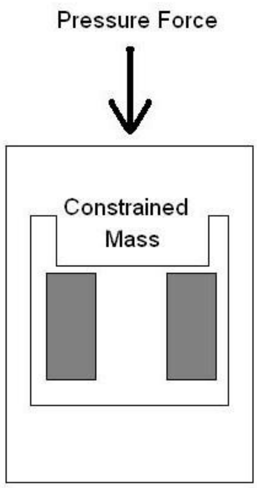

Fig 3.5: A constrained mass is allowed to deform the crystal sensor in one axis. This configuration is good for force and pressure.

An accelerometer based on the piezoelectric effect, would use a known mass to deform the sensing crystal part in either a positive or negative direction depending on the excitation force. It should be noted that you need a known modulus of elasticity in the sensor substrate.

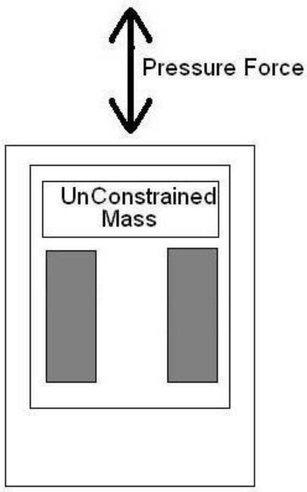

Fig 3.6: Because the modulus of elasticity is known for a substrate material, the unconstrained mass is allowed to move with vibration making this type of piezoelectric sensor ideal for detecting shock and vibration.

Designing with piezoelectric sensors

Piezoelectric sensors require some precautions when connecting to sensitive electronic components. First and foremost, the voltage levels created by hard shock can be very high, even around 100-V spikes.

More than likely, an op amp will be used to interface these sensors to an A/D converter, either discrete or on a microcontroller. One tip is to choose a high-input-impedance op amp to minimize current. One possible candidate is the Linear Technology JFET input dual op amp. It has 10^{12} Ω input resistance and a 1 MHz gain bandwidth product, good enough to easily handle the vibration ranges of piezoelectric sensors.

Another suitable part is the TLV2771 from Texas Instruments. This rail-to-rail low-power op-amp also has a 10^{12} Ω differential input resistance and a 5 MHz unity-gain bandwidth. Signal conditioning in a single stage can prepare the input from the shock sensor directly into an A/D converter.

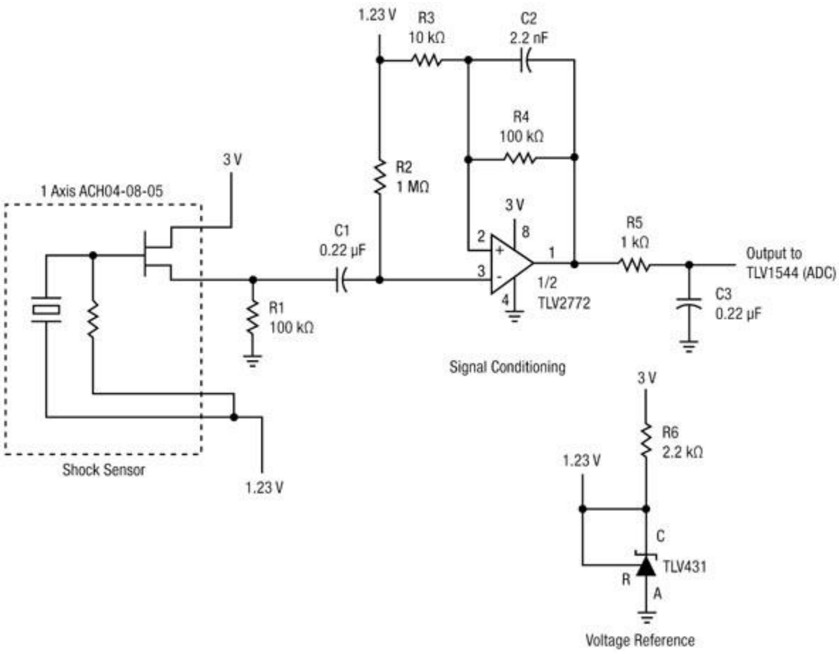

Fig 3.7: Op amps such as the TI TLV2772 feature high input impedances to help minimize current from the potentially high-voltage inputs from the piezoelectric sensors.

