HOME AUTOMATION USING IOT

Submitted in partial fulfilment of the requirements for the award

of Bachelor of Engineering Degree

in

Electronics and Communication Engineering

by

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

SCHOOL OF ELECTRICAL AND ELECTRONICS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600119

MAY 2022

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SAURABH ANAND (38130198) and SUMON SOURAB GHOSH (38130215)** Who carried out the project entitled **"HOME AUTOMATION USING IOT"** under our supervision from November 2021 to May 2022.

INTERNAL GUIDE

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DECLARATION

We Saurabh Anand (38130198) and Sumon Sourabh Ghosh (38130215) .hereby declare that the Project Report entitled "**HOME AUTOMATION USING IOT",**done by us under the guidance of Mr. L. Jegan Antony Marcilin, M.Tech., submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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2. SUMON SOURAB GHOSH

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ABSTRACT

Home monitoring system and control system are a device that is implemented using Internet of Things. The Internet of Things is the internetworking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The home monitoring system monitors doors and windows of your home and notifies you of any new access of your property via a data feed. Home monitoring system consists of sensors to detect intrusion and captures and sends multiple pictures of the intruder to the user anywhere through Internet. The system is implemented via the use of IOT, which is the interconnection of machines via Internet for advanced connectivity. . This proposed work presents a low cost and flexible le home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling devices and appliances remotely. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality

The primary objective of this project is to reduce human work. Automation has always been a prime factor for security system. We aimed in the project is to design and implement a security system. System that offers controllability through a hand held mobile phone by means of IOT and we controlling the home appliance through the internet there is no distance parameter for that we have to control the electrical appliance at anywhere in the world

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CHAPTER- 1.1

INTRODUCTION

Home monitoring system and control system are a device that is implemented using Internet of Things. The Internet of Things is the inter-networking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.The home monitoring system monitors doors and windows of your home and notifies you of any new access of your property via a data feed. Home monitoring system consists of sensors to detect intrusion and captures and sends multiple pictures of the intruder to the user anywhere through Internet.

The system is implemented via the use of IOT, which is the interconnection of machines via Internet for advanced connectivity. This paper presents a low cost and flexible le home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling devices and appliances remotely. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality Home automation is the control of any or all electrical devices in our home or office.

There are many different types of home automation system available. These systems are typically designed and purchased for different purposes. In fact, one of the major problems in the area is that these different systems are neither interoperable nor interconnected. There are number of issues involve when designing a home automation system. It should also provide a user friendly interface on the host side, so that the devices can be easily setup, monitored and controlled. In smart home systems, the internet is also use to ensure remote control. For years, the internet has been widely use for the processes such as surfing on the pages, searching information, chatting, downloading and installation.

By the rapid developments of new technologies, monitoring, controlling services have been started to be served along with internet as an instrument providing interaction with machinery and devices. The system can be use in several places like banks, hospital, labs and other sophisticated automated system, which dramatically reduced the hazards of unauthorized entry. The main reason to develop this system is to save time and man power along with maintaining security and convenience.

1.2 EXECUTIVE SUMMARY

The world has seen tremendous growth in telecom technology during the last decade. As a result of this, a multitude of new applications of the Information & Communication Technologies have emerged and changed the way we live, work, play, interact and even think. This has created a lot of momentum in many spheres that impact our lives. Latest trend is Machine-to-Machine (M2M) communication / Internet of Things (IoT) which has led to a new world of possibilities and opportunities. Smart Home is one of the focus areas in this initiative as is evident from the large number of IoT / M2M enabled nodes being created for this sector.

While 'Smart' inherently means 'connected' in IoT world, Smart Homes could have multiple meanings for different people and even different situations. A Smart Home is a user's private space and each user may have different needs. The users spend a significant amount of time at their homes and may have different expectations depending on their background, taste, affordability and availability of common services. A Smart Home is an aggregation of all the needs of its occupants while they are inside and also when they are not.

Remote control, Security, surveillance, remote monitoring of premises including monitoring those who are sick, young, elderly, etc are all requirements of users. In This document of Telecom Engineering Centre describes M2M/IoT Enablement in Homes to take into account the diverse needs of users as stated in previous paragraphs.It introduces the subject with brief illustration of M2M communication and its framework for Smart Homes. The report identifies key challenges: lack of standards and non-availability of high speed and reliable Internet services, indigenous manufacturing, etc.

