IOT BASED ACCIDENT DETECTION SYSTEM FOR SMART VECHICLES

Submitted in partial fulfillment of the requirements for the award of Bachelor of

Engineering degree in Electronics and Communication Engineering

By

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INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC|12B Status by UGC | Approved by AICTE

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MADALA SAI TEJA (38130116), VUNDAMODUGULA RAHUL (38130242)** who have done the project work as a team who carried out the project entitled **"IOT Based Accident Detection System for Smart Vehicles"** under mu supervision from September 2021 to April 2022.

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Submitted for Viva voce Examination held on_____________________

Internal Examiner **External Examiner**

DECLARATION

We **MADALA SAI TEJA (38130116), VUNDAMODUGULA RAHUL (38130242)** hereby declare that the Project Report entitled "**IOT Based Accident Detection System for Smart Vehicles"** done by us under the guidance of **Mr. V Kalist M.E** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE: 05/05/2022

PLACE: Chennai

SIGNATURE OF THE CANDIDATES

1. Madala Sai Teja
2. Vundamodugula Rahul

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ABSTRACT

The Internet of Things (IoT) offers limitless possibilities to both the public and private sectors. Automobile manufacturers are interested in IoT applications to increase the safety of their vehicles, to meet customers' demands and ultimately to offer cutting-edge products which maximize profit. The healthcare industry is concerned with how the IoT can improve the speed and accuracy of communication. This paper describes the feasibility of equipping a vehicle with technology that can detect an accident and immediately alert emergency personnel. When there is a car accident someone has to actively seek help such as calling 911 for emergency services. There is no automatic notification to the police, ambulance, friends, or family. The Internet of Things (IoT) can be used to produce an automatic notification and response to the scene.

Our project will provide an optimum solution to this drawback. According to this project, when a vehicle meets with an accident immediately Vibration sensor will detect the signal or if a car rolls over, the vibration sensor will detect the signal and send it to the Nodemcu controller.

Alcohol detection eye blinks monitoring is performed by the Nodemcu Microcontroller and sends it alert mail through the IOT including the location to police control room or a rescue team. So the police can immediately then after confirming the location necessary action will be taken.If the person meets with a small accident or if there is no serious threat to anyone's life, then the alert message can be terminated by the driver by a switch provided in order to avoid wasting the valuable time of the medical rescue team. This paper is useful in detecting the accident precisely by means for both vibration sensor and Alcohol detection content and eye blinding

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LIST OF ABBREVIATIONS

List Of Abbreviations

BLE	BLUETOOTH LOW ENERGY
LI-FI	LIGHT-FIDELITY
NFC	NEAR-FIELD COMMUNICATION
RFID	RADIO FREQUENCY IDENTIFICATION
VSAT	VERY SMALL APERTURE TERMINAL
PLC	POWER LINE COMMUNICATION

CHAPTER 1

INTRODUCTION

In this project, we are going to build an IoT based accident detection system with the help of NodeMCU ESP8266 Module and a Vibration Sensor which will detect the accident and send an Emergency Email to the registered Email address using unbidots cloud.Nowadays, there is an increase in the number of accidents that happen in the world. As the population is increasing, there is the number of cars increasing on the road that contributes to severe accidents that happen daily. Around 80 per cent of accidents contribute to the loss of many lives. Mostly, the growing countries are being targeted by the day to day road accidents. The major reason is the lack of infrastructure, lack of traffic control and accident management. Out of all the developing countries, India has been listed as the country with a higher number of accidents. The most prominent reason for the loss of a life during an accident is the unavailability of immediate help that can save a person's life by a few seconds. The moment an accident has occurred, the life of all passengers travelling in the vehicle is at stake. It all depends on response time that can save their lives by a few minutes or seconds. According to the statistics, reducing accident delay time by even 1 minute can save 6 per cent of lives. Hence, this response time is very crucial, and it needs to be reduced or at least either improved to save their lives.

To contribute to our society and reduce the number of accidents happening in our day to day life, there are several techniques and mechanisms that can drop down the rate of accidents and can save lot lives. Living in a tech world that is growing day by day with new technologies, we can apply these techniques in our society and help them overcome such problems. The Vision of the Internet of Things (IoT) has come out to reach unexpected bounds of today's computing world. It is a concept that not only can impact human's life but also how they function.In present days the rate of accidents can be increased rapidly. Due to employment the usage of vehicles like cars, bikes can be increased, because of this reason the accidents can be happened due to over speed. People are going under risk because of their over speed, due to unavailability of advanced techniques, the rate of accidents can't be decreased. To reduce the accident rate in the country this paper introduces a optimum solution. Automatic alert system for vehicle accidents is introduced; the main objective is to control the accidents by sending a message to the registered mobile using wireless communications techniques. When an accident occurs at a city, the message is sent to the registered mobile through ubidots cloud module in less time. Nodemcu is the heart of the system which helps in transferring the message to different devices in the system. Vibration sensor will be activated when the accident occurs and the information is transferred to the registered number through ubidots cloud module. GPS system will help in finding the location of the accident spot. The proposed system will check whether an accident has occurred and notifies to nearest medical centers and registered mobile numbers about the place of accident using GSM and GPS modules. The location can be sent through tracking system to cover the geographical coordinates over the area. The accident can be detected by a vibration sensor which is used as major module in the system.

1.1 Existed System

When a car meets with an accident, immediately the car’s number and the GPS coordinates of the location are messaged to the nearby hospitals, thereby ensuring timely help to the needy.

▪ When the car is tried to crank, a text message is sent to the owner thereby intimating the status of the car. While during a long drive, if the car’s engine goes faulty. The error signals from the dashboard of the car and the GPS coordinates are captured and sent to the near-by service center, thereby saving time. Here the GSM is used to send the text message and the GPS is used to track the exact coordinates of the car.

▪ The serial communication interface UART is used for the communication between the Microcontroller (PIC16F877A), GSM and GPS module. The RS232 communication standard is used for the following purposes. Electrical signal characteristics such as voltage levels, signaling rate, timing and slew rate of signals, voltage withstand level, short-circuit behavior.

Disadvantages:

- Cannot be heard in buildings
- Cannot identify exact accident locations during accidents
- Communication speed is very less
- We can’t locate the vehicle

1.2 Proposed system:

▪ In our country, many people have lost their lives by accidents, because of casualties or improper communication. So, an automatic vehicle accident and theft detection system are implemented. Also, it is used in theft detection. To minimize deaths and to treat people with high injury due to accidents, immediate action would be taken by rescue teams.

The project is built around the NODEMCU. This micro controller provides all the functionality of the mail alert system.

The vibration sensor, Eye blink sensor, alcohol detection sensor transmitting the information to the mail.

Advantages:

- A quick medical support for the accident victims in the given.
- Exact coordinates can be identified during accidents.
- Drunk and Drive will be avoided and also we can monitor the heart beat level of the driver.

CHAPTER 2

LITERATURE SURVEY

Title 1: Electric Vehicle Intelligent Control System-Hardware modules configurations

Author: Gan Yu Han; Leong Chee Ken; Chew Kuew Wai Content:

The Electric Vehicle Intelligent Control System(EVICS) project where the EVICS is a 2-in-1 system for an Electric Vehicle(EV) which consists of a Monitoring System for the front seat driver and Infotainment System for the rear seat passengers. The Monitoring system consists of battery voltage, current and temperature monitoring modules, battery energy status(%), distance left(km), km/h and rpm meter, offline and online Global Positioning System(GPS) and Contour Positioning System(CPS).

Title 2: An intelligent automotive climate control system

Author: K.C. Wei; G.A. Dage Content:

An intelligent automotive climate control system based on human-sensory response is developed and described in this paper. The system uses the skin temperature of the vehicle occupant, measured by a passive remote infrared sensor, and an intelligent controller to improve the perceived thermal comfort of the occupant. Thermal comfort is characterized in terms of a set of comfortable skin temperatures for different climate conditions. The controller monitors and regulates the skin temperature and air temperature to maintain the desired thermal comfort level. The new system not only increases the robustness of the controller, but also renders a structure for a fully automatic (with minimal human intervention) climate control system.

Title 3: Smart temperature-controlled infant car seat using thermoelectric devices

Author: Roshni Senthil Kumar, Mohamed Al Musleh Content:

The thermal comfort for children and adults inside the car is a crucial issue to improve as the hot environmental conditions can be irritable and uncomfortable. Being inside an extremely hot car for a prolonged time can lead to major health problems. This paper focuses on the thermal comfort of infants. Traditionally air conditioning systems are used to cool down an infant car seat which is not effective due to the portability and cooling duration. In this paper, heat relief for the child is researched using a thermoelectric cooling system. This paper reviews various factors concerning the development of a temperature controlled infant car seat. This study focuses on the health and safety of children inside the cars, the subjective needs of the parent, heat management in the car cabin environment, thermoelectric modeling, and the methods for precise temperature control for effective thermoelectric cooling

Title 4: IoT based Smart Vehicle Ignition and Monitoring System Author: Fathima Jabeen; Sudhir Rao Rupanagudi; Varsha G Bhat Content:

With the advancements in technology, several smart innovations are being introduced by automobile manufacturers across the world to enhance their product portfolio. These can vary from implementing simple solutions such as navigation systems, to more complex ones such as driver assistance systems, which in turn could monitor multiple parameters of the vehicle in order to assist the driver. This paper focuses on one such driver assistance solution which not only intimates the driver on the well-being of his or her car but also adds additional layers of security to prevent vehicular theft. Keeping in mind driver safety, the paper also proposes an idea to prevent the vehicle from starting in case of alcohol consumption by the driver and also incorporates an emergency alert system in case of accidents

Chapter 3

Aim and Scope of the Project

3.1 Aim:

- The main aim of our system is to detect the accident and send alerts to parents as well as hospital management.
- The proposed system uses the IOT for vehicle accident detection and alarming the authorities regarding accidents, vehicle tracking using GPS Modem.

3.2 Scope:

- The system is useful in developing accident prevention and vehicle theft prevention using the features of message, alert and location. It enhances the safety and security.
- The hardware can be further improved using an alcohol sensor, where most of the accidents are occurring due to intoxication. This can be implemented by placing an alcohol sensor to detect the alcohol by giving a certain limit value of the alcohol.
- This system can also have an eye blink sensor which prevents the individual who meets with an accident due to drowsiness. It can be overcome by placing eye blink sensors as required for the individual.

3.3 Objective:

In our country, many people have lost their lives by accidents because of casualties or improper communication. So, an automatic vehicle accident and theft detection system are implemented. Also, it is used in theft detection. To minimize deaths and to treat people with high injury due to accidents, immediate action would be taken by the rescue teams.

The project is built around the NodeMCU. The microcontroller provides all the functionality of the mail alert system. The vibration sensor, I blink sensor, alcohol sensor, ultrasonic sensor transmitting information to the mail.

3.4 Problem Statement:

In India 1lakh cases of vehicle theft on average are reported each year and the number is still increasing. If the vehicles that have been stolen are not recovered early they are mostly sold and in some cases it is burned if the resale value is low. In this project we proposed a design and implementation of vehicle tracking anti-theft system using IOT that will protect the secured vehicles.

Chapter 4

Methodology

4.1 INTRODUCTION

In this chapter, the procedure for the design and development of the vehicle theft accident using IOT is explained. The block diagram of the system is shown. The schematic of the microcontroller hardware circuit is shown in the diagram. The hardware and software description of the data acquisition is described below.

4.2 HARDWARE REQUIRED

* NodeMCU

* Ultrasonic sensor

* Vibration sensor

* Alcohol sensor

* Eye blink sensor

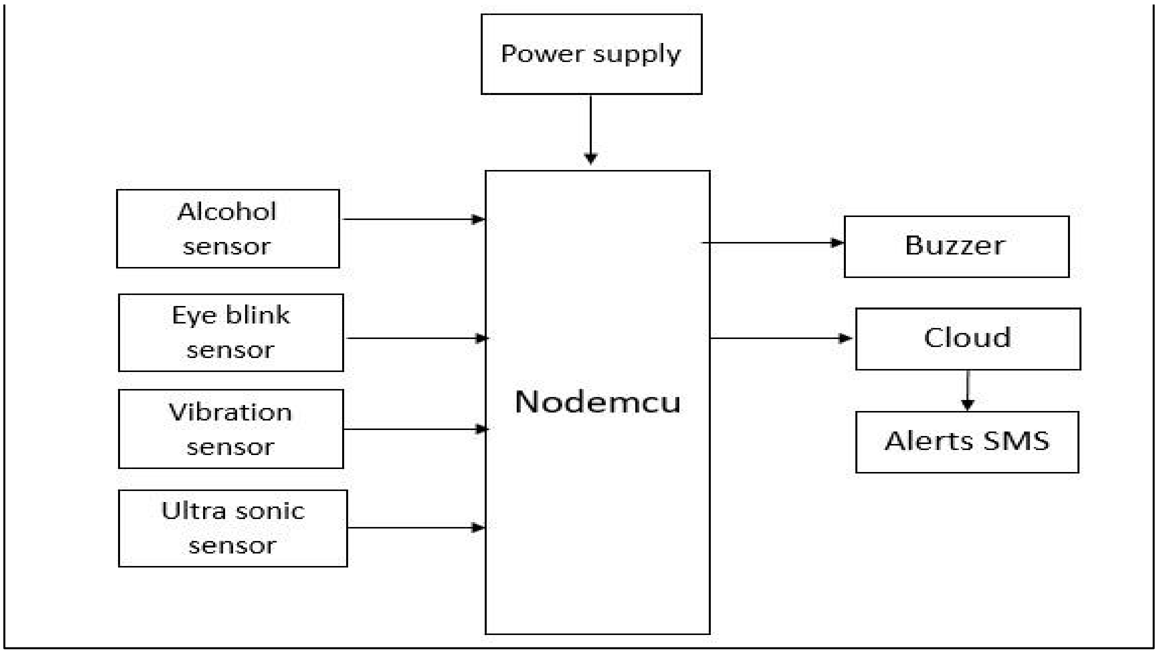


Fig:4.1 block diagram of smart vechicle

4.2.1 NODEMCU

Nodemcu is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espress if Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems[6] began production of the ESP8266.[10] The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core,[*citation needed*] widely used in IoT applications (see related projects). NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub.[11] 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.[12]Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform,[13] 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[14] to NodeMCU project,[15] enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In summer 2015 the creators abandoned the firmware project and a group of independent contributors took over. By summer 2016 the NodeMCU included more than 40 different modules. Due to resource constraints users need to select the modules relevant for their project and build a firmware tailored to their needs.

s 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 WiFi SoC, popularly called the "ESP8266 Core for the Arduino IDE".[16] This has become a leading software development platform for the various ESP8266-based modules and development boards, including NodeMCUs.

IoT platform node MCU is open source . Language used in it is lua scripting language. It is based on the eLua project, and built on the ESP8266 SDK 0.9.5. It uses many open source projects, such as lua-cjson, and spiffs. It includes firmware which runs on the ESP8266 Wi-Fi SoC, and hardware which is based on the ESP-12 module. NodeMCU was created shortly after the ESP8266 came out. In December 30, 2013, Espressif systems began production of the ESP8266.The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications. NodeMCU started in 13 Oct 2014, when Hong committed the first file of NodeMCU - firmware to GitHub. 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 1.0. Later that month, Tuan PM ported MQTT client library from Contiki to theESP8266 SoC platform, and committed to Node MCU project, then Node MCU was able to support the MQTT IoT protocol, using Lua to access 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 to NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

The main objective of this project is to develop a home automation system using an Node MCU board with Internet being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones.

In order to achieve this, a relay module is interfaced to the Node MCU board at the receiver end while on the transmitter end, a GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected. By touching the specified location on the GUI, the loads can be turned ON/OFF remotely through this technology. The loads are operated by IOT board through Relay Module.

NODEMCU (esp8266) has been selected as the controller for this system due to its compact size, compatibility, easy interfacing over several other type of controller including Programmable Integrated Circuit (PIC), Programmable Logic Controller (PLC) and others. ESP8266 is an open source firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment, which is a very simple and fast scripting language The ESP8266 chip incorporates on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board..Figure-4.2.1 shows the diagram of NODEMCU (ESP8266).It has Processor called L106 32bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106Micro running at 80 MHz and has a memory of 32 Kbit instruction RAM ,32 Kbit instruction cache RAM, 80 Kbit user data RAM&16 KbitETS system data RAM. It has inbuilt Wi-Fi module of IEEE 802.11 b/g/n Wi-Fi.