Op-amp circuits can be designed to operate in voltage mode or charge mode. Charge mode is used when the amplifier is remote to the sensor. Voltage mode is used when the amplifier is very close to the sensor.

Another tip is to attenuate the input signal and use the op amp’s gain to bring into the desired range. Be aware that you may need snubbing protection on the inputs of the op amp, especially if the design could be subjected to harsh hits.

Also note that you may think that a pressure sensor would generate only a positive voltage, but, in reality, the signal from the sensor can ring and introduce negative voltage spikes (Figure 4). This means that you may need to squelch negative voltage levels on the op-amp inputs, especially if using only a single rail power supply on the op amp.

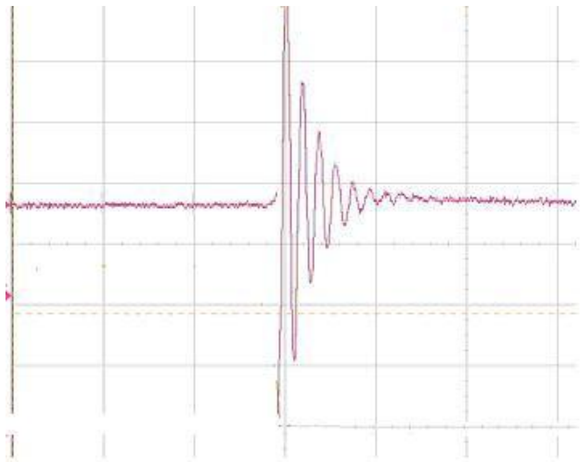

Fig 3.8: Care must be taken when using single rail op amps since shock can cause negative voltage spike ringing that can damage op-amp inputs if not squelched.

Parts for the design

Many off the shelf piezoelectric sensors are readily available to use in your designs. A case in point is the Parallax 605-00004, which is a piezo vibra tab sensor capable of acting as a switch, or as a vibration sensor. A polymer film laminate uses crimped contacts and features a sensitivity of 50 mV/g.

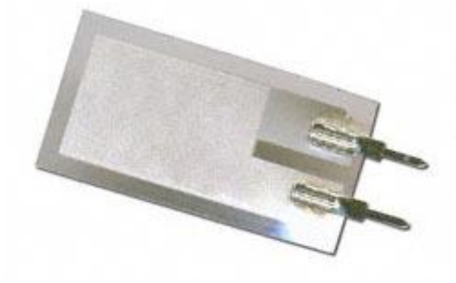

Fig 3.9: The flexible through-hole LDTO polymer film piezoelectric sensors can be hard mounted or free floating to detect strain, shock, or vibration.

You should be aware that adding mass to a piezoelectric sensor can change its resonant frequency as well as change its baseline sensitivity. Many piezoelectric sensors like the 605-00004 are characterized to be used this way and provide supporting tables and graphs (Figure 6).

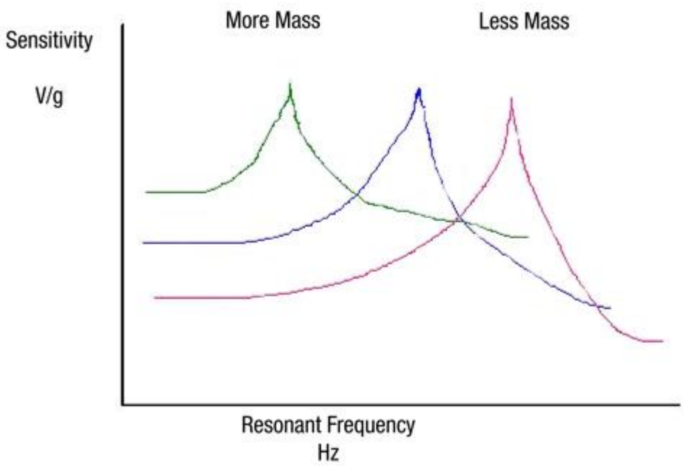

Fig 3.10: Loading a sensor with mass changes its resonant frequency and sensitivity in a predictable and repeatable way.

Another part worth considering is the Measurement Specialties 0-1002794-0 cantilever piezo film sensor. This is also a vibra tab sensor capable of hard mounting to a surface, floating in an axis of inertia, or mass loaded to prebias and calibrate. The output voltage swings can directly trip a FET or CMOS input, and a response can be obtained by offsetting the mass centre.