Standards will allow for a level playing field for all participants that will benefit the customers. In the end, way forward has been suggested wherein action points on various aspects like adoption of standards, development of devices, certification mechanism etc. have been brought out. It may be mentioned here that the needs relevant to individual apartments, homes, and small establishments like shops or small scale industries operating from small buildings are covered in this document.

CHAPTER-2

LITERATURE SURVEY

Assaf Mansour and Ronaldo Mootoo ET AL(2012)

The conventional design of home security systems typically monitors only the property and lacks physical control aspects of the house itself. Also, the term security is not well defined because there is a time delay between the alarm system going on and actual arrival of the security personnel. This paper discusses the development of a home security and monitoring system that works where the traditional security systems that are mainly concerned about curbing burglary and gathering evidence against trespassing fail. The paper presents the design and implementation details of this new home control and security system based on field programmable gate array (FPGA) The user here can interact directly with the system through a web-based interface over the Internet, while home appliances like air conditioners, lights, door locks and gates are remotely controlled through a user-friendly web page. An additional feature that enhances the security aspect of the system is its capability of monitoring entry points such as doors and windows so that in the event any breach, an alerting email message is sent to the home owner instant.

Aman jha,Ranajay Malik ET AL (2017)

In today's world where energy management and conservation is a talked subject and smartphones are reshaping our lives, "Smart Home Lighting System" is one such area which is gaining lot of attraction in lighting industry. Major advancement in this field is "Bluetooth Low Energy" for connectivity and remote control. Bluetooth Low Energy (BLE) is seen as a promising technology for Smart Home Automation and Lighting. It is upward version of classic Bluetooth and works in same 2.4 GHz radio frequency band. One feature that is more prominent in BLE compared with classic Bluetooth is the reduced power consumption which makes it suitable for LED lighting segment. For high efficiency, long lifetime, better light quality and reliability, LED is already a winner in lighting technology. Adding smartness to LED light further boost its superiority. Selective turn on/turn off and brightness control results in increased system life and reduced energy consumption. As input is from AC source and LED is a constant current DC load, power quality is another major area of concern for LED lighting which need to be taken care. The recommended harmonic norms IEC61000-3-2 Class C, EMI limits (CISPR 15) and Energy Star (standby consumption) are also imposed for LED lighting.

Adrain Loan lita,D.Visan ET AL(2017)

In this paper is presented the design and the prototype implementation of a pneumatic door automation system intended to be used for access control in smart homes. The structure of the developed application is realized around the PIC 16F877A microcontroller which operates together with a pneumatic actuator based on a double acting cylinder controlled through an air distributor with solenoid valve. In the basic mode, the door opening and closing actions can be initiated manually by the user, through password authentification. The main parameters of the system can be configured locally, but an indepth diagnoses and reconfiguration can be performed only through the serial interface which ensure the communication between the main module of the system and an external PC. Compared with other similar systems, the proposed solution allows a high operation speed and very good reliability due to the pneumatic actuation. In addition, the door automation module can be integrated in a centralized access control system dedicated to the smart homes that has all the appliances and other electricity based equipments connected into a local network

Akshay Sharma A S, ET AL (2020)

In any household or industry or any agricultural field, water is a part of life and water tank is principal part of any building, home. In any common household, most of them have a water pump, which is operated manually by a person, switching it on and off, which is inconvenient and also sometimes causes wastage of water due to overflowing, which may in turn cause damage to roof, and also may cost you some penalty. Here, we use an ultrasonic sensor to sense the water level in the tank, which is processed by Node MCU, the water level in the sump is also sensed using Water level sensor. The water level in the tank and sump is noted and is sent to the Blynk IoT cloud, which a user can monitor remotely. The water in the tank is replenished immediately when it goes below prescribed level and stops pumping when tank reaches prescribed full level. The Blynk IoT also sends a notification to user whenever tank is empty or full. The user is also given manual control to turn the pump on and off. The pump doesn’trun and Blynk sends notification when the water in sump is low. Notification is also sent when there is a power failure.