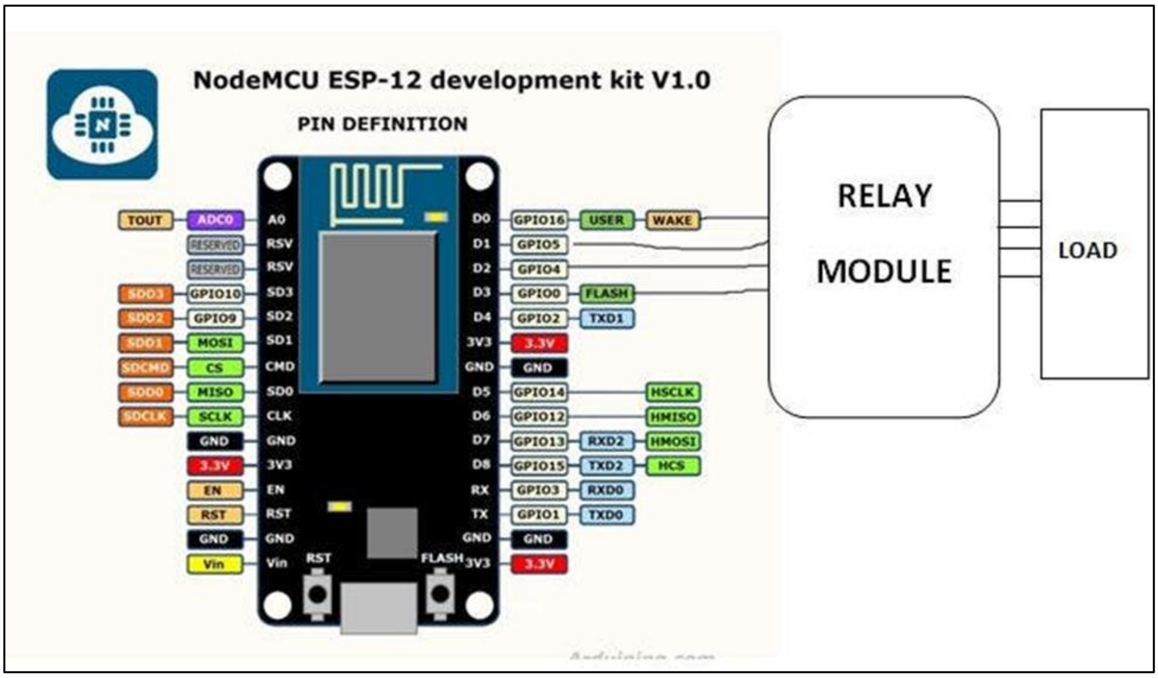


Figure :4.2 NodeMcu

CIRCUIT DIAGRAM DESCRIPTION

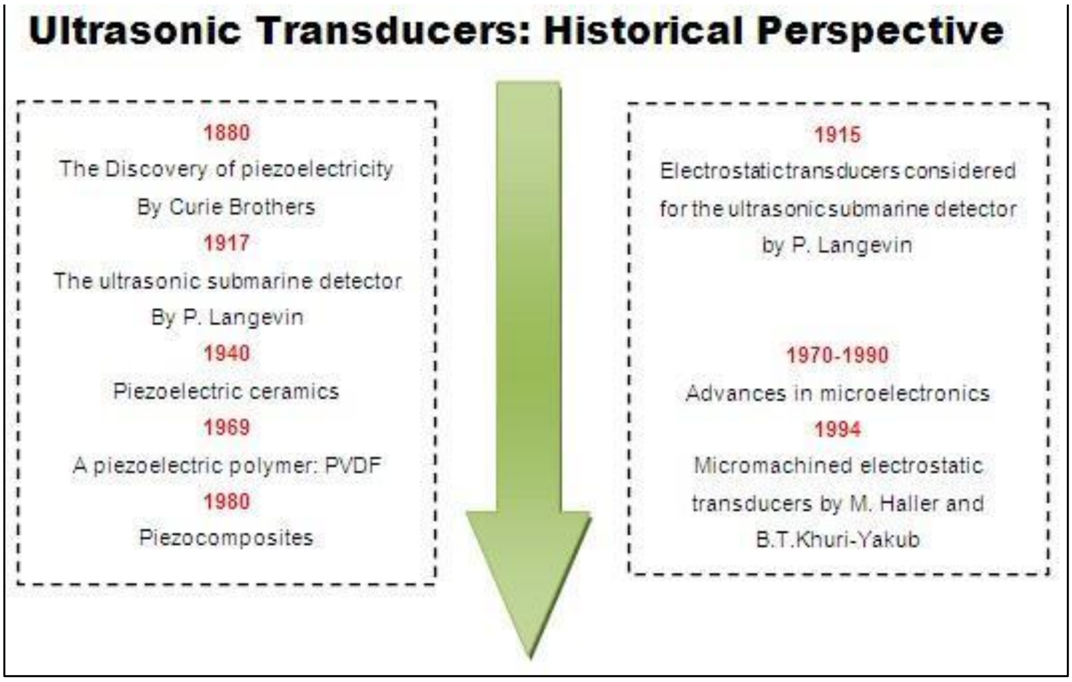
The operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, Then filtering to a DC level, and finally, regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator Unit, which takes a DC voltage and provides a somewhat lower DC voltage, Which remains the same even if the input DC voltage varies, or the output Load connected to the DC voltage changes

4.2.2 ULTRASONIC SENSOR:

Ultrasonic (UV) Sensors or Ultrasound Sensors

Bats are wonderful creatures. Blind from the eyes and yet a vision so precise that could distinguish between a moth and a broken leaf even when flying at full speed. No doubt the vision is sharper than ours and is much beyond human capabilities of seeing, but is certainly not beyond our understanding. **Ultrasonic ranging** is the technique used by bats and many other creatures of the animal kingdom for navigational purposes. In a bid to imitate the ways of nature to obtain an edge over everything, we humans have not only understood it but have successfully imitated some of these manifestations and harnessed their potential to the greatest extent.

History



The history dates back to 1790, when Lazzaro Spallanzani first discovered that bats maneuvered in flight using their hearing rather than sight. Jean-Daniel Colladon in 1826 discovered sonography using an underwater bell, successfully and accurately determining the speed of sound in water. Thereafter, the study and research work in this field went on slowly until 1881 when Pierre Curie's discovery set the stage for modern ultrasound transducers. He found out the relationship between electrical voltage and pressure on crystalline material. The unfortunate Titanic accident spurred rigorous interest into this field as a result of which Paul Langevin invented the hydrophone to detect icebergs. It was the first ultrasonic transducer. The hydrophone could send and receive low frequency sound waves and was later used in the detection of submarines in World War 1.

On a note parallel to the SONAR, medical research also started taking interest in ultrasonics. In the late 1930's Dr. Karl Dussik used a technique called hyperphonography which recorded echoes of ultrasonic waves on a sensitive paper. This technique was used to produce ultrasound pictures of the brain to help detect tumors and marked the birth of ultrasound imaging. After that, many scientists like Ian Donald, Douglas Howry, Joseph Holmes, John Wild and John Reid improved upon the various aspects of ultrasonic sensors in the medical field which enabled diagnosis of stomach cancers, ovarian cysts, detection of twin pregnancies, tumors etc. Industry too did not waste time in jumping on to the bandwagon and soon developed techniques like ultrasonic welding and non-destructive testing at the outset of the 1960s.

How do Ultrasonic Sensors work?

Ultrasonic sensors are devices that use electrical–mechanical energy transformation, the mechanical energy being in the form of ultrasonic waves, to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a succession of compressions and rarefactions along the direction of wave propagation through the medium. Any sound wave above the human auditory range of 20,000 Hz is called ultrasound. Depending on the type of application, the range of frequencies has been broadly categorized as shown in the figure below:

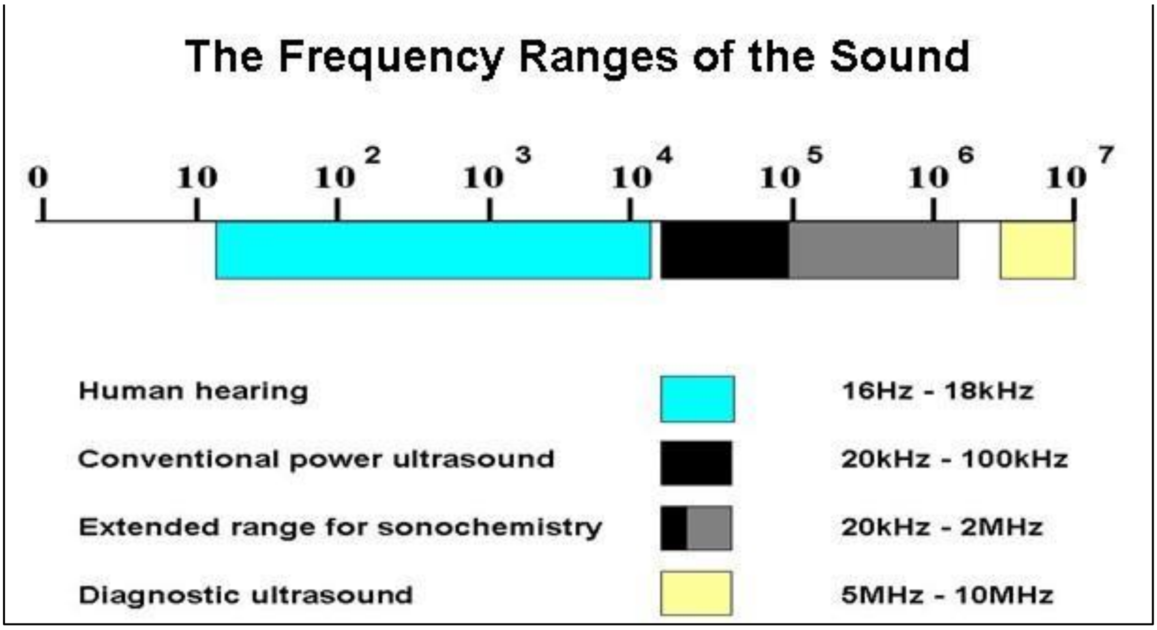


Fig:4.3 freqency of range of the sound

When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes and is detected. The distance to the object (L) can then be calculated through the speed of ultrasonic waves (v) in the medium by the relation

figno4.4horizontalandpath takenWhere' is the time taken

by the wave to reach back to the sensor and ' ' is the angle between the horizontal and the path taken as shown in the figure. If the object is in motion, instruments based on Doppler shift are used. Get all the details about internal structure and working of an ultrasound sensor at Insight-How Ultrasonic Sensors Work.

Generating Ultrasonic Waves

For the generation of such mechanical waves, movement of some surface like a diaphragm is required which can then induce the motion to the medium in front of it in the form of compression and rarefaction. Piezoelectric materials operating in the motor mode and magnetostrictive materials have been widely employed in the generation of ultrasonic waves at frequency ranges of 1-20 MHz and 20-40 kHz respectively. The sensors employ piezoelectric ceramic transducers which flex when an electric signal is applied to them. These are connected to an electronic oscillator whose output generates the oscillating voltages at the required frequency. Materials like Lead Zirconate Titanate are popular piezoelectric materials used in medical ultrasound imaging. For best results, the frequency of the applied oscillations must be equal to the natural frequency of the ceramic, which produces oscillations readily through resonance. It offers maximum sensitivity and efficiency when operated at resonance.

Piezoelectricity being a reversible phenomenon produces electrical voltages when ultrasonic waves reflect back from the target and impinge upon the ceramic structure. In this way, a transducer may work both as a transmitter and a receiver in pulsed mode. When continuous measurement of distances is required, separate transducers may be used for transmission and reception. The sensors when used in industry are generally employed in arrays which may be mechanical arrays consisting of oscillating or rotating sensors, or electronic arrays which may be linear, curved or phased. To visualize the output of an ultrasonic sensor, displays of different kind are used whose shape depends on the type of transducer array used and the function. A sectored Field of View is produced by mechanical arrays and curved and phased electronic arrays, while a linear field is generated by linear arrays. The display modes may be linear graphical plotting with amplitude on y-axis and time on x-axis called Amplitude mode or A-mode, or intensity modulated B-scans where the brightness of a spot indicates the amplitude of reflected waves. Other modes include M-mode, Doppler (D) Mode etc.

The parameterization of these sensors is generally done by monitoring the reflected and transmitted signals from the lateral and axial motion of the transducer while keeping the target fixed in a specific medium (water in general). The sound beam diverges rapidly, hence care is taken that the transducer produces the smallest possible beams. The narrower the beam pattern, the more sensitive the sensor is. However, the angle possible between the transducer and the surface increases with the beam width. The beam patterns of the kind shown below are observed:

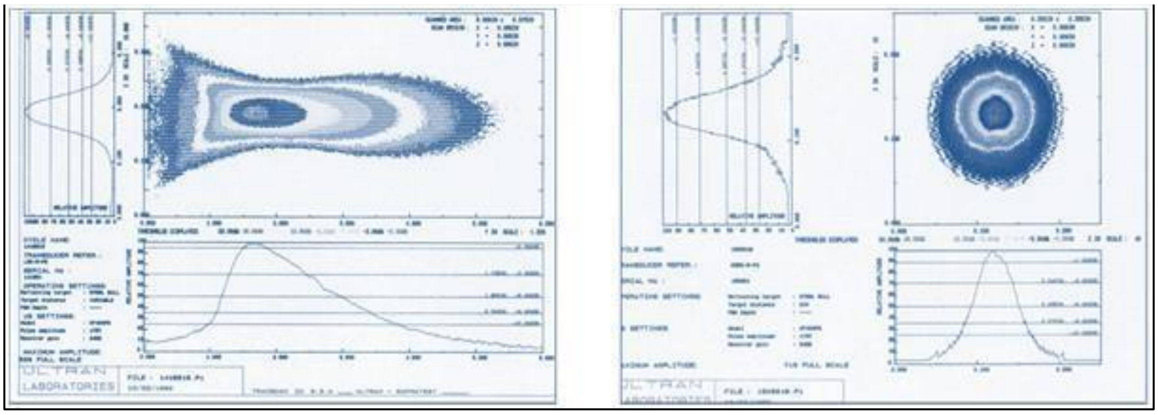


Fig no 4.4 Axial and Cross Sectional beam profiles

The parameters on which the performance of an ultrasonic sensor is measured include bandwidth, attenuation, dynamic range and resolution like grayscale, axial and lateral resolution. Other parameters are Nominal Frequency, Peak Frequency, Bandwidth center Frequency, Pulse Width, sensitivity and Signal to Noise Ratio (SNR).

Importance of Ultrasonic Sensors

There are a variety of sensors based on other physical transduction principles like the optical range finding sensors and the microwave based devices too. Then why should one use ultrasonic transducers in the first place, given that the speed of sound is very slow than the speed of electromagnetic waves? The answer lies in the question itself. Because the EM waves based devices are too fast. Being slower that the EM waves, the time taken by ultrasonic waves is much longer than that taken by the latter and hence its measurement can be done more easily and less expensively. Because these are based on sound waves rather than EM waves, these would work in places where the latter would not.

For example, in the case of clear object detection and measurement of liquid levels or high glare environments, light based sensors would suffer greatly because of the transmittance of the target or the translucence of the propagating media. Ultrasonic devices being based upon sound propagation would remain practically unaffected. These also function well in wet environments where optical beams may suffer from refraction from the water droplets in the environment. On account of range and accuracy, the ultrasonic sensors may lie in between two EM wave based sensors, the Infrared rangefinders on the lower end and the LIDARs on the upper end. Not as accurate or long distance as the LIDARs, the Ultrasonic rangefinders fare better than the IR rangefinders which are highly susceptible to ambient conditions and require recalibration when environment changes. Further these devices offer advantage in medical imaging as compared to MRI or X-Ray scans due to inexpensiveness and portability. No harmful effects of ultrasonic waves at the intensity levels used have been detected in contrast to X-rays or radioactivity based methods and are particularly suited for imaging soft tissues.

Problems & Concerns

However, Ultrasonic sensors too aren't free of all the problems. The speed of sound in a medium increases as the temperature of the medium increases. Thus even when the target has remained in the same place, it may now seem that it has shifted to a place closer to the sensor. Air currents due to varied reasons may disturb the path of the wave which could lead to 'Missed Detection' or a wrong measurement.

Acoustic noise like high pitched sounds created due to whistling or hissing of valves and pneumatic devices at the frequency close to the operating frequency may interfere with the output of the sensor. Electrical noise also affects the performance of the sensor. These may generate artifacts which are not a true representation of the imaged object. Just like the vision starts to blur when the distance of the object from the eye gets too small for the eyes to see it, ultrasonic devices also have a 'dead zone' where the sensor cannot reliably make measurements.

This happens due to a phenomenon called ringing which is the continuous vibration of the transducer after emitting the pulse. Thus when the distance is too small, the transducer has not yet come to rest to be able to differentiate between the vibration due to the incident radiation or the oscillation from the electrical excitation. The dangers of Ultrasonic waves are also well founded. If the intensity is too high, it can cause human tissues to heat and may cause ruptures in people exposed to it. Ethical issues like fetus identification and resulting abortions in medical field are also a widespread concern.

Applications

The applications of ultrasonic sensors can be classified on the basis of the property that they exploit. These can be summarized as:

Domain	Parameter	Applications
Time	Tile-of-Flight, Velocity	Density, Thickness, Flaw Detection, Anisotropy, Robotics, Remote Sensing etc.
Attenuation	Fluctuations in reflected and Transmitted Signals	Defect characterization, microstructures, interface analysis
Frequency	Ultrasonic Spectroscopy	Microstructure, grain size, porosity, phase analysis.
Image	Time-of-Flight, velocity, attenuation mapping in Raster C-Scan or SARs	Surface and internal Defect imaging, density, velocity, 2D and 3D imaging.