Other uses

In addition to sensing vibration and shock, a piezoelectric device can also be used to extract ambient energy. Take for example the MideV22BL, which is a hermetically sealed piezoelectric sensor capable of sensing from 26 to 100 Hz vibrations. It can be evaluated using the company's VR001 data logger, which is a portable rechargeable data logger that can measure acceleration and vibration in three axes (Figure 7). As a USB peripheral, it can be configured and have its data transferred to a PC or other USB host device. It can also be used to help you develop your own designs based on the piezoelectric sensors you choose. A Mide training module is available on the Digi-Key website to help bring you up to speed quickly when starting a new design.

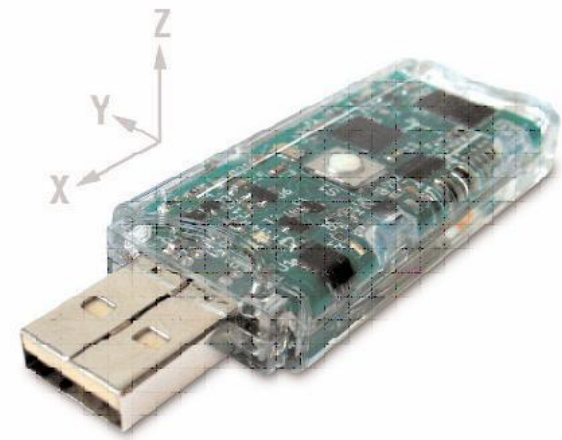

Fig 3.11: The USB plug in three-axis sensor can be used as a development tool and evaluation tool when learning or starting a new design.

Finally, before you select a piezoelectric sensor for shock or vibration duty, evaluate the criteria specific to your intended application (we've provided some examples here), then, spend some time with the manufacturer data sheets and use the links above to get further information from the product and technology pages on the Digi-Key website.

Touch Sensor

The human body has five sense elements which are used to interact with our surroundings. Machines also need some sensing elements to interact with their surroundings. To make this possible sensor was invented. The invention of the first manmade sensor, thermostat, dates back to 1883. In 1940s infrared sensors were introduced. Today we have sensors that can sense motion, light, humidity, temperature, smoke, etc…Analog and digital both types of sensors are available today. Sensors have brought a revolutionary change in the size and cost of various control systems. One of such sensors which can detect touch is the Touch sensor

Touch Sensors are the electronic sensors that can detect touch. They operate as a switch when touched. These sensors are used in lamps, touch screens of the mobile, etc… Touch sensors offer an intuitive user interface.

Touch sensors are also known as Tactile sensors. These are simple to design, low cost and are produced in large scale. With the advance in technology, these sensors are rapidly replacing the mechanical switches. Based on their functions there are two types of touch sensors- Capacitive sensor and Resistive sensor

Capacitive sensors work by measuring capacitance and are seen in portable devices. These are durable, robust and attractive with low cost. Resistive sensors don't depend on any electrical properties for operation. These sensors work by measuring the pressure applied to their surface.

Touch sensors work similar to a switch. When they are subjected to touch, pressure or force they get activated and acts as a closed switch. When the pressure or contact is removed, they act as an open switch.

Capacitive touch sensor contains two parallel conductors with an insulator between them. These conductors' plates act as a capacitor with a capacitance value C0.
When these conductor plates come in contact with our fingers, our finger acts as a conductive object. Due to this, there will be an uncertain increase in the capacitance.

A capacitance measuring circuit continuously measures the capacitance C0 of the sensor. When this circuit detects a change in capacitance it generates a signal.

The resistive touch sensors calculate the pressure applied on the surface to sense the touch. These sensors contain two conductive films coated with indium tin oxide, which is a good conductor of electricity, separated by a very small distance.

Across the surface of the films, a constant voltage is applied. When pressure is applied to the top film, it touches the bottom film. This generates a voltage drop which is detected by a controller circuit and signal is generated thereby detecting the touch.

The piezoelectric sensor is used for flex, touch, vibration and shock measurement. Its basic principle, at the risk of oversimplification, is as follows: whenever a structure moves, it experiences acceleration.

A piezoelectric shock sensor, in turn, can generate a charge when physically accelerated. This combination of properties is then used to modify response or reduce noise and vibration.