Lamir Shkurti, Xhevahir Bajrami, Ercan Canhasi ET AL(2017)

In this paper they have developed a system for web based environment monitoring using the WSN Technology. WSN sensor nodes transmit data to the cloud-based database via Web API request. Measured data can be monitored by the user anywhere from internet by using the Web Application which one is also compatible for mobile phones. If the data measured by sensor node exceeds the configured value range in Web Application, Web Application sends a warning e-mail to users for improving environmental conditions.

Hayet Lamine and Hafedh Abid ET AL (2014)

In this paper, they proposed a Remote control of a domestic equipment from an Android application based on Raspberry pi card. Home automation has been recalled in the first stage. In the second stage an application has been developed based on the android system. The different diagrams have been presented. Different codes have been developed to allow the communication between the remote user, the web server, the raspberry pi card and the home components. Also an interface card has been developed to assure the communication between the home components and raspberry pi card. The application has been installed on a Smartphone, a web server and a raspberry pi card to order the shutter of windows. The experimental results are successful.

Vaishnavi S. Gunge and Pratibha S. Yalagi ET AL (2016)

Home automation is becoming popular due to its numerous benefits. Home automation refers to the control of home appliances and domestic features by local networking or by remote control. Artificial Intelligence provides us the framework to go real-time decision and automation for Internet of Things (IoT). The work deals with discussion about different intelligent home automation systems and technologies from a various features standpoint. The work focuses on concept of home automation where the monitoring and control operations are facilitating through smart devices installed in residential buildings. Heterogeneous home-automation systems and technologies considered in review with central controller based (Arduino or Raspberry pi), web based, email based, Bluetooth-based, mobile-based, SMS based, ZigBee based, Dual Tone Multi Frequency-based, cloud-based and the Internet with performance.

Abhishek Vichare,Shilpa Verma (2012)

Main aim of this paper is to describe how to connect a micro- controller to LAN or Internet and use it as a web server. This paper offers a new approach to control home appliances from a remote terminal, with an option from a local server, using the Internet. This system is accomplished by personal computers, interface cards, microcontroller, along with window-type software and microcontroller control software. The system is designed to control home appliances' on/off, to regulate their output power, and to set their usage timing. The microcontroller which is used in this project is the Philips P89C51RD2BN microcontroller.

CHAPTER-3

EXISTING SYSTEM

Design and Realization of Home Appliances Control System Based on The Android Smartphone present the information about the remote appliances control system based on the Android smart phone is designed and realized. A user logs into the smart phone interface, and clicks the buttons gently to send message commands which will be transmitted to home information Center through the GSM network. Then the PIC processor recognizes the specified command, and controls the home appliance switches in the wireless radio frequency manner to achieve remote control of appliances ultimately. The existing system of our project didn't use Internet of things concept to control the home appliances. This is suitable for modern technologies to control devices wherever you located in the world. So, we are moving to the IOT technology as proposed system in our project for the home automation.

DISDAVANTAGES OF EXISTING SYSTEM:

- No remote control operation
- Depend on others to operate
- No muscle contraction sensing
- Direct pc interaction
- There are various existing technologies available for similar purposes but their cost and complexity is major disadvantage.
- To use system that takes the input from the voice recognition module and uses the microcontroller's intelligence to operate different devices.

CHAPTER – 4

PROPOSED SYSTEM

The proposed system designed for security purpose and to monitor the basically consists of Arduino module and sensor. Node MCU is connected to the internet through IOT Technology with sensors to monitor the home efficiently. We connected PIR,Vibration,Gas and LDR Sensors to the Node MCU to monitor our home through IOT Technology. We can control home electrical devices such as bulb, fan, motor through the Internet of Things(IOT)

Home monitoring system consists of sensors to detect intrusion and captures and sends multiple pictures of the intruder to the user anywhere through Internet. The system is implemented via the use of IOT, which is the interconnection of machines via Internet for advanced connectivity

ADVANTAGES OF PROPOSED SYSTEM:

- Long distance coverage
- Real time controlling and monitoring
- Control through mobile, pc and also the phablets
- Low cost and expandable allowing a variety of devices to be controlled
- Saves money and energy
- All in one user friendly system
- This is noise free system.
- High secured