Research has been going on to overcome the problems of ultrasonic sensors, particularly in medical imaging where it is known as ultrasound. The artifacts of ultrasonic sensors like Acoustic shadowing and Acoustic Enhancement are being exploited to characterize tissues which allow the differentiation between solid and cystic tissues. The industry too has reaped the benefits from ultrasonic sensors in applications like plastic welding, jewelry cleaning, remote sensing and telemetry, assisted parking systems etc. Robotics has been known to use ultrasonic rangefinders as a favorite tool for distance ranging and mapping. Even the fashion industry is using ultrasonic sensors in hair styling like hair extension implants.

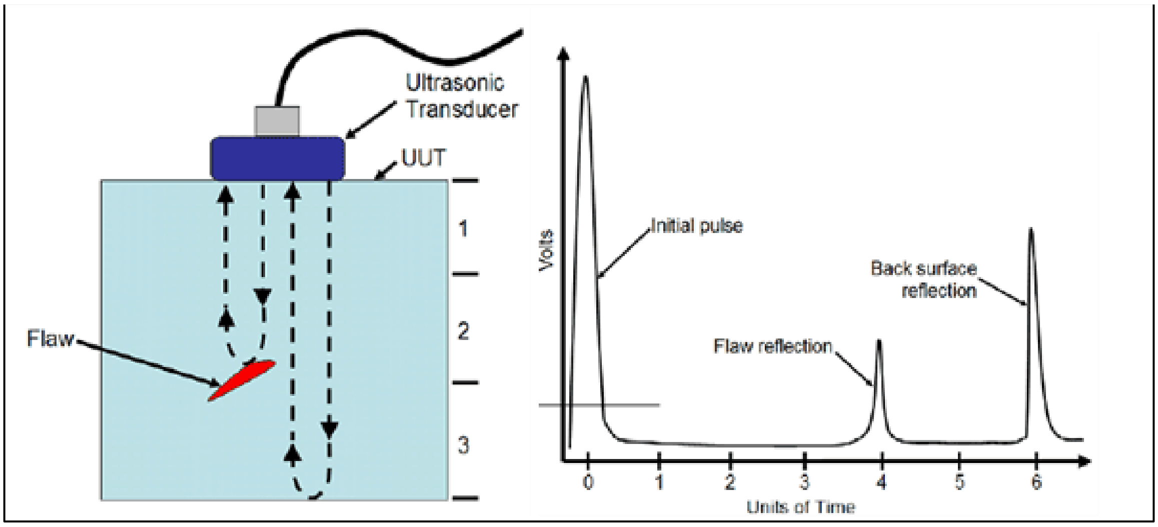


figure 4.5 ultrasonic transducer

Flaw Detection Using Ultrasonic Sensors

Future

Non-destructive testing and flaw detection uses ultrasonic waves in various modes like the Longitudinal (L-wave) mode and the Shear (S-wave) mode to detect flaws in materials. With the advances in Science new materials offering increased performance at lower voltages like the capacitive micromachined ultrasonic transducers (CMUTs) are being developed which are expected to have higher bandwidth and greater potential for integration with electronic circuits.

These devices provide non-invasive measures for the detection of problems in all kinds of materials, be it a living tissue or non-living manufactured goods. With a healthy history of being able to detect many problems which otherwise left the doctors dazed and the problem untreated, ultrasonic sensors do offer a lot of promise even in the coming times. The environmental and psychological effects of exposure to EM-radiation being rigorously being put under the scanner, ultrasonic applications are expected to thrive and offer a substantial alternative to the contemporary technologies.

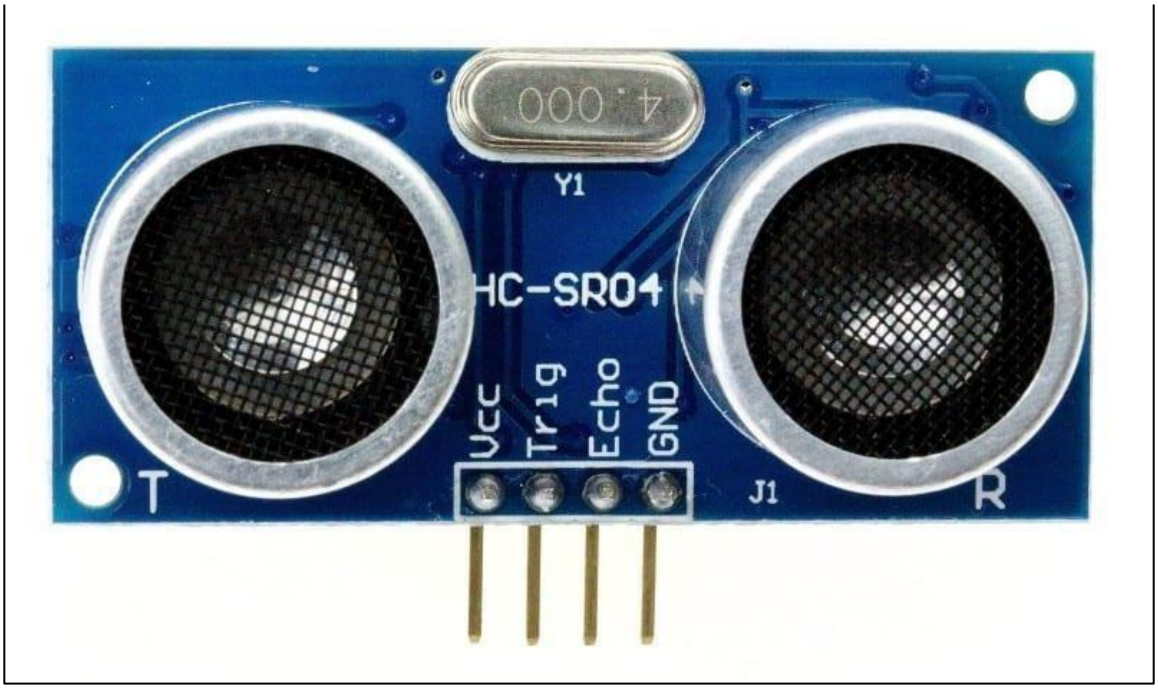


Fig 4.6 ultrasonic sensor

4.2.3 VIBRATION SENSOR

Vibration sensors are piezoelectric accelerometers that sense vibration. They are used for measuring fluctuating accelerations or speeds or for normal vibration measurement. Maintenance professionals use the sensors in order to predict the maintenance of the machinery, to reduce overall costs and increase the performance of the machinery.

Examples of applications where the vibration sensors are used: process control systems, aerial navigation and underwater-applications. Frequencies range from 0.2 up to 2500 Hz. The operating temperature of these sensors is between -50°C and +85°C.

4.2.3.1 Wireless IoT Vibration Solution

Smart Industrial IoT measurement solution for condition monitoring applications. The IoT system consists of wireless battery powered industrial sensor nodes and a gateway for communication to transmit data to the cloud.

4.2.3.2 Wireless condition monitoring

Abnormal vibrations or high temperatures give early signs of machine failure due component imbalance, misalignment, wear or improper use of equipment. Those can be now effortlessly identified without manual measurements or expensive wired equipment to increase machine uptime and extend mean time between failures.

The Industrial IoT Measurement Solution for condition monitoring applications consists of wireless battery powered industrial sensor node(s) and a gateway for communication to transmit data to the cloud.

4.2.4 POWER SUPPLY

The vibration sensor receives its voltage using IEPE technology. The sensor requires DC voltage between 15 and 18 V at constant current. This is controlled by a constant-current diode. The output of the vibration sensor is then modulated up to BIAS voltage.

Unlike our force and pressure sensors, vibration sensors with integrated signal amplifiers require constant current power supply. That means that the supply electronics include a constant-current diode which supplies the right voltage at a constant current between 2 and 5 mA.

Our VIB-KS measurement amplifiers for vibration sensors are ideally equipped for this task. In addition to the peak-to-peak acceleration, they also output the effective value or limit contacts.

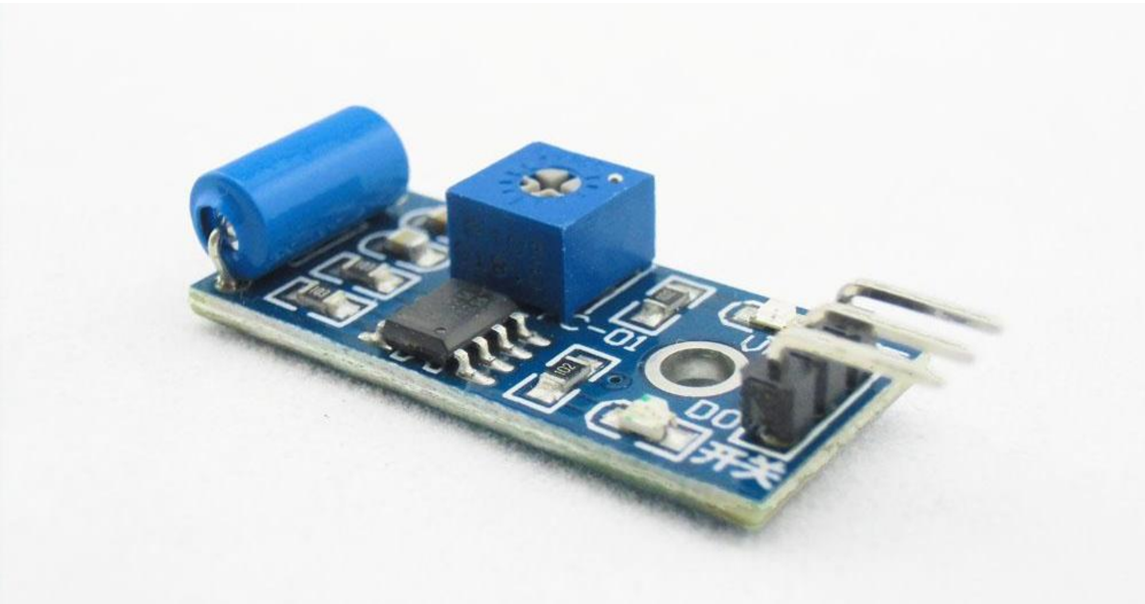


figure 4.7 vibration sensor

OUTLINE

Vibration sensor---whose internal structure is like a metal ball that is fixed in a special spring as pole, around it is the other pole. When the vibration gets to an extent, the two poles are connected so as to judge the shock occurs. Vibration sensor outputs digital signal.

Specification

- Electrical specification
- Operation voltage: 5V
- Input device
- Tech parameters
- Wide vibration detection range
- Without direction limitation
- 60,000,000 times of vibration insurance. (Special gold plating on the surface of the connection foot)
- Size
- Sensor size: 9.0mm*9.15mm
- Board size: 20mm*20mm
- the 1.27mm-pitch 4 PIN interface can be connected with the sensor hub.
- Connection method
- Pin description: GND, VCC, signal input and NC(empty).
- Digital input

Development

Equipment

- **mCookie-CoreUSB**
- **mCookie-Hub**
- **Microduino-Shake**

- Other hardware equipment
- A USB cable

Preparation

- Setup 1: Connect the Shake sensor's interface with the Hub's digital D6 port.

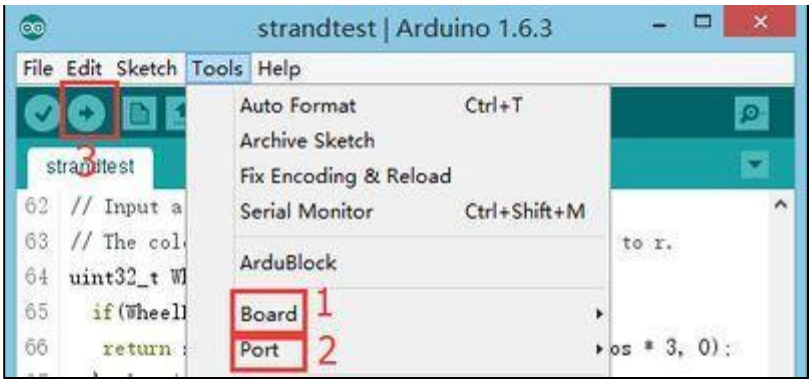
- Setup 2: Stack the CoreUSB, Hub and Shake sensor together and then connect them to the computer with a USB cable.

Debugging

- Open Arduino IDE and copy the following code into IDE.

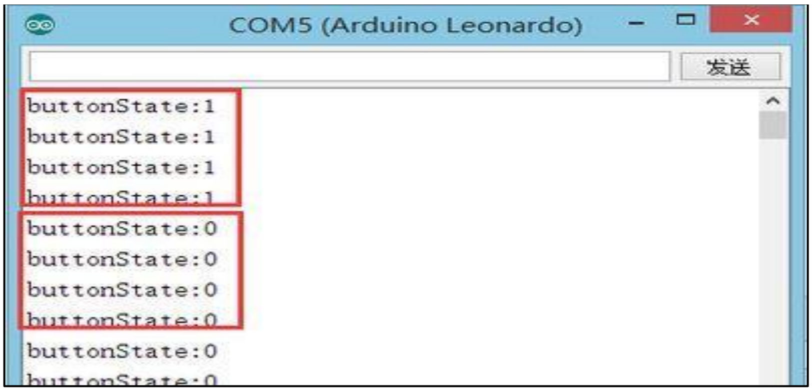
```
#define pushButton  6

int buttonState;

// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
  // make the pushbutton's pin an input:
  pinMode(pushButton, INPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input pin:
  buttonState = digitalRead(pushButton);//Read the input value of the Shake sensor.
  // print out the state of the button:
  Serial.print("buttonState:");
  Serial.println(buttonState);  //Print the sensor value in the serial port.
  delay(100);     //100ms delay
}
```

● Select the right board and COM port, compile and download.



● Open the serial monitor.

● The value of " buttonState " is 0 when there is no vibration or it is 1 when there exists vibration.



***Adopt "digitalRead(XX)" function to read vibration digital signal with two status of "0" and "1".**

Possible Applications for Vibration Sensors

● Measuring building vibrations
● Vibrations affecting humans in buildings
● Vibrations affecting humans in railway vehicles and on ships
● Vibrations affecting humans in vehicles or when working on machines
● Vibrations of wind turbines

4.2.5 **ALCOHOL DETECTION SENSOR**

MQ-3AlcoholSensor

MQ-3 is an alcohol sensor that can be used to measure or detect breath alcohol concentration. It is a highly sensitive sensor with fast response time.

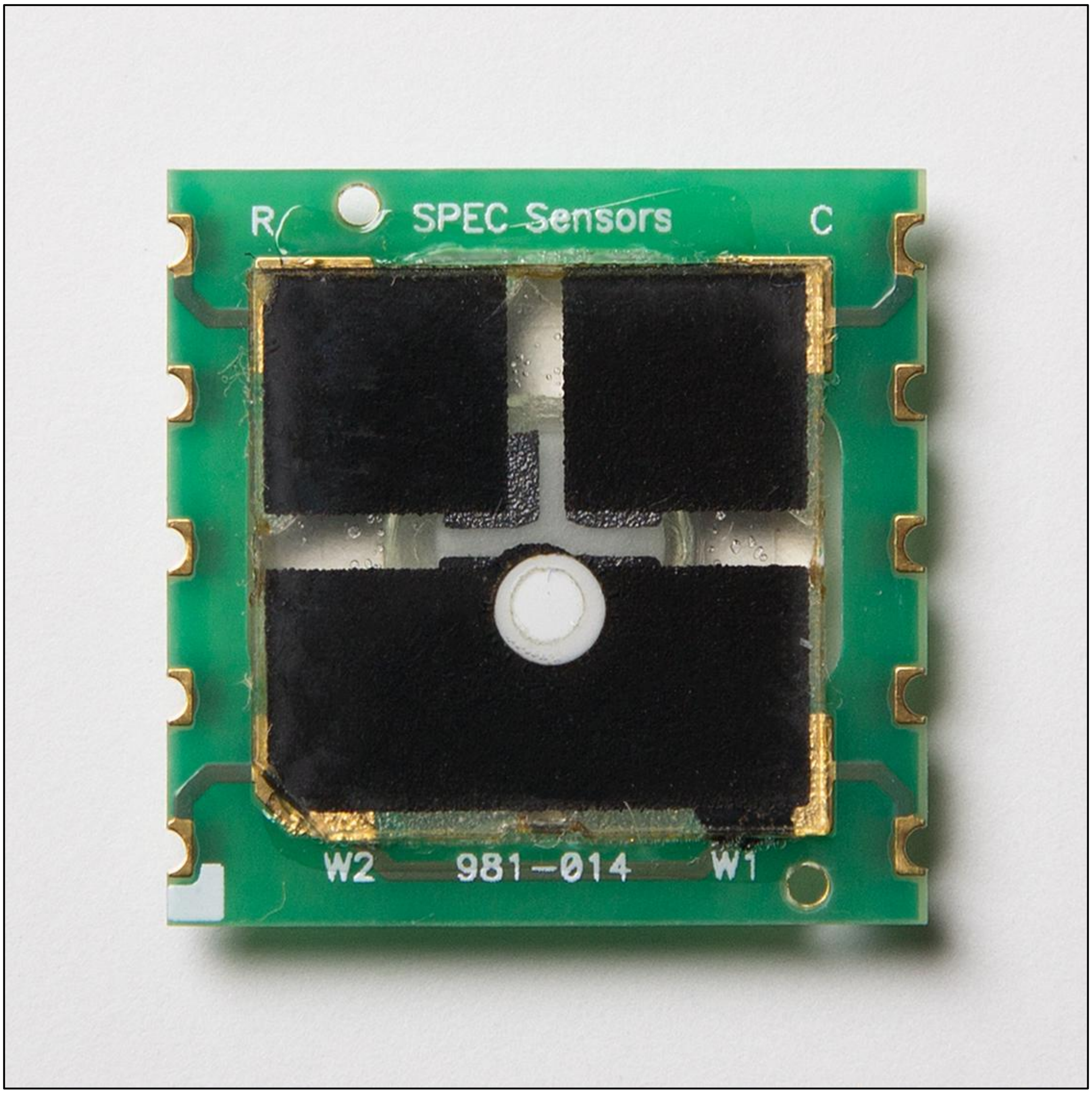


Fig 4.8 alcohol sensor

Infrared Breath-Alcohol Analyzers

Most of the breath-alcohol analyzers currently used for evidential purposes use infrared (IR) spectrometry as the analytical principle for quantitative analysis and identification of ethanol

(Harding and Zettl, 2008). Infrared analysis is a nondestructive technology and calibration of the instruments shows good long-term stability. The theory and practice of infrared spectrometry is well established and is widely used in analytical chemistry for identifying functional groups in organic compounds. Infrared spectrometry applied to breath-alcohol analysis monitors the absorption of selected wavelengths of infrared radiation after passage through a known volume of the breath sample. The higher the concentration of ethanol in the sample the more infrared energy is absorbed and the lower is the percent transmittance. When organic compounds absorb IR energy at certain wavelengths, the vibration and rotational motion of chemical bonds in the molecule become amplified and more intense.