Several materials can be used to make piezoelectric sensors, including tourmaline, gallium phosphate, salts, and quartz. Most electronic applications use quartz since its growth technology is far along, thanks to development of the reverse application of the piezoelectric effect; the quartz oscillator.

Sensitivity: Height adjustable

Consistency and Interchangeability: Good

Reliability and Interference: Accurate triggering strong anti-interference

Automatic Reset: Automatic reset is strong

Signal Post-processing: Simple

Output Signal: Switch signal

No External Vibration Analysis of Plates: Product design vibration analysis of the internal amplifier circuit

Detection Direction: Omni-directional

Signal Output: Switch signals

Output Pulse Width: The vibration signal amplitude is proportional to

Operating Voltage: 12VDC (red V + shield V-)

Sensitivity: Greater than or equal 0.2g

Frequency Range: 0.5HZ ~ 20HZ

Operating Temperature Range: -10 ~ 50 degree Celsius

Applications

Capacitor sensors are easily available and are of very low cost. These sensors are highly used in mobile phones, iPods, automotive, small home appliances, etc.… These are also used for measuring pressure, distance, etc.… A drawback of these sensors is that they can give a false alarm.

Resistive touch sensors only work when sufficient pressure is applied. Hence, these sensors are not useful for detecting small contact or pressure. These are used in applications such as musical instruments, keypads, touch-pads, etc... where a large amount of pressure is applied.

Crash sensors: Crash sensors need to detect a collision and convert it to usable signals within milliseconds. The accelerating forces acting on the sensors after a collision can be as high as 100g (100 times the earth's gravitational force). When a car is stopped abruptly by an impact, all bodies or objects that are not firmly fixed to the car will continue to move at the impact speed. The sensors measure this acceleration and relay it to the control unit as usable data.

Many of our cars are fitted with ultra-fast pressure sensors in the front doors. These sensors detect a side collision that pushes the outer door panel inwards, creating excess pressure. Acceleration sensors are also fitted near the C-pillars so that collisions from the side, which don't cause deformation of the front doors, can also be detected in time.

These small pieces of electronics are designed to tell when the vehicle has been damaged in an accident. They respond to several different sets of stimuli, including sudden stopping, increased pressure as pieces of the car is moved due to the force of the collision, and more.

Different types of sensors measuring wheel speed, seat occupant status, brake pressure and impact, and other vehicle status indicators are monitored by the airbag control unit located in the front portion of the cabin. The sensors relay signals to the airbag control unit, which analyzes the data and can orchestrate safety features like seat belt lock, automatic door locks, as well as airbag deployment.

Two types of airbag sensors used in cars are electrical and mechanical. Electrical sensors vary in design. Some use an electromechanical "ball and tube" mechanism, which basically consists of a small tube containing a circuit switch and ball that's held together by a small magnet. If a collision occurs, the ball is dislodged from the magnet and rolls forward in the tube, hitting a switch that completes the electrical circuit. Other electrical designs are similar in principle, using a metal roller or spring-loaded weight instead of a ball, or in newer cars, an accelerometer to trip the sensor. Mechanical sensors work independent of the electrical system and respond similarly to the electrical sensors, with a design that actuates a firing pin triggering a small explosion after a crash. Since a mechanical sensor does not require a power source, it cannot be deactivated like an electrical sensor can when the battery is disconnected.

The success of the airbag system relies upon the crash sensors working not only accurately but also extremely quickly, so the most expensive and technologically advanced part of the airbag system are here.

Alcohol Sensor

If the person inside car has consumed alcohol, then it is detected by the Alcohol sensor. In this project the MQ3 alcohol sensor is used. The MQ3 alcohol sensor is one of a series of easy-to-use gas sensors that can be directly connected to an ARDUINO. This sensor can be used to measure the percentage of alcohol content in a person by measuring the amount of alcohol is on their breath. MQ3 gas sensor has highly sensitive to alcohol and has good resistance to disturb of gasoline, smoke. The sensor would be used to detect alcohol with a different concentration; it is with a low cost and suitable for different application.

Gas sensor

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial. Gas sensors are very important part of such systems. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state.

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. What is this sensing element? Is it kept in some chamber or is kept exposed? How does it get current and how it is taken out? Let’s find out in this Insight!!!