4.1.BLOCK DIAGRAM

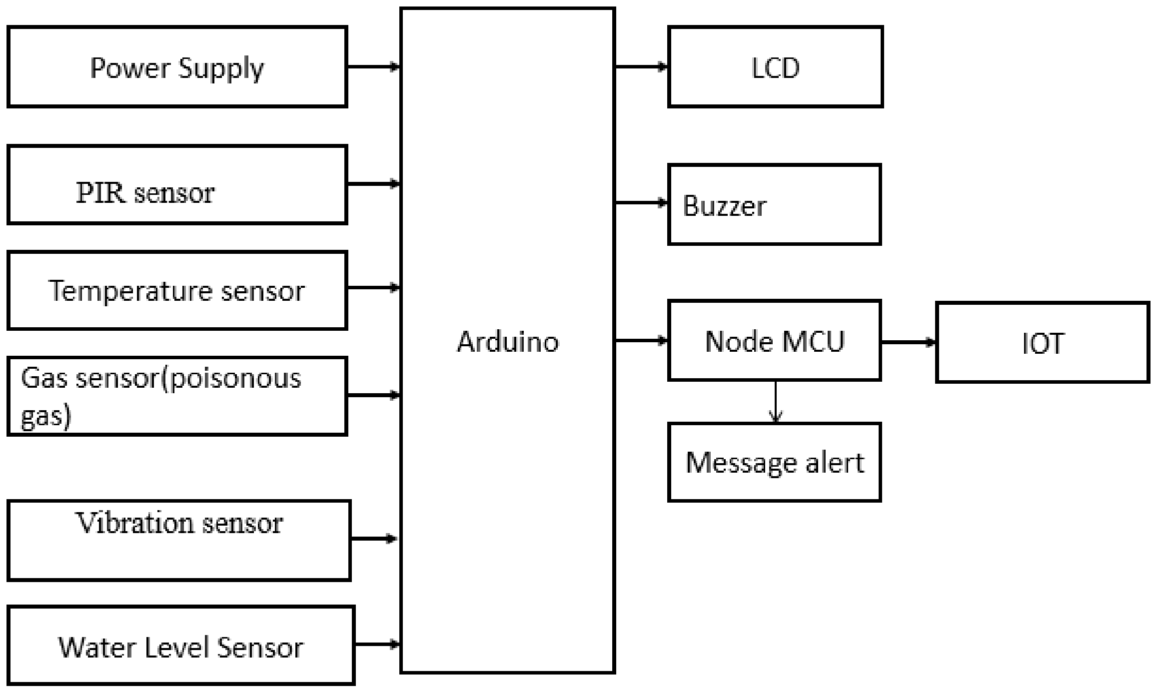


Fig:4.1: Block Diagram of proposed system.

4.2. HARDWARE USED:

- **Node MCU**
- **Temperature sensor**
- **PIR sensor**
- **Gas sensor**
- **Vibration sensor**
- **Arduino Nano**
- **Water Level Sensor**

SOFTWARE USED:

- **Arduino IDE**
- **Proteus simulator**
- **Embedded C Programming**

4.3. 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 be 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.

4.3.1 Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Nano board (Spark fun DEV-09950, $29.95), a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. Many of the pictures and drawings in this guide were taken from the documentation on the

The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Nano is a microcontroller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Nano differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.3.2. FEATURES OF ARDUINO

Microcontroller ATmega328

Operating Voltage 5V

Input Voltage (recommended) 7-12V

Input Voltage (limits) 6-20V

Digital I/O Pins 14 (of which 6 provide PWM output)

Analog Input Pins 6

DC Current per I/O Pin 40 mA

DC Current for 3.3V Pin 50 mA

Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader

SRAM 2 KB (ATmega328)

EEPROM 1 KB (ATmega328)

Clock Speed 16 MHz

4.3.3 Pin Configuration

The Arduino Nano can be powered via the USB connection or with an external power supply. The power source is selected automatically.External (non-USB) power can come either from an AC-to-DC adapter (wall- wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

VIN.- The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V- this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.

3V3 -A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND -Ground pins.

IOREF - This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digital Write( ), and digital Read( ) functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull- up resistor (disconnected by default) of 20-50 kohms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and Trans mit (TX) TTL serial data.