Alcohols have characteristic IR absorptions associated with O H, C O, and C H bond stretching vibrations. The C H bond vibrations are not unique for alcohols, because many other simple organic molecules, such as hydrocarbons and acetone, also have C H bonds that can absorb IR radiation at the 3.3–3.5 µm wavelength. Nevertheless, using several narrow band width optical filters the specificity for detecting just ethanol is improved considerably. Several infrared breath analyzers incorporate between three and five filters that absorb IR light at fixed wavelengths of 3.32, 3.40, and 3.49 µm and a reference wavelength common to several potential interfering substances (Jones and Andersson, 2008). A typical vapor phase infrared absorption spectrum for ethanol is shown in Figure 2 with frequency shown both as wave number (cm^{-1}) and in micrometers (µm).

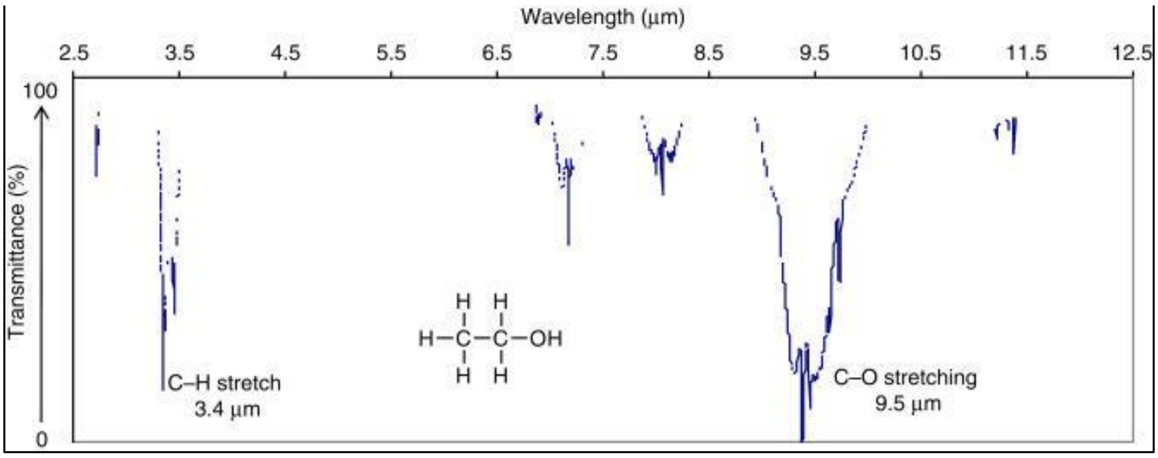


Fig no: 4.9 absorption spectrum of ethanol

4.2.5.1 Infrared absorption spectrum of ethanol molecules in the gas phase showing the parts of the spectrum that correspond to vibrations of the C H bond (3.4 µm) and C O bond (9.5 µm).

Ethanol molecules absorb IR light at wave number 3391 cm^{-1} (2.95 µm) and this corresponds to the O H stretching vibrations, whereas the C O stretching is prominent at 1102 and 1055 cm^{-1} (9.1–9.5 µm). To enhance the analytical selectivity some infrared breath analyzers are designed with optical filters that absorb infrared energy at 3.4 and 9.5 µm wavelengths, corresponding to C H stretch and C O stretch.

4.2.5.2 Breath Alcohol Determination

Breath analyzers have been reliably used to estimate blood alcohol concentration since the 1970s. Depending on the state, for prosecution of DWI, alcohol determined by an evidentiary breath analyzer may be admissible in the court of law. In general, blood alcohol determined by gas chromatography (GC) is subjected to very little interference, but breath alcohol may be affected by certain interfering substances. Nevertheless, evidentiary breath analyzers that are approved by the National Highway Traffic Safety Administration and used by law enforcement are reliable, and evidence is admissible in court. Moreover, interlock devices in vehicles also work on the principle of breath alcohol analysis.

A very small amount of alcohol is found in human breath. Only air in the deepest portion of the lung known as the alveolar sacs comes into contact with alcohol if present in blood, and there is equilibrium between alcohol in the exhaled air and alcohol in blood. The estimated ratio between breath alcohol and blood alcohol is 1:2100. This ratio is used in various breath alcohol analyzers to calculate blood alcohol level based on the concentration of ethanol in exhaled air by multiplying breath alcohol concentration expressed in milligrams per liter by 2100 to obtain the ethanol level per liter of blood (or by multiplying by 210 to obtain blood alcohol expressed as milligrams per deciliter). Some breath analyzer software may automatically calculate blood alcohol values from the observed breath alcohol level. This process of equilibrium of alcohol between alveolar air and blood is based on Henry's law, which states that the ratio between alcohol in blood and alcohol in deep lung air is constant. However, blood alcohol measurement is a direct measurement, and there are established guidelines for assessing the degree of impairment of individuals based on blood alcohol level and drinking history.

4.2.5.3 Chemical Principle of Breath Alcohol Analyzers

There are four types of breath analyzer:

*Analyzers that use color change due to a chemical reaction to determine alcohol level

*Analyzers based on infrared spectroscopy

*Analyzers based on fuel cell technology

*Analyzers based on mixed technology (infrared and fuel cell) and other techniques.

The earliest developed breath analyzer was based on a chemical principle in which exhaled air passed through a cocktail of chemicals containing sulfuric acid, potassium dichromate, silver nitrate, and water. Silver nitrate catalyzes the reaction in which alcohol, in the presence of sulfuric acid, turns orange potassium dichromate solution green due to conversion of potassium dichromate into chromium sulfate. The intensity of the green color can be used to estimate the amount of alcohol in the exhaled air. Captain Robert Borkenstein of the Indiana State Police used this chemical principle to develop breath analyzers in 1954, and some breath alcohol analyzers still use this principle. The Breathalyzer is the oldest breath alcohol analyzer; it is based on the principle of color change of potassium dichromate solution in the presence of alcohol and then analysis using spectroscopy after a specified time to ensure complete reaction. The analyzer contains two vials of chemical cocktail. After a subject exhales into the device, the air is passed through one vial; if alcohol is present in the exhale, a color change occurs. A system of photocells is connected to a meter to measure color change associated with the chemical reaction by comparing the response from the second vial (through which no air is passed), thus producing an electrical signal proportional to color change in the reaction vial. This electrical signal can cause the meter indicator to move (more alcohol, more signal and higher reading), and the alcohol level in subjects can be thus determined. Breathalyzer was the brand name originally developed and marketed by Smith & Wesson, which sold the brand to the German company Draeger.

The Breathalyzer 900 model was replaced by newer versions, such as model 1100, but this technology is subject to interference from a variety of substances; as such, other companies have focused on developing more robust technology for breath alcohol analysis.

There are many evidentiary breath alcohol analyzers that are based on the principle of infrared (IR) spectroscopy for quantitative determination of alcohol in exhaled air. The Intoxilyzer was originally developed by Omicron (Palo Alto, CA) and later sold to CMI (Owensboro, KY). The earlier models were 4011 A, 4011 S, and the Intoxilyzer 5000, which is used as an evidentiary breath alcohol analyzer; an Intoxilyzer 8000 model is now commercially available. Many states use this analyzer as the evidentiary breath analyzer. In addition to the Intoxilyzer, DataMaster cdm (National Patent Analytical System, Mansfield, OH), which is also used in many states as the evidentiary breath alcohol analyzer, is based on IR spectroscopy technology. The Intoxilyzer 5000 uses a five-wavelength filter at 3.36, 3.4, 3.47, 3.52, and 3.8 μm and thus can differentiate between ethanol and common sources of interference in exhaled air, such as acetone, acetaldehyde, and toluene. The 3.4-μm wavelength is used to detect alcohol, the 3.47-μm wavelength identifies interfering substances, and the 3.9-μm wavelength is used as the reference wavelength. The Intoxilyzer 8000 uses a pulsed IR source instead of moving wavelength filter and also uses dual wavelength for measuring alcohol in breath (3.4 and 9.36 μm). It also has more advanced computer technology to provide more accurate alcohol level results. DataMaster cdm, an evidentiary breath analyzer widely used by police officers in many states, is also based on the principle of IR spectra, where alcohol is detected using two different wavelengths (3.37 and 3.44 μm).

Several different brands of evidentiary breath alcohol analyzers are based on the principle of fuel cell technology, including Alcotest models 6510, 6810, and 7410 (National Drager, Durango, CO) and Alco-Sensor III and IV (Intoximeters, St. Louis, MO), which are evidentiary breath analyzers. The fuel cell is a porous disk coated on both sides with platinum oxide (also called platinum black). The porous layer is impregnated with acidic solution containing various electrolytes so that charged particles such as hydrogen ions can travel through the medium. In addition, both sides of the disk containing platinum oxide are connected with a platinum wire. The fuel cell is mounted in a case along with the entire assembly so that when a person blows into the disposable mouthpiece, the air travels through the fuel cell. If any alcohol is present in the exhaled air, the alcohol is converted into acetic acid, hydrogen ions, and electrons on the top surface by the platinum oxide. Then the hydrogen ions travel to the bottom surface (which also contains platinum oxide) and water is formed by their combining with oxygen present in the air. In this process, electrons are removed from the platinum oxide. Because there is an electron excess on the top surface and an electron deficit on the bottom surface, electrons flow from one surface to another, generating an electric current that flows through the platinum wire. The intensity of the current is proportional to the amount of alcohol present in the exhaled air. The instrument's microprocessor then converts the current to equivalent blood alcohol.

Some evidentiary breath analyzers are based on both fuel cell and IR spectroscopy technology, which gives them good sensitivity and specificity for analyzing alcohol on breath. Various models of the Intox EC/IR I desktop evidentiary alcohol breath analyzers (Intoximeters) combine reliable fuel cell analysis with the real-time analytical advantages of IR technology. Semiconductor alcohol sensors are used in inexpensive breath analyzers marketed to the general public. However, sensor response is nonspecific to alcohol and nonlinear in response. For example, semiconductor sensors will respond to particles and gases present in cigarette smoke. The gas chromatography technique (discussed later) applied for analysis of blood alcohol may also be used for breath alcohol analysis [4].

4.2.5.4 Effect of Breathing Pattern on Breath Alcohol Test Results

The breath alcohol test is a single exhalation maneuver in which a subject is asked to inhale air (preferably a full inhalation to total lung capacity) and then exhale (preferably a full exhalation to residual volume) into the breath analyzer instrument. The assumption is that alcohol concentration in exhaled breath is equal to that in alveolar air. Very few restrictions, such as exhaled volume, exhaled flow rate, inhaled volume, and pretest breathing pattern, are placed on the breathing maneuver. In general, the ethanol level in end-exhaled air is always lower than that in alveolar air. When performing a breath alcohol test, the subject is asked to inhale ambient air and exhale into the breath analyzer (usually 1.1–1.5 L of exhaled air is required for the test). Therefore, smaller subjects with smaller lung capacity must exhale a greater fraction of air in their lungs to fulfill the minimum volume requirement of the analyzer; as a result, the alcohol breath test could overestimate the blood alcohol level in smaller subjects compared to larger subjects with larger lung capacity. In addition, in normal circumstances, a single exhalation alcohol breath test shows a gradual and continually increasing breath alcohol level [5]. Breathing pattern may also affect breath alcohol test results because values may decrease by 11% in the case of pretest hyperventilation and may increase by 15% in the case of pretest breath hold. However, other investigators have reported an average decrease of 4.4% due to hyperventilation and an average increase of

6.7% due to breath hold (relative hypoventilation). George *et al*. used a mathematical model and reported that hyperventilation may cause an average 4.4% decrease in the breath alcohol test result, whereas hypoventilation may increase the value by 3.7%. Inhaling hot humid air may decrease the value by 2.9%, whereas inhaling hot dry air, cold humid air, or cold dry air has minimal effects [6].

4.2.5.5 Interference in Various Breath Alcohol Analyzers

Kechagias *et al*. compared blood alcohol values with values obtained by breath alcohol analyzer (DataMaster) in patients with gastroesophageal reflux disease and concluded that it is highly improbable that breath alcohol analyzers overestimate true blood alcohol values due to eruption of alcohol from the stomach to the mouth caused by gastric reflux [7]. Sometimes a driver stopped by police may use mouthwash to hide alcoholic breath. Because some mouthwashes contain alcohol, use of a mouthwash prior to taking a breath alcohol analysis may cause falsely elevated breath alcohol results. However, residual alcohol evaporates from the mouth rapidly; this is the reason why there is a 15-min waiting period in police stations that is supervised so that suspects cannot take anything by mouth during this period. Fessler *et al*. studied the effect of alcohol-based substances, such as mouthwash, cough mixture, and breath spray, just prior to breath alcohol measurement using the Drager evidentiary portable breath alcohol analyzer on 25 volunteers. The authors concluded that a 15-min waiting period was necessary to ensure that there was no residual alcohol in the mouth after using mouthwash and other alcohol-containing products. Otherwise, alcohol from mouthwash may interfere with breath alcohol analysis, causing falsely elevated values [8]. Harding *et al*. studied the effect of dentures and denture adhesives on mouth alcohol retention using the Intoxilyzer 5000 and concluded that dentures had no significant effect on breath alcohol test results as long as a waiting period of 20 min was observed prior to testing [9]. Logan *et al*. evaluated the effect of asthma inhalers and nasal decongestant sprays on breath alcohol tests and observed that the only product that had any effect on breath alcohol tests was Primatene Mist containing 34% ethyl alcohol, but alcohol was eliminated from the breath within 5 min. The authors concluded that inclusion of a 15-min deprivation period during which no food or drink could be consumed prior to an evidential breath test was an adequate safeguard against interference in the test caused by alcohol-containing inhalers [10].

Consuming energy drinks while driving is legal, but some energy drinks contain very low levels of alcohol. When volunteers drank various energy drinks, 11 of 27 drinks gave positive results using evidentiary breath analyzers when testing was done just after consumption. However, after a 15-min waiting period, all breath alcohol analysis reports were negative. The authors concluded that a 15-min waiting period eliminates the possibility of testing false positive after consuming an energy drink with low alcohol content [11]. Laakso *et al*. studied the effect of various volatile solvents for potential interference with breath alcohol analysis using the Drager 7110 evidentiary breath analyzer. They concluded that acetone, methyl ethyl ketone, methyl isobutyl ketone, ethyl acetate, and diethyl ether did not interfere with breath alcohol measurement significantly, but propyl alcohol and isopropyl alcohol had a significant effect on breath alcohol measurement [12]. Jones and Rossner described a case in which a 59-year-old man undergoing a weight loss program using a ketogenic diet attempted to drive a car that was fitted with an alcohol ignition interlock device, the vehicle proving impossible to start. Because he had completely stopped drinking, he was surprised and upset. The ketogenic diet used for treating obesity and controlling seizures in some epileptic children is high in fat, very low in carbohydrates, and also has adequate protein. The goal is to burn fat to get energy rather than getting it from glucose, which is formed by carbohydrate metabolism. However, consuming the ketogenic diet led to a stage called ketonemia, in which concentrations of acetone, acetoacetic acid, and β-hydroxybutyric acid are high. The high levels of acetone lead to its presence in exhaled air. The interlock device in the car determines alcohol by an electrochemical oxidation method, and acetone does not interfere with the process. However, acetone is known to be converted into isopropyl alcohol by the action of liver alcohol dehydrogenase, and isopropyl alcohol can be falsely identified as ethanol by the ignition interlock device. In addition, methanol and propanol can also be falsely identified as alcohol. The authors concluded that the side effects of ketogenic diets need further evaluation by authorities, especially for people involved in safety-sensitive positions such as airline pilots and bus drivers who are subjected to much tougher alcohol tolerance policies [13]. Glue sniffing may cause false-positive breath alcohol test results because glue contains aliphatic hydrocarbons, ethyl acetate, and toluene [14]. Methanol poisoning is dangerous because it may cause death or blindness. Methanol poisoning may cause false-positive test results with breath analyzers. In one report, the authors observed that toluene, xylene, methanol, and isopropyl alcohol in exhaled air were mistakenly identified as breath alcohol by the Intoxilyzer 5000 evidentiary breath alcohol analyzer.