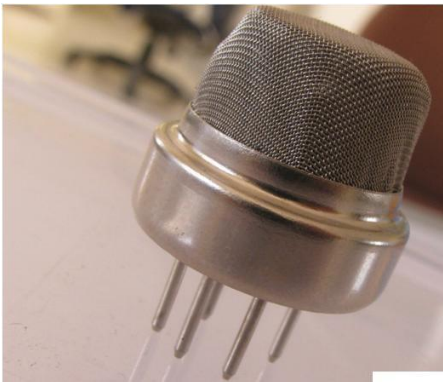

Fig 3.12 – Gas Sensor

The gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

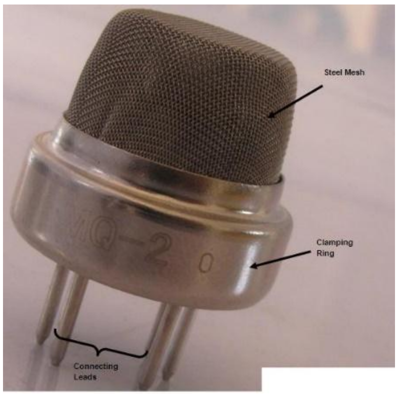

Fig 3.13 – MQ-2 Gas Sensor

Image shows externals of a standard gas sensor module: a steel mesh, copper clamping ring and connecting leads. The top part is a stainless-steel mesh which takes care of the following:

- ✓ Protecting the insides of the sensor.
- ✓ Exhibits an anti-explosion network that keeps the sensor module intact at high temperatures and gas pressures.

In order to manage above listed functions efficiently, the steel mesh is made into two layers. The mesh is bound to rest of the body via a copper plated clamping ring.

The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them. Four of the six leads (A, B, C, D) are for signal fetching while two (1, 2) are used to provide sufficient heat to the sensing element.

The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor. The top of the gas sensor is removed off to see the internals parts of the sensor: sensing element and connection wiring. The hexapod structure is constituted by the sensing element and six connecting legs that extend beyond the Bakelite base.

Image shows the hollow sensing element which is made up from Aluminium Oxide based ceramic and has a coating of tin oxide. Using a ceramic substrate increases the heating efficiency and tin oxide, being sensitive towards adsorbing desired gas' components (in this case methane and its products) suffices as sensing coating.

The leads responsible for heating the sensing element are connected through Nickel-Chromium, well known conductive alloy. Leads responsible for output signals are connected using platinum wires which convey small changes in the current that passes through the sensing element. The platinum wires are connected to the body of the sensing element while Nickel-Chromium wires pass through its hollow structure. While other wires are attached to the outer body of the element, Nickel-Chromium wires are placed inside the element in a spring shaped. Image shows coiled part of the wire which is placed on the inside of the hollow ceramic.

Image shows the ceramic with tin dioxide on the top coating that has good adsorbing property. Any gas to be monitored has specific temperature at which it ionizes. The task of the sensor is to work at the desired temperature so that gas molecules get ionized. Through Nickel-chromium wire, the ceramic region of the sensing element is subjected to heating current. The heat is radiated by the element in the nearby region where gases interact with it and get ionized. Once, ionized, they are absorbed by the tin dioxide. Adsorbed molecules change the resistance of the tin dioxide layer. This changes the current flowing through the sensing element and is conveyed through the output leads to the unit that controls the working of the gas sensor.

IOT

The structure of this chapter is the following: Section 1.1 defines the motivation for this work. Section 1.2 shows the research objectives and questions. Section 1.3 presents the steps required to achieve our objectives. Section 1.4 shows the structure of the report.

- **Background**

The Future Internet goal is to provide an infrastructure to have an immediate access to information about the physical world and its objects. Physical objects can be applicable to different application domains, such as e-health, warehouse management, etc. Each application domain may have different types of physical devices. Each physical device can have its own specifications, which is required to use in order to interact with it. To achieve the future Internet goal, a layered vision is required that can facilitate data access. Internet of Things (IoT) is a vision that aims to integrate the virtual world of information to the real world of devices through a layered architecture.

The term „Internet of Things" consists of two words, namely *Internet* and *Things*. *Internet* refers to the global network infrastructure with scalable, configurable capabilities based on interoperable and standard communication protocols. *Things* are physical objects or devices, or virtual objects, devices or information, which have identities, physical attributes and virtual personalities, and use intelligent interfaces. For instance, a virtual object can represent an abstract unit of sensor nodes that contains metadata to identify and discover its corresponding sensor nodes. Therefore, IoT refers to the *things* that can provide information from the physical environment through the Internet.