These pins are connected to the corresponding pins of the ATmega8U2 USB-to- TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13. There is a built- in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference () function. Additionally, some pins have specialized functionality:

TWI - A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

AREF - Reference voltage for the analog inputs. Used with analog Reference ().

Reset - Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.3.4.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 proposed system. 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, a 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 Nano'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 t hings 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” codeRepositories that extend core programming functionality. Libraries let you re- use code without having to physically copy and paste it into all your programs.

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

4.3.5 ARDUINO SOFTWARE

1. Open Arduino IDE as shown below

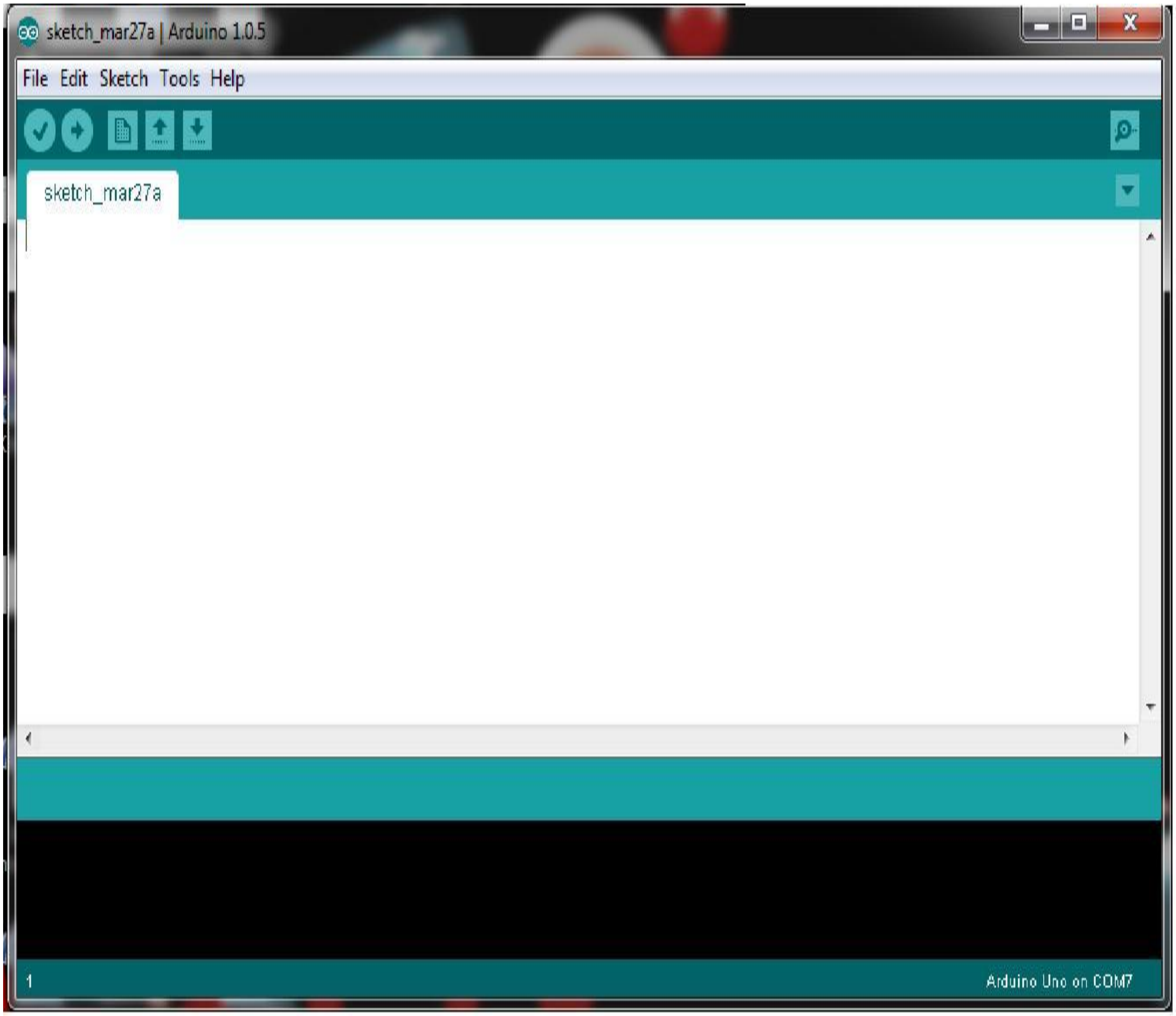


FIG: 4.2: Arduino IDE

2.Select the COM Port

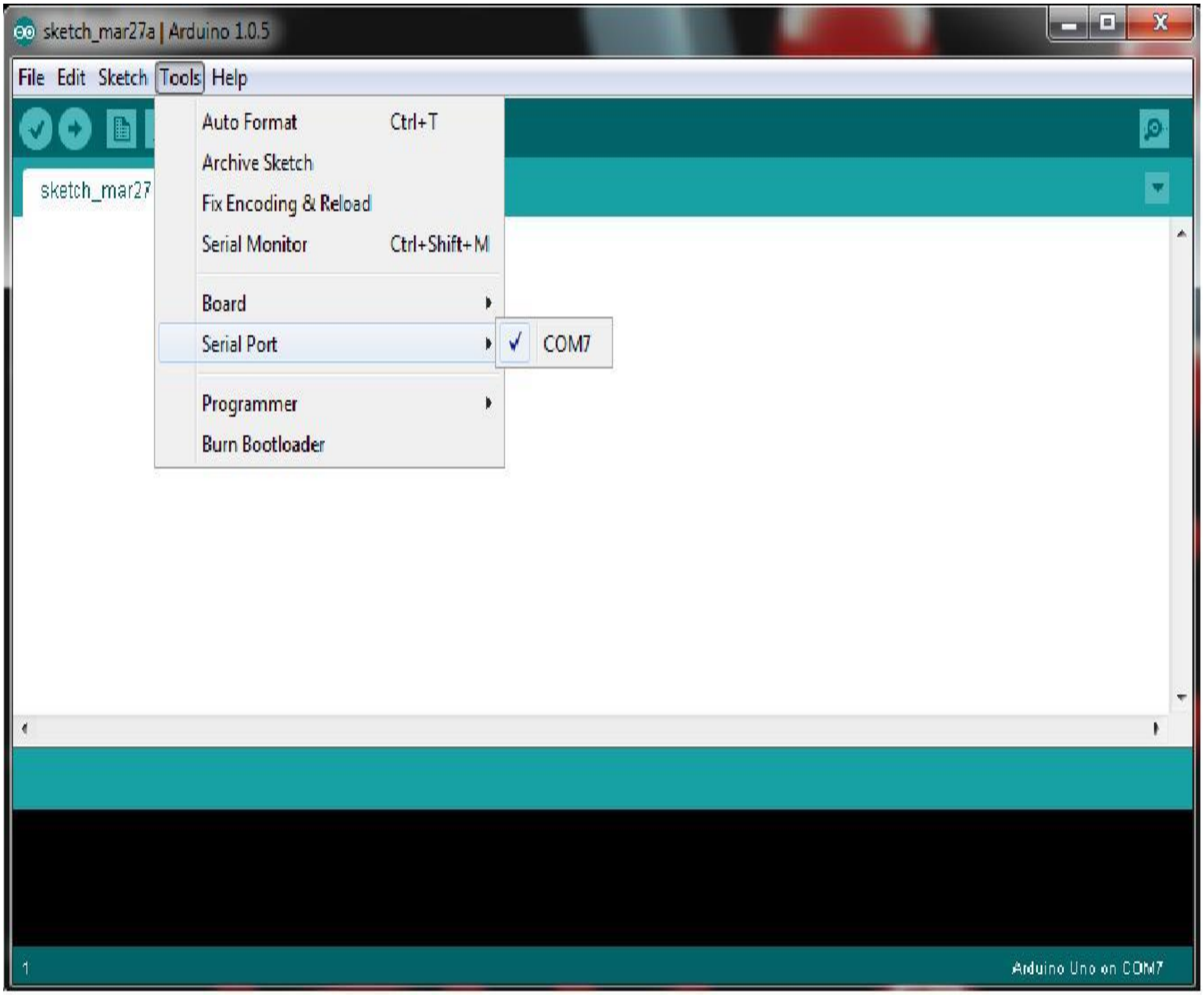


Fig:4.3: COM Port to recognize the arduino.