4.2.6 EYE BLINK SENSOR

Most road accidents occur due to careless driving of drivers because of drowsiness. This paper provides Eye Blink Monitoring System (EBM) that will alert the driver in drowsiness. A system for monitoring eye movements would be useful in warning drivers when they fall asleep. The driver's eye is continuously monitored using an IR sensor. The normal eye blink rate will have no effect on the output of the system. If Driver fell asleep, then IR sensor receives abnormal blinking rate & an alarm will ring, to wake him/her up. The sensor part of the EBM system is implemented as a goggle. This goggle is to be worn by the driver while driving the vehicle.

The majority of car accidents are caused by bad driving: driver inattention, failure to merge or yield, speeding, racing, aggressive driving and failure to exercise care in passing. Accidents can be attributed to specific causes aside from poor driving itself include falling asleep, weather (snow, Ice or Rain, Fog); alcohol,drugs & drunk driving, driver distractions which includes cell phones, playing music; collisions with animals in the road usually deer, horses, cows and dogs etc.

It is found that Driver Fatigue and falling asleep at the wheel is a major cause of car crashes. Fatigue can be very difficult to identify as the source of accidents because estimates are made based almost solely on police reports, and driver statements. It is estimated that 10-20% of fatal accidents and about 5 to 10% of all car accidents may be related to tired drivers.

According to the National Highway Traffic Safety Administration there may be as many as 100,000 crashes from driver fatigue each year, with an estimated 1,550 deaths, 71,000 people injured, causing $12.5 billion economic losses. These figures may be the tip of the iceberg, since currently it is difficult to attribute crashes to sleepiness. In India about 250 people die in road accidents everyday [1].

The drivers tend to sleep while driving due to tiredness caused because of several reasons. Presently no system has been implemented in the vehicle, though developed, to indicate or prevent Drowsiness/asleep of the driver. He has to take care while driving. Some drivers take strong tea before driving so that they would not fell asleep while some drivers avoids driving in such situations. This may create delay in reaching to the destination.

In this paper we are presenting a system entitled 'Eye Blink Monitoring (EBM) System' which will help drivers to alert in drowsiness.

This system is based on principle of monitoring eye movements of driver continuously using an IR sensor. If he/she falls asleep, then an alarm will ring to wake him/her up.

Basic electronics concepts have been used along with micro-controller to implement this system. Infra- red emitter & detector are used for monitoring the driver's eye, which will provide corresponding output according to the eye blink rate of the driver. The output of IR sensor is given to microcontroller where it is decided whether to sound the buzzer or not. The status of operation is displayed on the LCD, which is connected to the microcontroller. As the output of microcontroller is low to drive the buzzer, a driver IC is used to amplify the output of microcontroller.

The sensor part of the EBM system is implemented using a goggle. This goggle is to be worn by the driver while driving the vehicle. It will not act as an obstacle while driving.

By monitoring the eye of a human being, we can determine whether he/she is sleeping or not. One common technique of monitoring eye blink rate is by measuring infrared (IR) light reflected from the surface of the eye.

The eye is illuminated by an IR LED, which is powered by the +5V power supply and the reflected light is recorded by an IR photo diode. The IR photo diode converts this reflected light into electrical signal and given to Op-Amp. The output of Op-Amp depends on the intensity of light received by the IR photo diode. The micro-controller drives the buzzer according to output of Op-Amp. The digital display provides various messages to the user.

When the eye is open, maximum amount of light will be reflected from the eye because our eyeball is transparent, while minimum of light will be reflected from the eye, when it is closed as skin part of eye is opaque.

As the output of IR detector is connected to the inverting terminal of Op-Amp, the input voltage of Op-Amp varies as per the intensity of light falling on IR detector. Hence the output of Op-Amp varies accordingly.

While driving, the IR emitter will continuously emit the light, which falls on the driver's eye. This light will be reflected from the driver's eye and detected by the IR detector. When the eye is open, maximum amount of light will be reflected from the eye, as our eye is transparent. So maximum amount of light will be detected by IR detector and so its output will be of maximum. Hence, voltage at inverting input of Op-Amp will be more compared to non-inverting input of Op-Amp. So the output of Op-Amp will be logic 0. When the eye is closed, minimum amount of light will be reflected from the eye, as the skin part is opaque. In this case minimum amount of light will be detected by IR detector hence its output will be of minimum. This causes less voltage at inverting input of Op-Amp as compared to non-inverting input. So the output of Op-Amp will be logic 1. These two states of output will be provided to the micro-controller to drive the buzzer circuit.

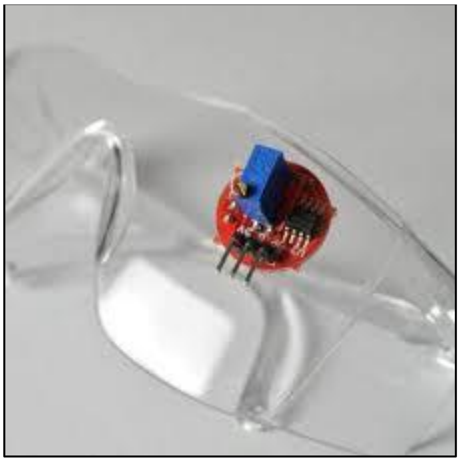


FIG no 4.10 EYE BLINK SENSOR

The sensor part of the EBM system is implemented in the form of a goggle. The goggle used is an ordinary one, in which IR LED & IR photo diode are placed in such

a way that light emitted by the IR LED falls on the eyeball and the reflected light is collected by the IR photo diode. The goggle receives the power from +5V power supply and it sends the signal to the input of Op-Amp.

The goggle is to be worn by the driver while driving. The sensors are implemented in such a way that it won't obstruct the sight of the driver.

The normal blinking rate of eye is 20 closures per minutes. It will not have any effect on the performance of the system.

When the driver falls asleep, his/her eyes will be closed; hence less light will be reflected from the skin part of the eye (as it is opaque). This produces maximum output of op-Amp. The op-amp output is given to micro-controller, which treats it as logic 1. The micro-controller will wait for 3 seconds. Then if it finds that the eyes are still closed, micro-controller sounds the buzzer.

Advantages

- Simple setup.
- Remote detection - no mechanical contact with eye.
- Stray visible and IR light not affected.
- Our system does not require the restraint of the external eyelids.
- Head movement not affected.
- Excellent frequency characteristics (DC to more than 500 Hz).
- Excellent working distance (15-25 mm).

Disadvantages

- Difficult to calibrate using common units of eye blink measurement. (e.g. mm of eyelid displacement)

The signal is proportional to the exposed area of the eyeball. Independent measurements of the individual eyelids are not possible

4.3 SOFTWARE REQUIRED

*** ARDUINO IDE**

*** UBIDOTS**

4.3.1 ARDUINO IDE

- **Arduino IDE** is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.

- If you aim to download the Windows app version, make sure you have Windows 8.1 or Windows 10, as the app version is not compatible with Windows 7 or older version of this operating system.
- You can download the latest version of Arduino IDE for Windows (Non-Admin standalone version), by clicking below button:

Download Arduino IDE

The IDE environment is mainly distributed into three sections

1. **Menu Bar**
2. **Text Editor**
3. **Output Pane**

As you download and open the IDE software, it will appear like an image below:

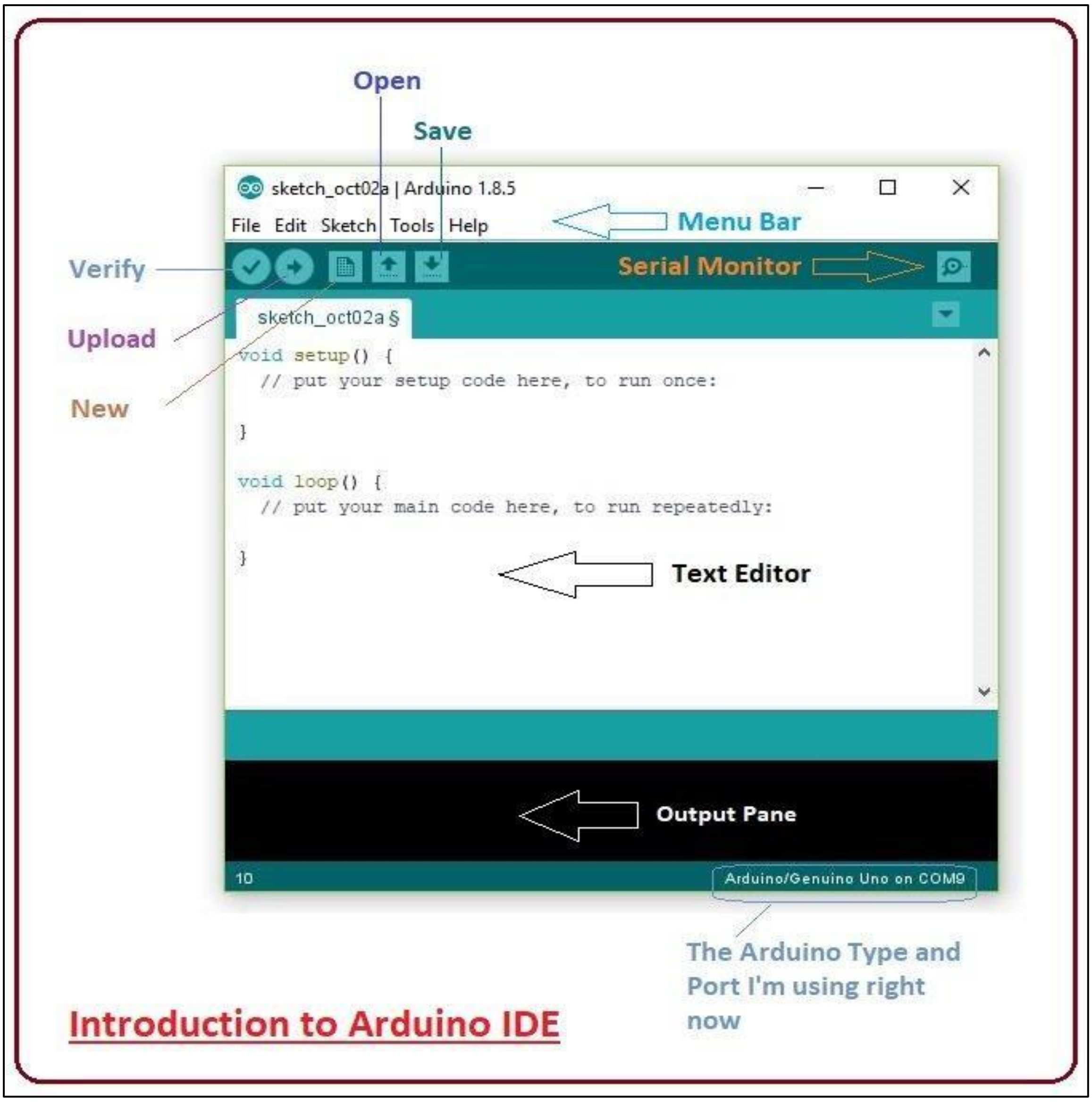


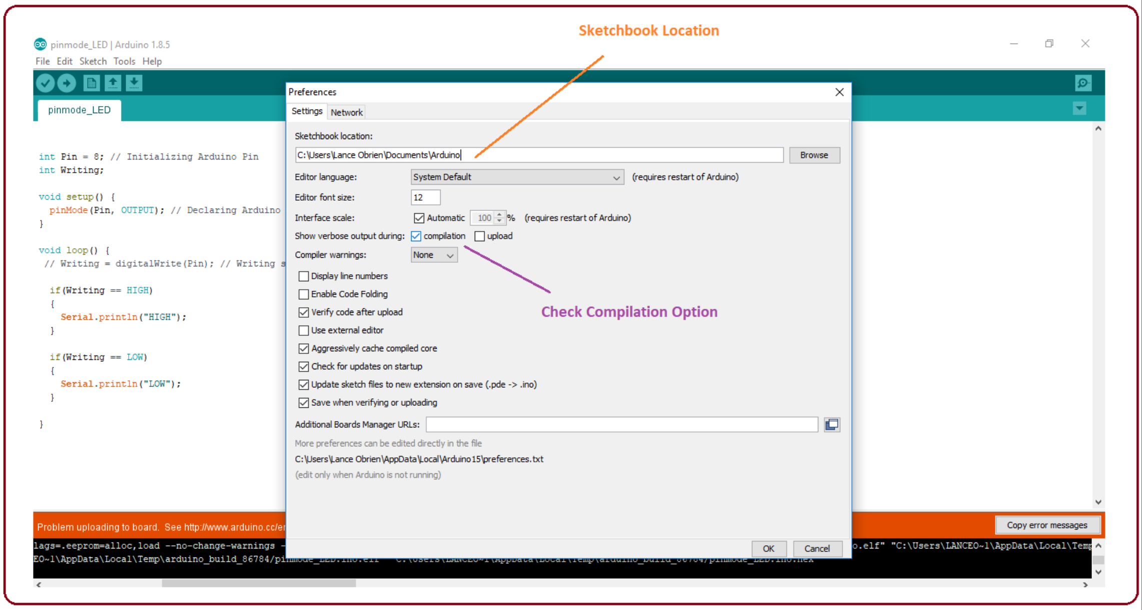
fig no: 4.11 arduino ide

The bar appearing on the top is called **Menu Bar** that comes with five different options as follow

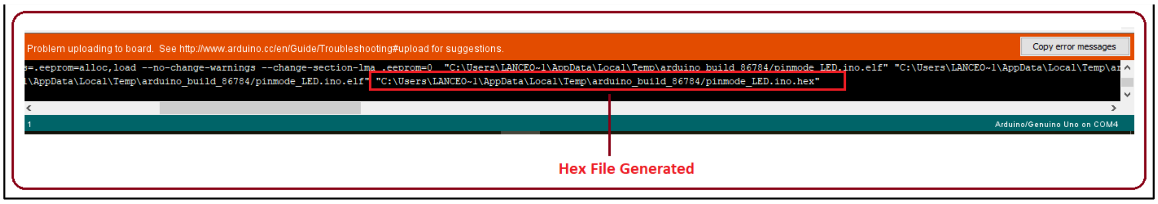
- **File** – You can open a new window for writing the code or open an existing one. The following table shows the number of further subdivisions the file option is categorized into.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

- As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

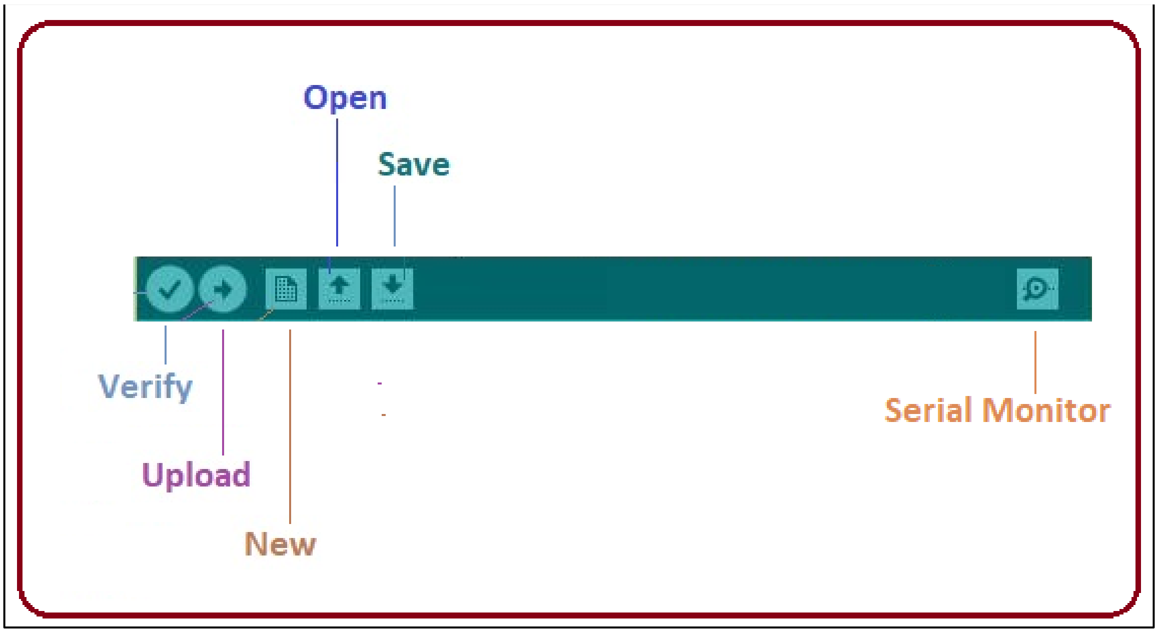


- And at the end of the compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.