Middleware is as an interface between the hardware layer and the application layer, which is responsible for interacting with devices and information management. The role of a middleware is to present a unified programming model to interact with devices. A middleware is in charge of masking the heterogeneity and distribution problems that we face when interacting with devices.

- **Motivation**

IoT-based system is in charge of providing knowledge from an environment to a non-expert user. IoT-based system can be used in different environments, so it needs to be able to address many heterogeneous devices. Thus, a major concern within developing an IoT-based system is how to handle the interaction with the heterogeneous devices for non-expert users. This concern can be addressed by a middleware layer between devices and non-expert users. This layer is responsible to hide the diversity of devices from the user perspective, and provides access transparency to the devices for the end users.

The idea of creating abstractions of devices been addressed in the literature. The middleware we found in the literature can provide satisfaction by facilitating the interaction with devices, but they do not support low-level device configuration.

- **IoT definition**

In this section, we explain some of the IoT definitions. Also, we explain the layered architecture for IoT.

Internet of Things (IoT) has increasingly gained attention in industry to interact with different types of devices. IoT can have influence on industry and society by integrating physical devices into information networks. IoT impacts can be on different perspectives, namely for private and business users. From the perspective of a private user, IoT has effect on both working and personal fields, such as smart homes and offices, e-health and assisted living. From the aspect of a business user the impacts would be in fields such as automation and industrial manufacturing, logistics, business process management, intelligent transportation of people and goods.

IoT integrates physical things into information networks. IoT covers the overall infrastructure, including software, hardware and services, which is used to support these information networks. The integrated physical things can exchange data about the physical properties and information that they sense in their environment. To identify devices, we can use identification technologies like for example RFID, which allow each device be uniquely identified.

International Telecommunication Union (ITU)[1] defines IoT as "*A global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies*"

IoT has a layered architecture designed to answer the demands of various industries, enterprises and society. Fig. 2.1 shows a generic layered architecture for IoT that consist of five layers, which are discussed, in the following:

- Edge Technology layer

  This is a hardware layer that consists of embedded systems, RFID tags, sensor networks and all of the other sensors in different forms. This hardware layer can perform several functions, such as collecting information from a system or an environment, processing information and supporting communication.

- Access Gateway layer

  This layer is concerned with data handling, and is responsible for publishing and subscribing the services that are provided by the *Things*, message routing, and hovelling the communication between platforms.

- Middleware layer

  This layer has some critical functionalities, such as aggregating and filtering the received data from the hardware devices, performing information discovery and providing access control to the devices for applications.

- Application layer

  This layer is responsible for delivering various application services. These services are provided through the middleware layer to different applications and users in IoT-based systems. The application services can be used in different industries such as, logistics, retail, healthcare, etc.

CHAPTER 4

SOFTWARE DESIGN

4.1 ARDUINO SOFTWARE:

ARDUINO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g., Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Why Arduino?

Arduino simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50.

Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and

Linux operating systems. Most microcontroller systems are limited to Windows.

Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino

Open source and extensible software- The Arduino software and is published as open-source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based.

CHAPTER 5

RESULT AND DISCUSSION

- When vehicle battery turn-on all the sensors continue to work. When vehicle ignition turned on registered mail address.
- gas and crash sensors send readings to the mobile device with If the threshold amount of gas is exceeded which means the driver or other toxic gas is pumped into the vehicle.
- Switch off the power engine and take an image, then send it to the mail, submit it to SMS with position coordinates gas sensor reading.

CONCLUSION

Setting up a postal contact and creating a black box to transfer data and pictures using the Internet of Things and using a webcam to figure out who took the vehicle by getting their snapshot while taking vehicle and data to find the vehicle if the vehicle is stolen using GPS coordinates. When the crash has happened, give the details of the sensor with the coordinates to the ambulance squad to save their lives. Additionally, the key system to provide coordinates with the position and speed of the vehicle in a smartphone device.