- **Edit** – Used for copying and pasting the code with further modification for font
- **Sketch** – For compiling and programming
- **Tools** – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- **Help** – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

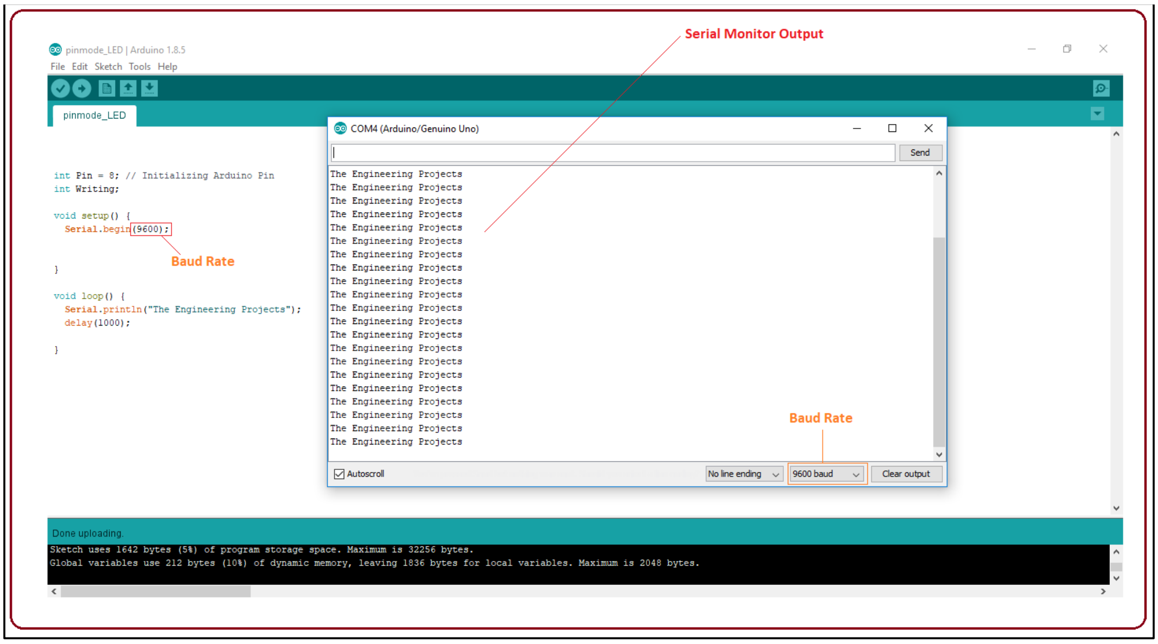
The **Six Buttons** appearing under the Menu tab are connected with the running program as follows.



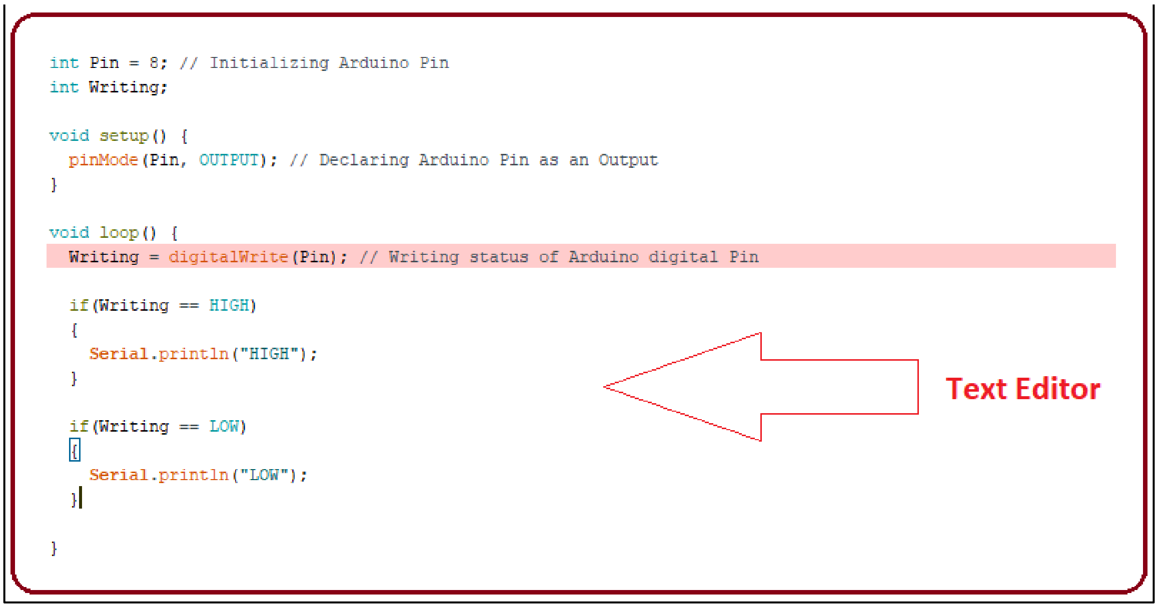
- The checkmark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role in sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing

Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

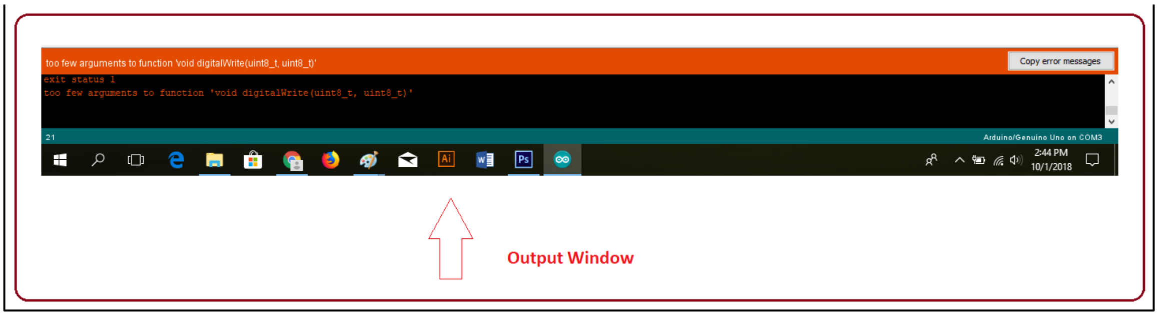
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.



- The main screen below the Menu bard is known as a simple text editor used for writing the required code.



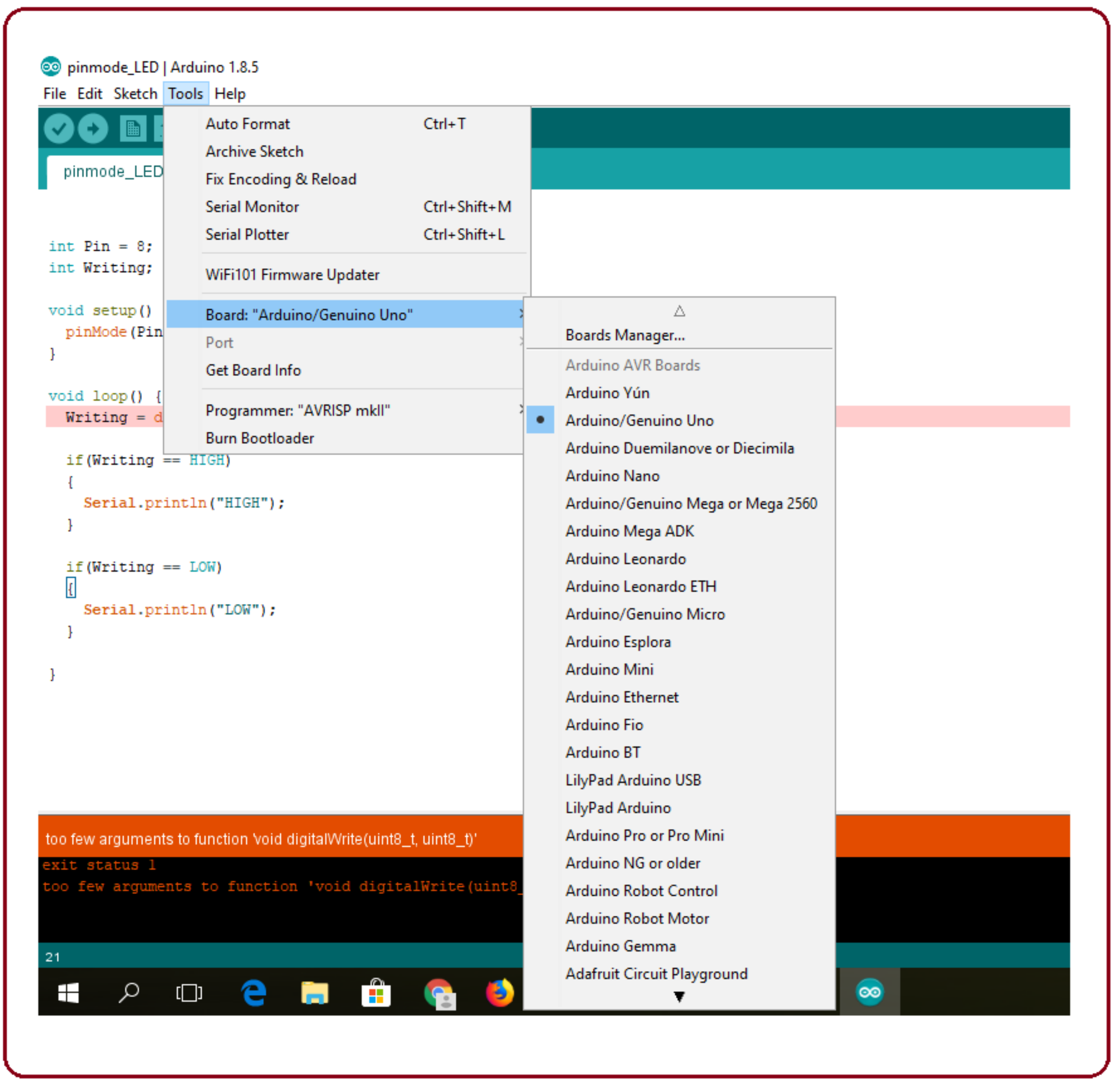
- The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors that occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.



- More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

Arduino Libraries

- Libraries are very useful for adding extra functionality into the Arduino Module.
- There is a list of libraries you can check by clicking the Sketch button in the menu bar and going to Include Library.



● As you click the Include Library and Add the respective library it will be on the top of the sketch with a #include sign. Suppose, I Include the EEPROM library, it will appear on the text editor as

#include <EEPROM.h>

● Most of the libraries are preinstalled and come with the Arduino software. However, you can also download them from external sources.

Making Pins Input or Output

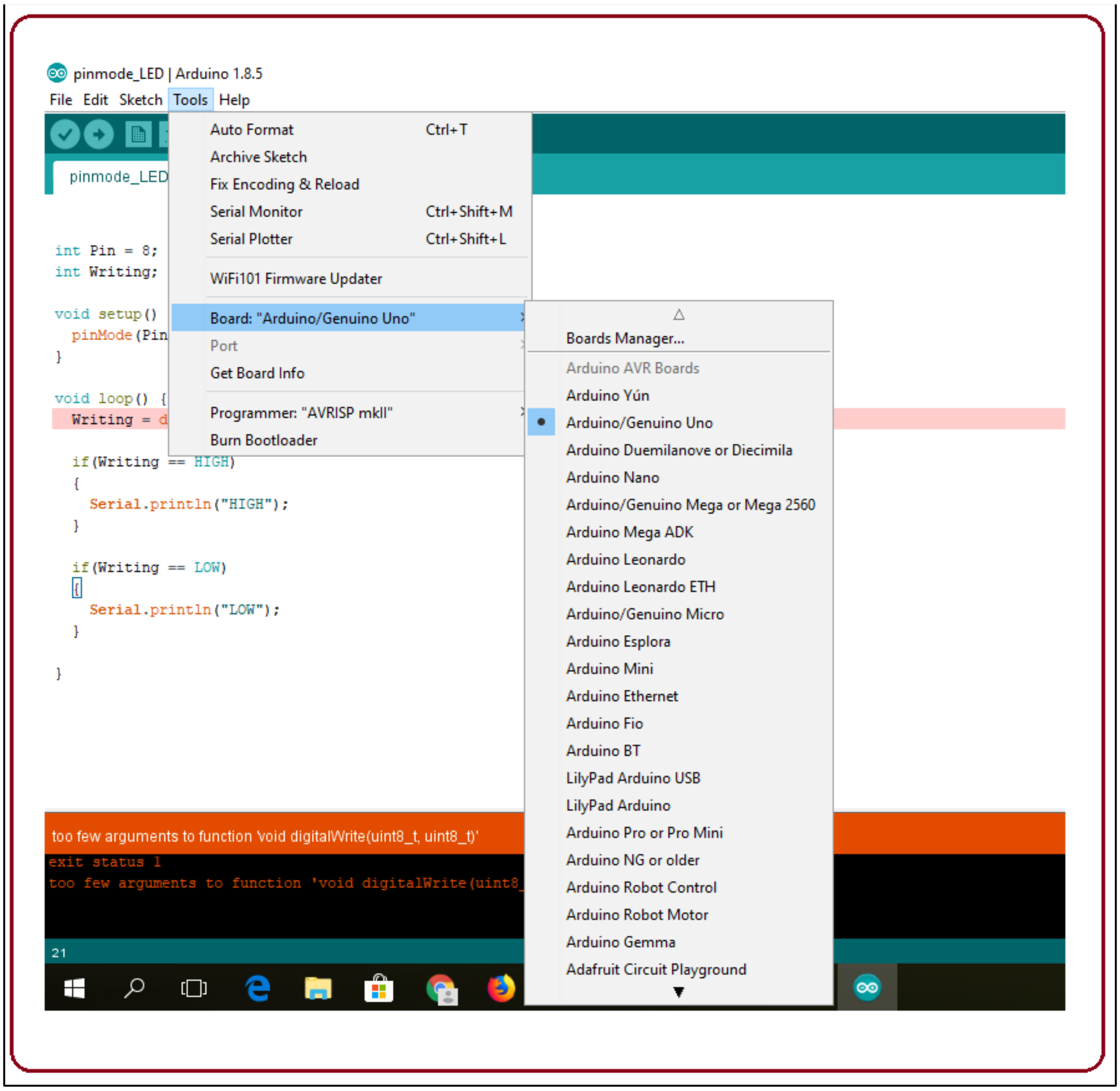
The digitalRead and digitalWrite commands are used for addressing and making the Arduino pins as an input and output respectively.

These commands are text sensitive i.e. you need to write them down the exact way they are given like digitalWrite starting with small “d” and write with capital “W”. Writing it down with Digitalwrite or digitalwrite won’t be calling or addressing any function.

How to Select the Board

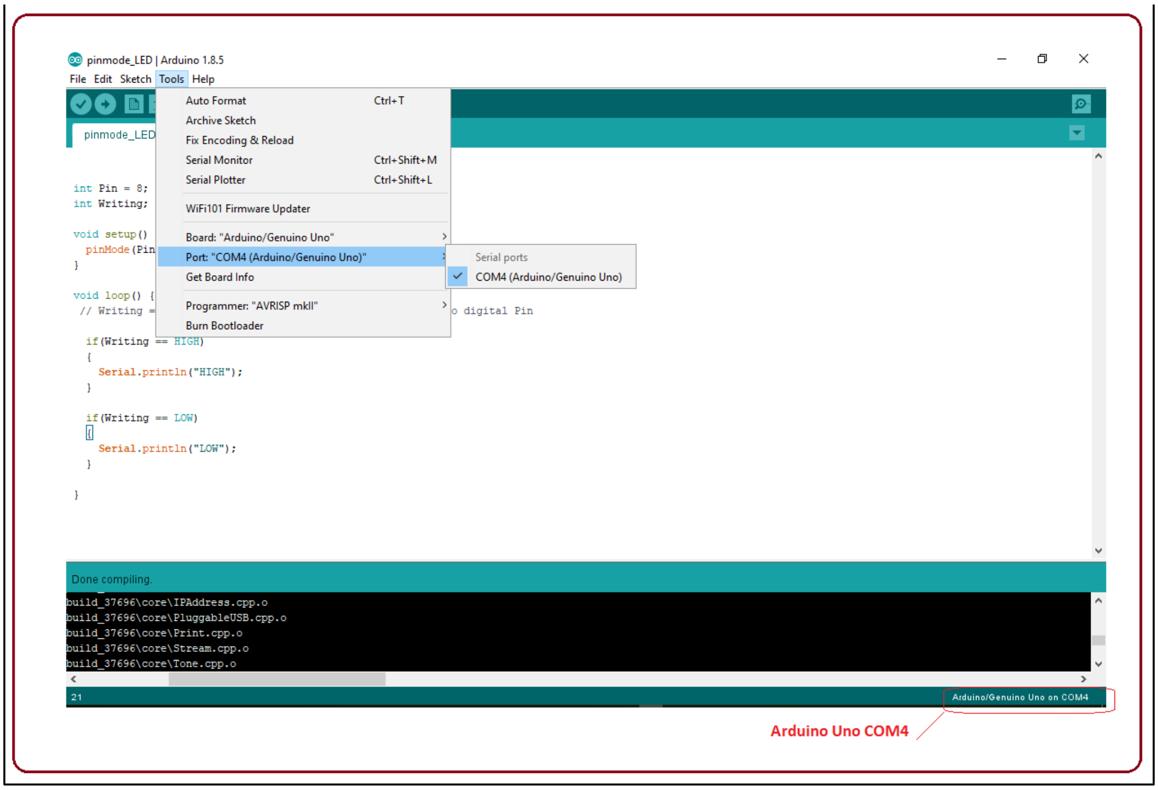
● In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system.

● As you click the Tools on the menu, it will open like the figure below:



● Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.

● The following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with the COM4 port at the right bottom corner of the screen.



● After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six-button section or you can go to the Sketch section and press verify/compile and then upload.

● The sketch is written in the text editor and is then saved with the file extension .ino.

It is important to note that the recent Arduino Modules will reset automatically as you compile and press the upload button the IDE software, however, the older versions may require the physical reset on the board.

● Once you upload the code, TX and RX LEDs will blink on the board, indicating the desired program is running successfully.

4.3.2 UBIDOTS EXPLORER

The basics components of any Internet of Things application powered by Ubidots are: Devices, Variables, Synthetic Variables Engine, Dashboards, and Events. Within this article we will address each of these concepts as they relate to Ubidots IoT Development and Deployment Platform and how you can better organize your Ubidots Apps to best connect with the users.

Once your devices, variables, and general Application is assembled, give your App some layers with Ubidots Device Management to learn more about Ubidots internal architecture and how you can use Apps, Organizations, and Users to efficiently connect your data with those who should be using it.

4.3.2.1. Devices

A Ubidots device is a virtual representation of a data-source or simply, an asset taking sensor data and transmitting said data through a connection protocol to Ubidots cloud. Click here for current firmware examples and tutorials for connecting your device to Ubidots.

All devices are different, but the standard setup on any device entails:

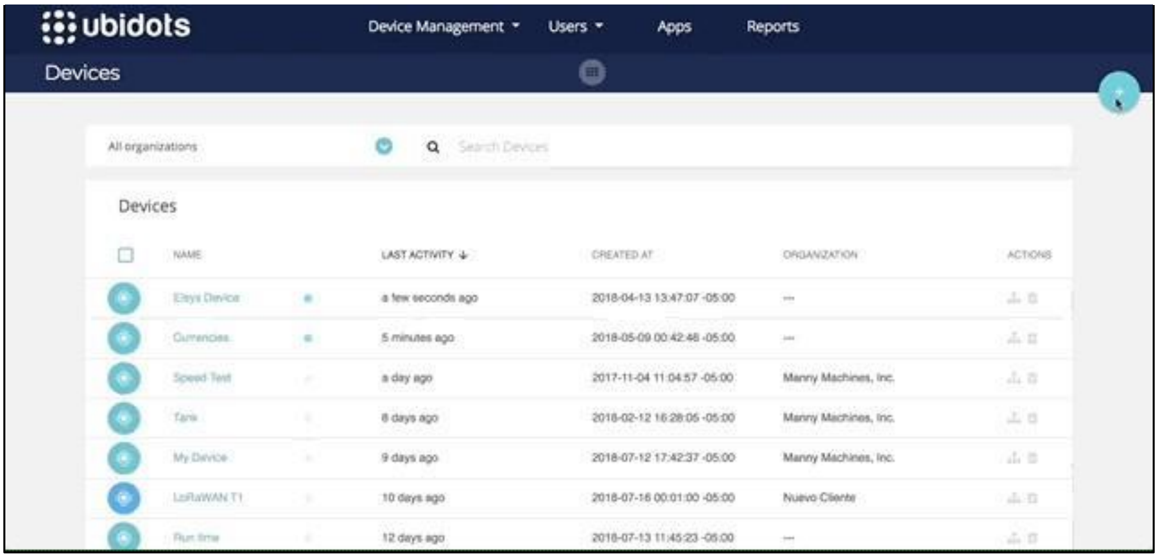
- A library that should be installed in the device's IDE. (not required)
- Filling parameters for authentication and connection such as a TOKEN (i.e. the unique ID for each account or user), device and variable labels (i.e. devices and variables unique identifiers in Ubidots), Wi-Fi SSID and Password, depending on the device and the requirements.
- Making API requests (i.e. a call from a device to the web server). Ubidots' libraries spare the need to manually make these requests. However, if you're working with a device not currently in the list of supported hardware, you can choose a connectivity protocol such as MQTT or HTTP and make a request using the API accordingly.

Creating devices: there are three ways to create devices:

. Devices are created automatically in Ubidots the first time a dot is received to a user's private TOKEN or an Organizational TOKEN.

. Clicking the "+" icon in the top right corner of any single device's screen.

. Creating a Device Type which then creates a new device with predetermined device properties, appearance, and variables and automates the on-boarding of thousands of devices.



4.3.2.2. Variables

Once a device is created and receiving data from your hardware or another 3rd party data-source, the data will be presented in its raw or calculated form as a variable.

Types of Variables:

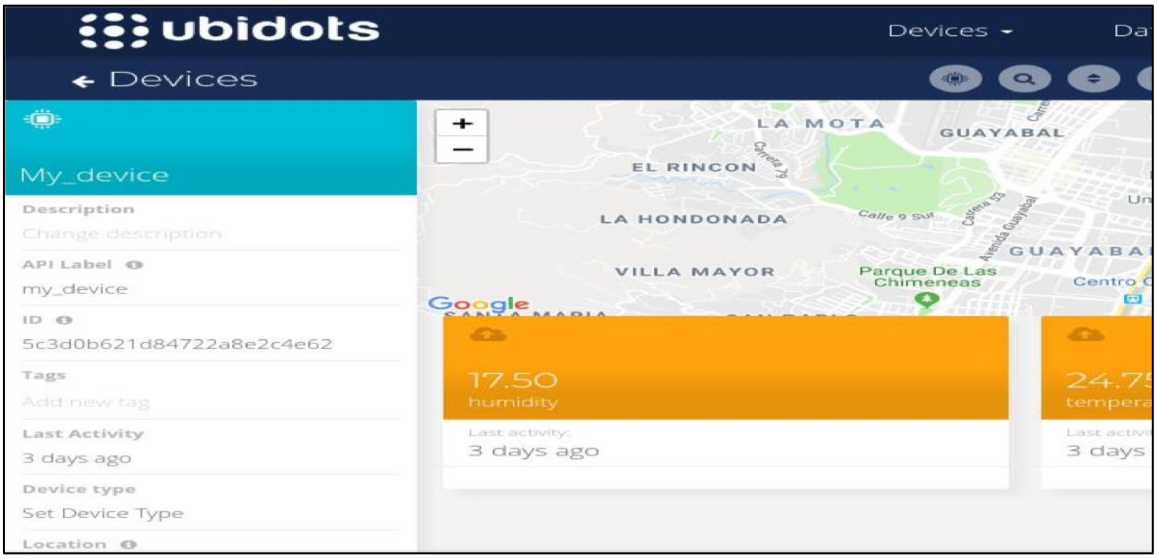
– Default - raw data coming from devices (people counted).

– Synthetic - correspond to statistical or arithmetical operations of default variables in a determined time-frame (e.g. average daily traffic this month).

Below you can read more about synthetic variable setups.

Creating variables: there are two ways to create variables.

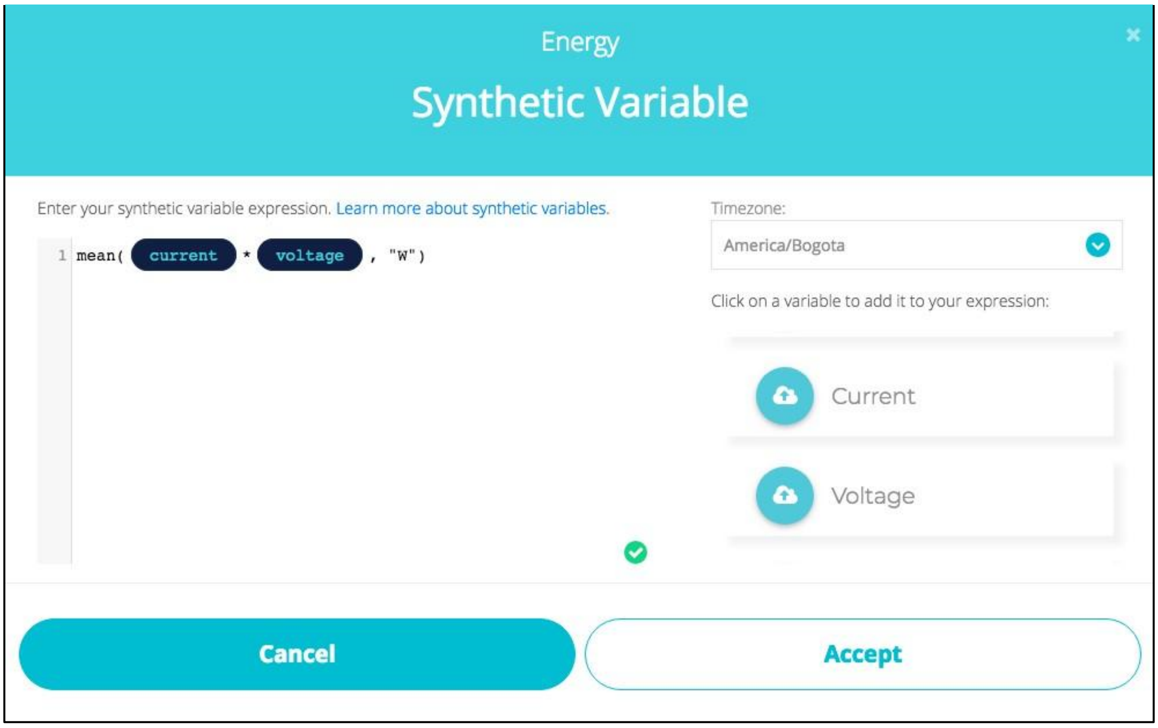
- Assigning a label as a variable within your hardware's code.
- Clicking the "+" icon found in any single device screen and assign a name which will also correspond to the variable's label. By default, Ubidots assigns an additional unique identifier to the variable called Variable ID. To find both the variable's ID and variable's label, select the "i" icon form the variables card.



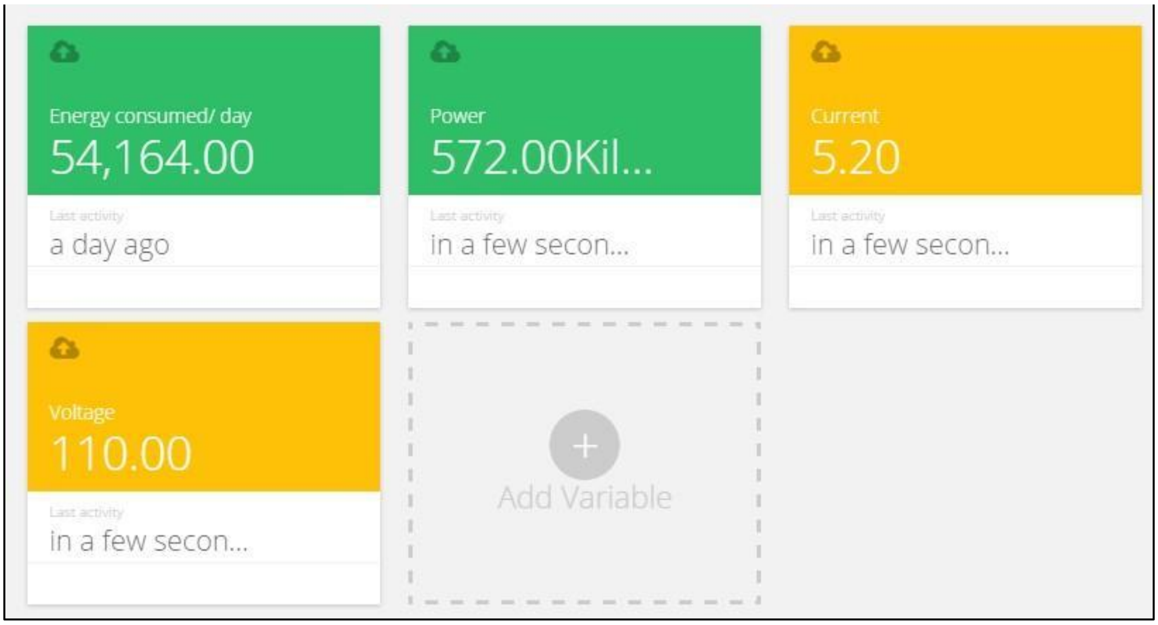
4.3.2.3 Synthetic Variables Engine

Ubidots Synthetic Variables (SV) Engine is a simple and effective way to create insights from the raw data stored in Ubidots' Cloud. Using Ubidots SV Engine, users can create Synthetic Variables that calculate and enhance data to give data-driven decision to user of an Ubidots powered application.

For example, to calculate Average (mean) Energy consumed this week, we will need to create a synthetic variable called Energy to calculate the product of Current and Voltage (P=C*V): the default variable Current is multiplied by Voltage. Then average the product every week with built-in function *mean()*. Synthetic Variables Analytics



Here is a complete list of available functions, such as cos(x) or ceil(x) functions, and more!



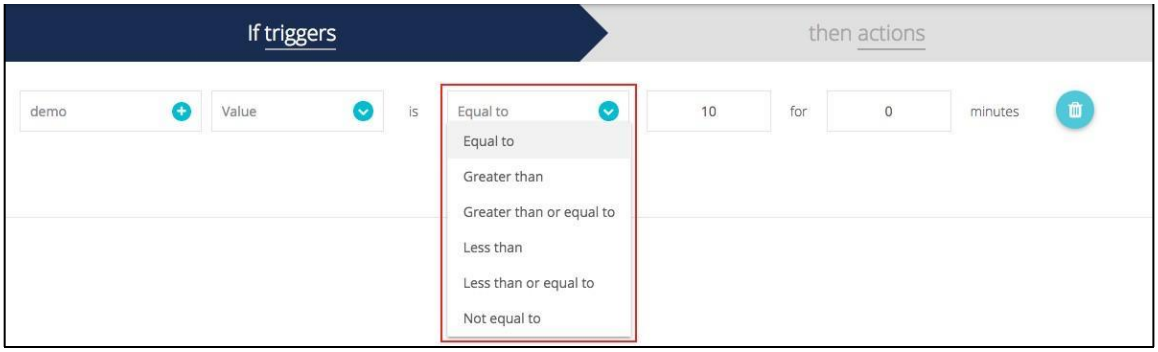
Note that default variables are yellow, and Synthetic Variables are green.

4. 4.3.2.4 Dashboards and Visualizations

Dashboards are the human-machine interfaces where data is easily visualized. Your Ubidots account will let you create as many dashboards as needed, containing widgets and data-visualizations to comprehend your data at a glance. For additional details on your dashboard's construction, check out this tutorial.

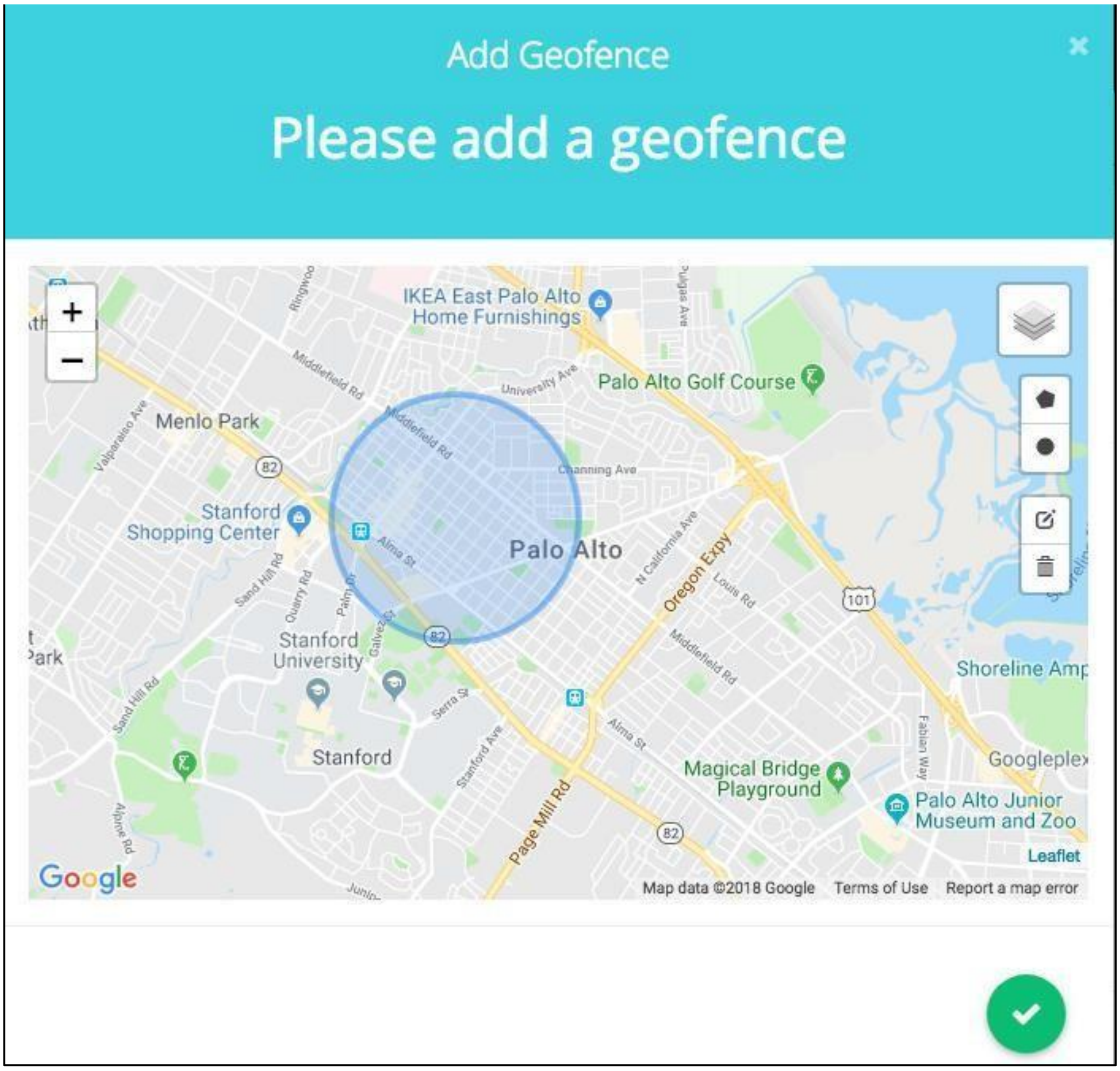
5. 4.3.2.5 Events

In Ubidots, Events are messages triggered and delivered through Email, SMS, Telegrams, Slack, Voice Call or webhook messages based on a customized design rule created in the application. If you wish to create alerts for your IoT application, check out this tutorial for additional support.