SCREENSHOT OF THE PROJECT

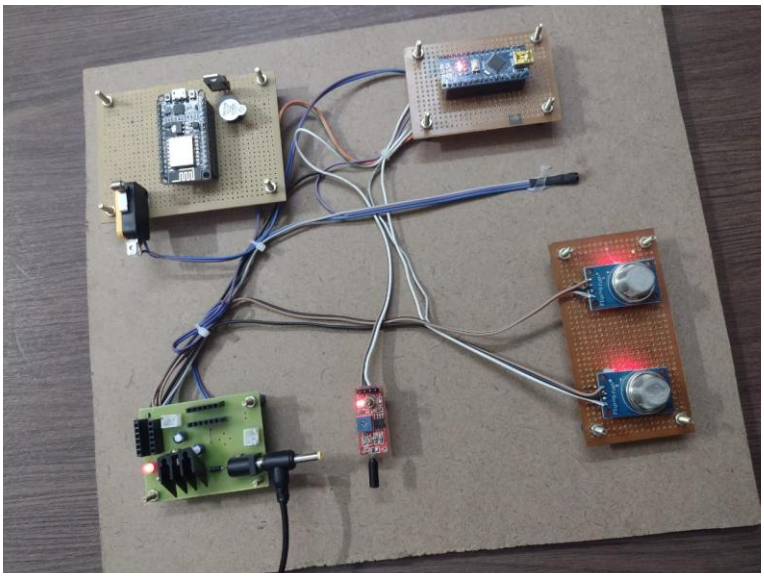

Fig 5.1 – Project hardware setup


```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(14, 12);
#include "Ubidots.h"
const char* UBIDOTS_TOKEN = "BBFF-PeF63PifCqxngR7d0uLgLoA74k1r78";  // Put here your Ubidots TOKEN
const char* WIFI_SSID = "blackbox";      // Put here your Wi-Fi SSID
const char* WIFI_PASS = "12345678";      // Put here your Wi-Fi password

Ubidots ubidots(UBIDOTS_TOKEN, UBI_HTTP);

int firstVal, secondVal, thirdVal, fourthVal,fifthVal;
int j=0;
int b=0;
void setup() {
  Serial.begin(9600);
  mySerial.begin(9600);
  ubidots.wifiConnect(WIFI_SSID, WIFI_PASS);
  pinMode(D0,OUTPUT);
  digitalWrite(D0,LOW);
  delay(250);
  digitalWrite(D0,HIGH);
  delay(250);
```

Fig 5.2 – Project Code

Fig 5.3 – Output in Ubidots

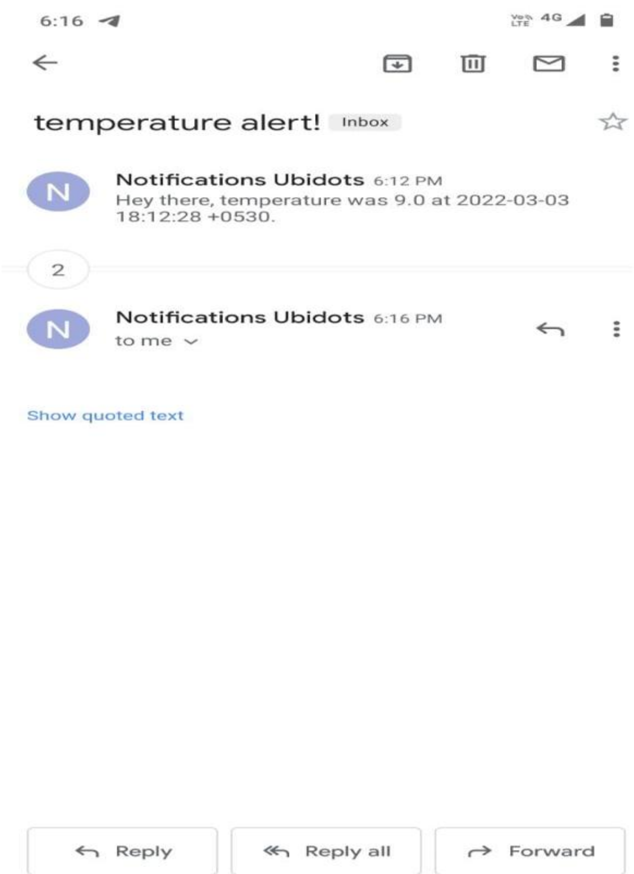

Fig 5.4 – Email Notification

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