- Variable is inactive during a specific amount of time:

- When a device enters or exits a specific area (geofence):



You can also determine the format of alerts by choosing between emails, SMS, Telegrams or Webhook.

Other users also found helpful:

- Creating Devices in Ubidots
- Events: Was my event triggered? How to check the event's Log

- Device Types

4.3.2 EXPERIMENTAL SETUP

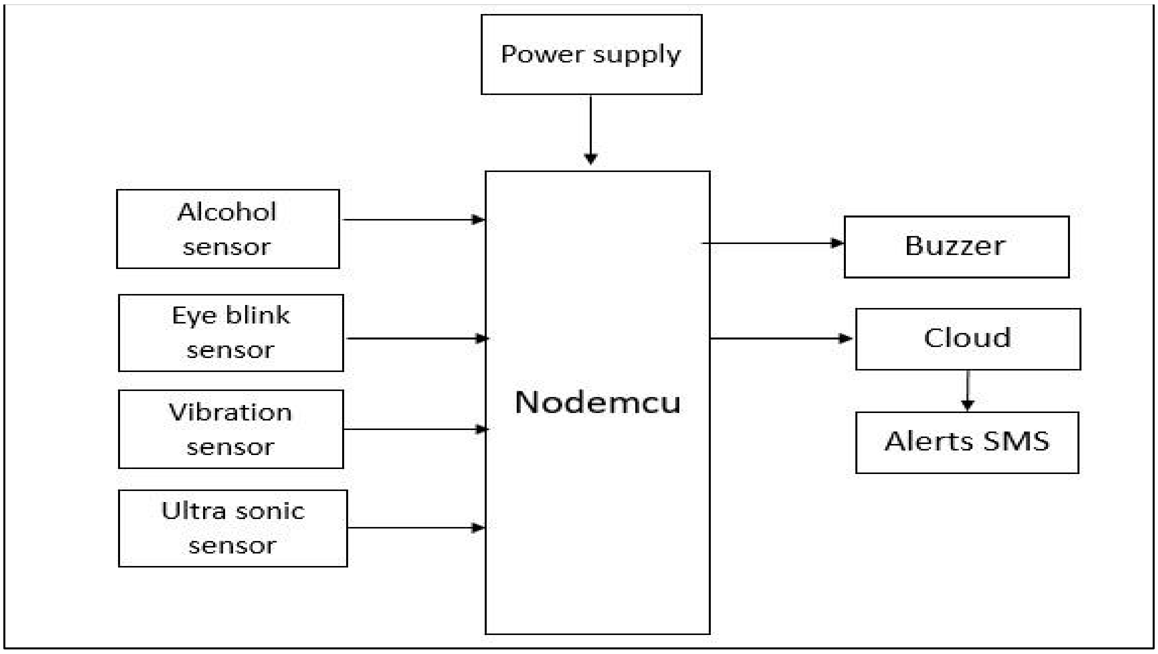


Fig:4.12 proposed block diagram

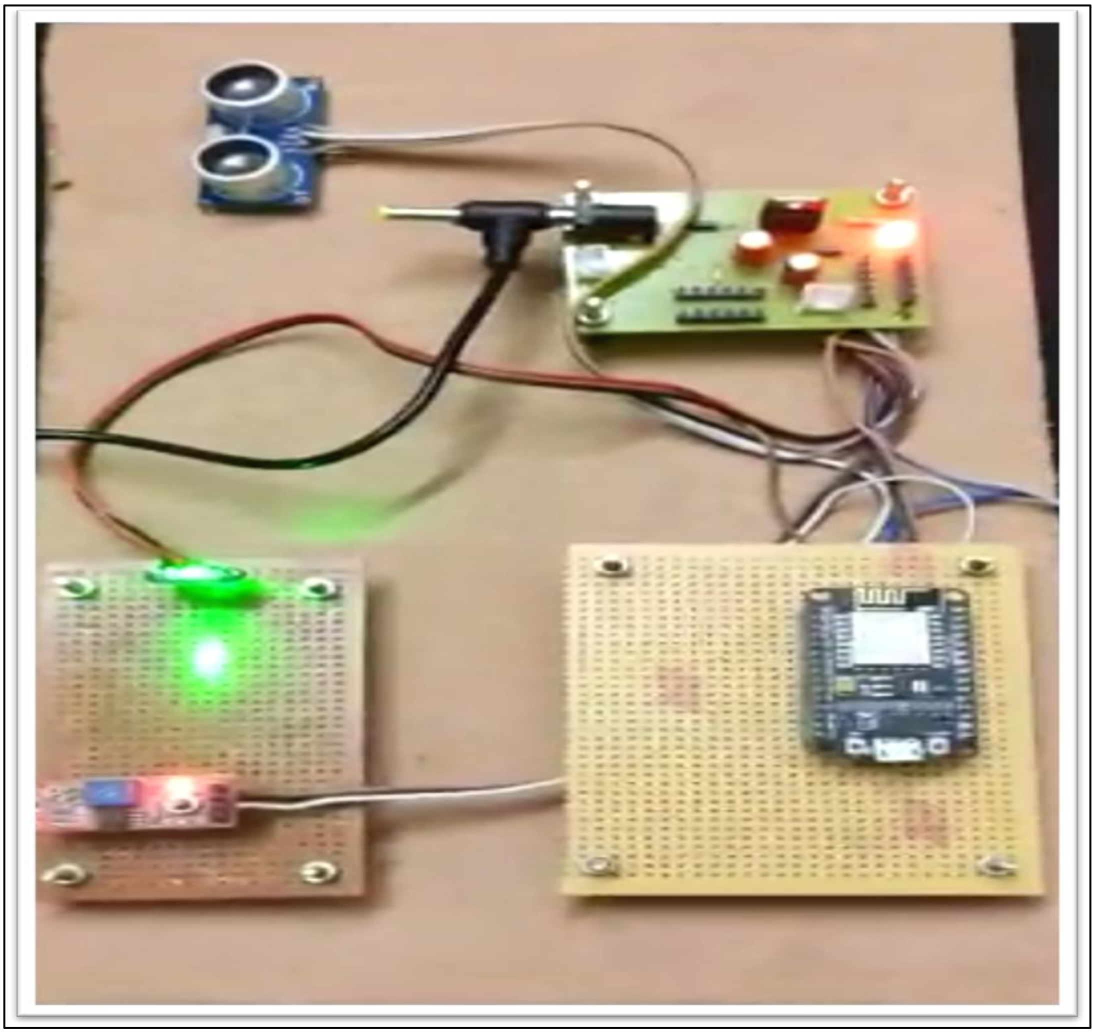


FIG no: 4.13 proposed connection diagram

CHAPTER

5.1 RESULTS AND DISCUSSION

The system is simulated using Arduino IDE as a tool to generate test results for each sensor by giving an input value to it. To use this tool, it is required to use a programmable circuit commonly known as a microcontroller which is the sole component for this tool. The code is written for sensors in C programming language in Arduino IDE and it is uploaded in the flash memory of the microcontroller to test the sensor. The data generated by the sensor can be analyzed in the output screen of the Arduino IDE.

• When accident is occurred, the location details of vehicle/object collected by the GPS from the cloud server, this information is in the form of latitude and longitude scale.

• Thus, collected information is then fed to NodeMCU. Necessary processing is completed and therefore the information is passed to the CLOUD and there it self we can get alerts.

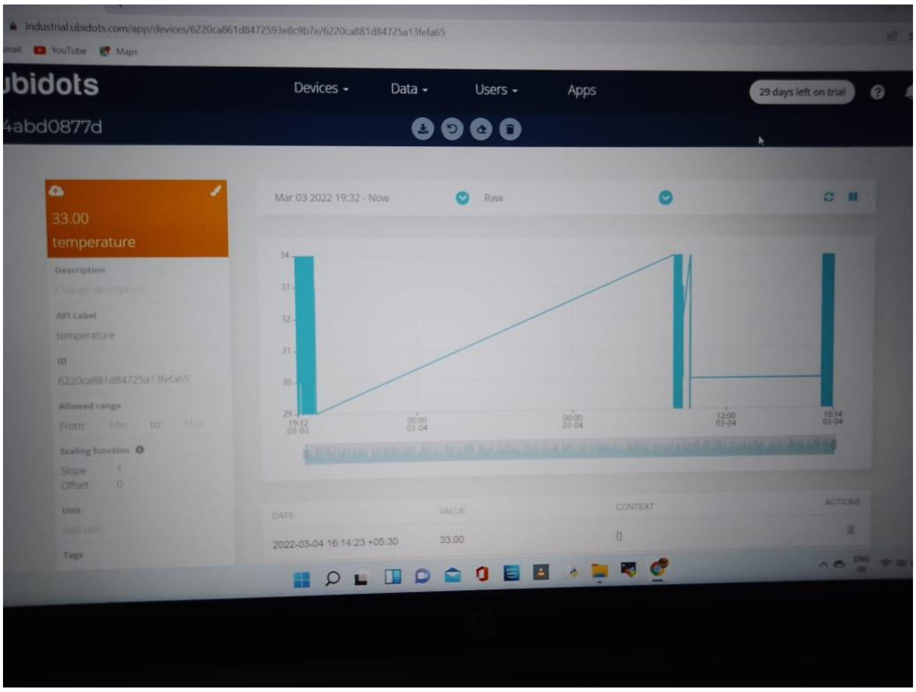


Fig no:5.1 temperature

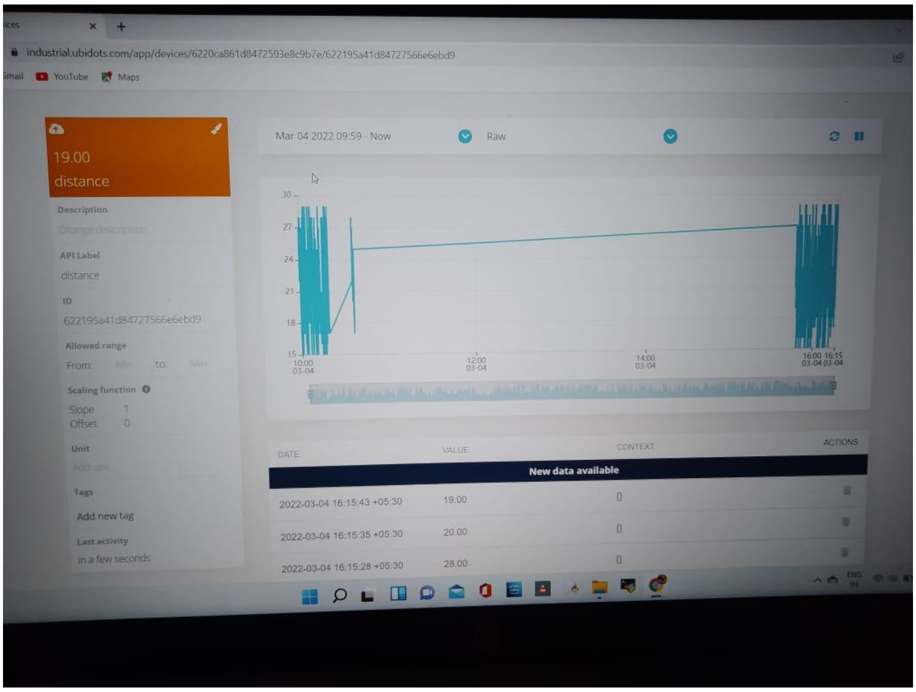


Fig no:5.2 distance

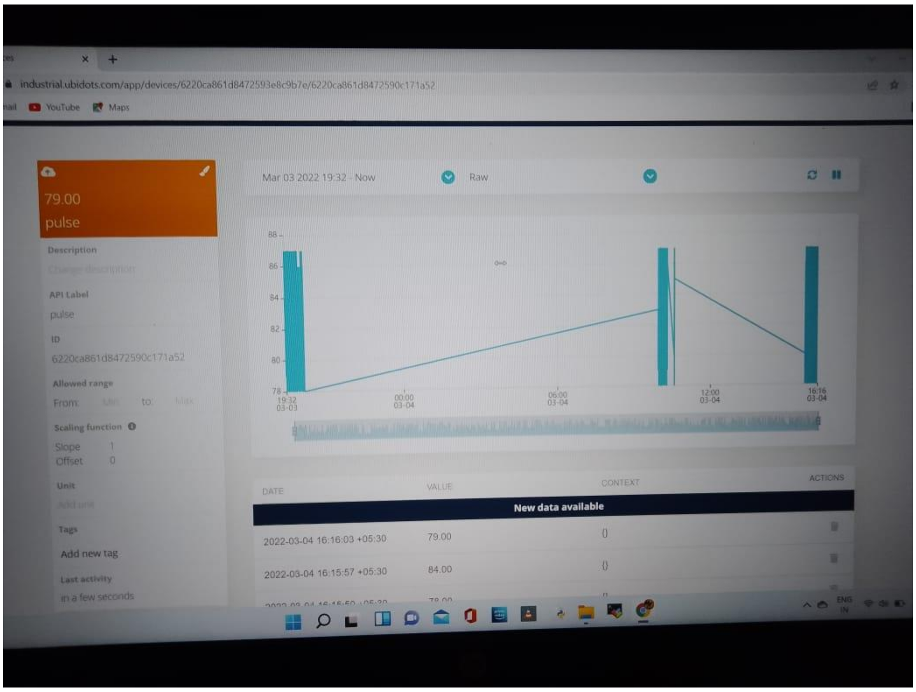


Fig no:5.3 pulse

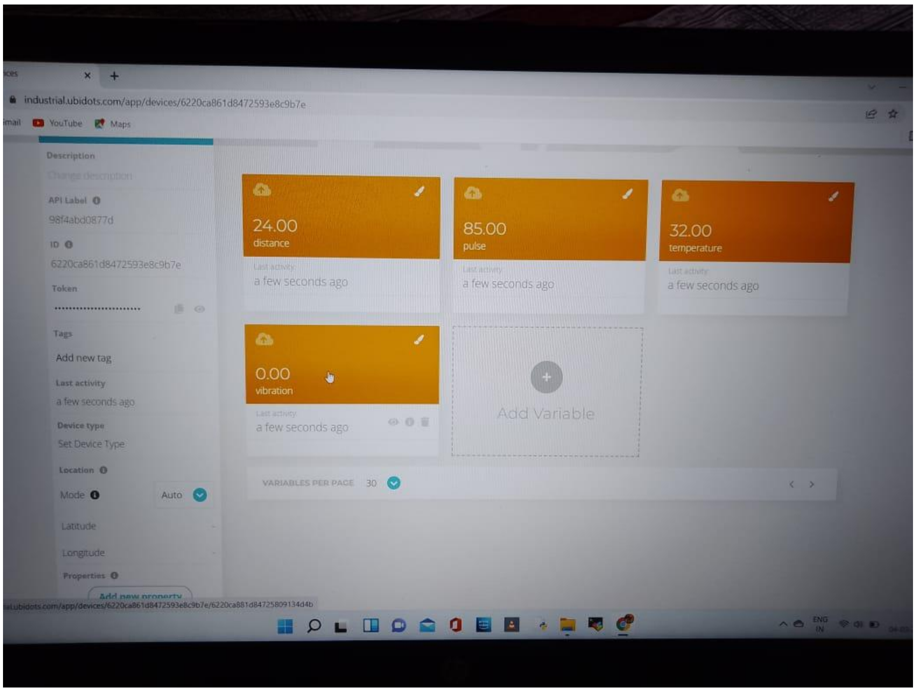


Fig no:5.4 outputs of all the sensors

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion:

IoT is a rapidly growing area of technology, and it has been successfully deployed in a car and a few tests have been conducted. Implementation of Vehicle Monitoring and Tracking system is implemented using Ultrasonic sensor, Gas Sensor, IR sensor, Temperature sensor, GPS Module to increase the safety of the driver and to avoid accidents, By using this system constant checking of the driver and also the conditions of the car is checked and also the location of the vehicle is traced. The driver or the person in the car is alerted by the mobile application. The system is cost-effective, dynamic and efficient.

6.2 Future scope:

This system can be interfaced with vehicle airbag system that prevents vehicle occupants from striking interior objects such as the steering wheel or window. This can also be developed by interconnecting a camera to the controller module that takes the photograph of the accident spot that makes the tracking easier.

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