3. Select the required Arduino board from Tools as shown below

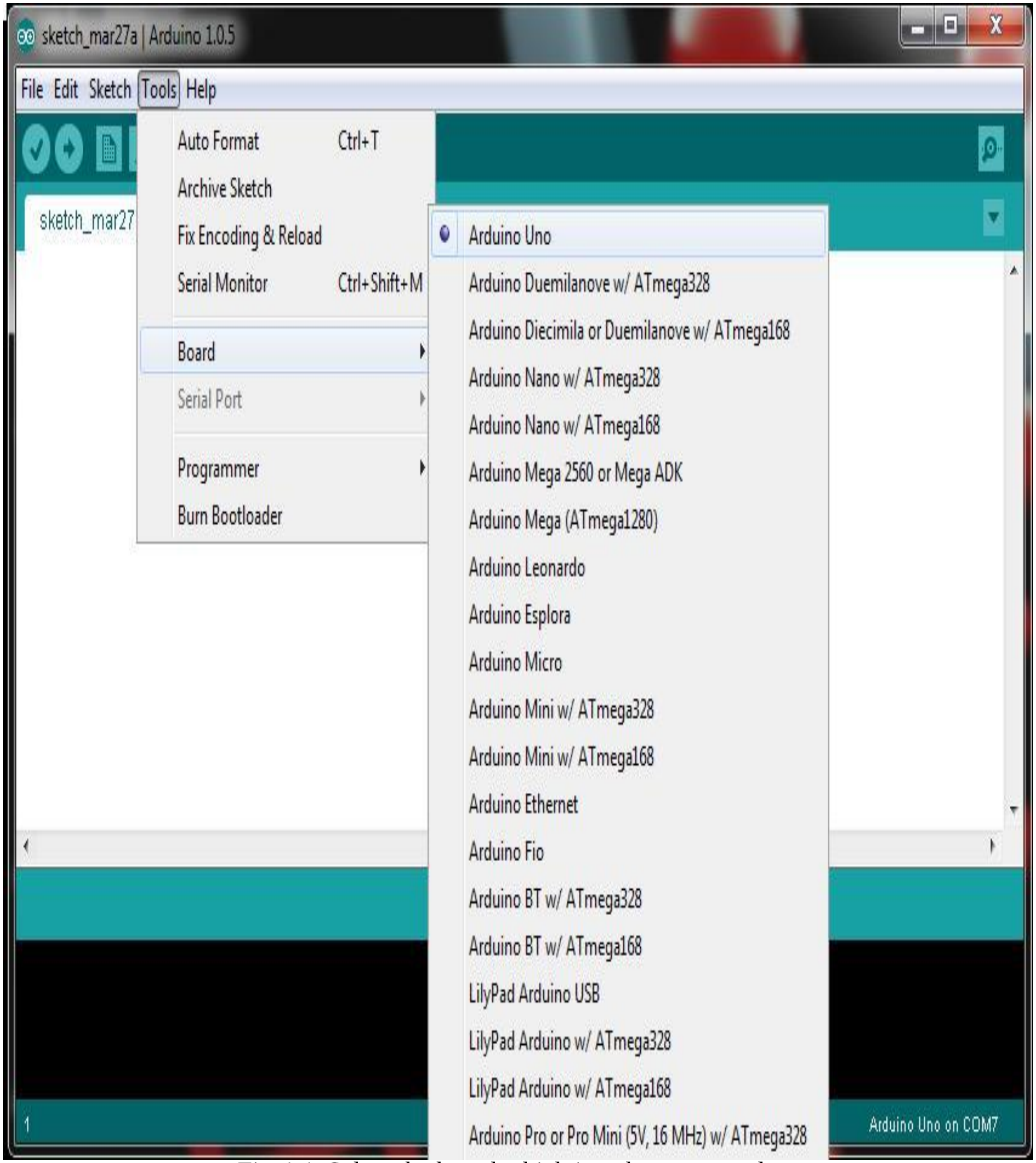


Fig:4.4: Select the board which is to be connected

4. Write the sketch in Arduino IDE

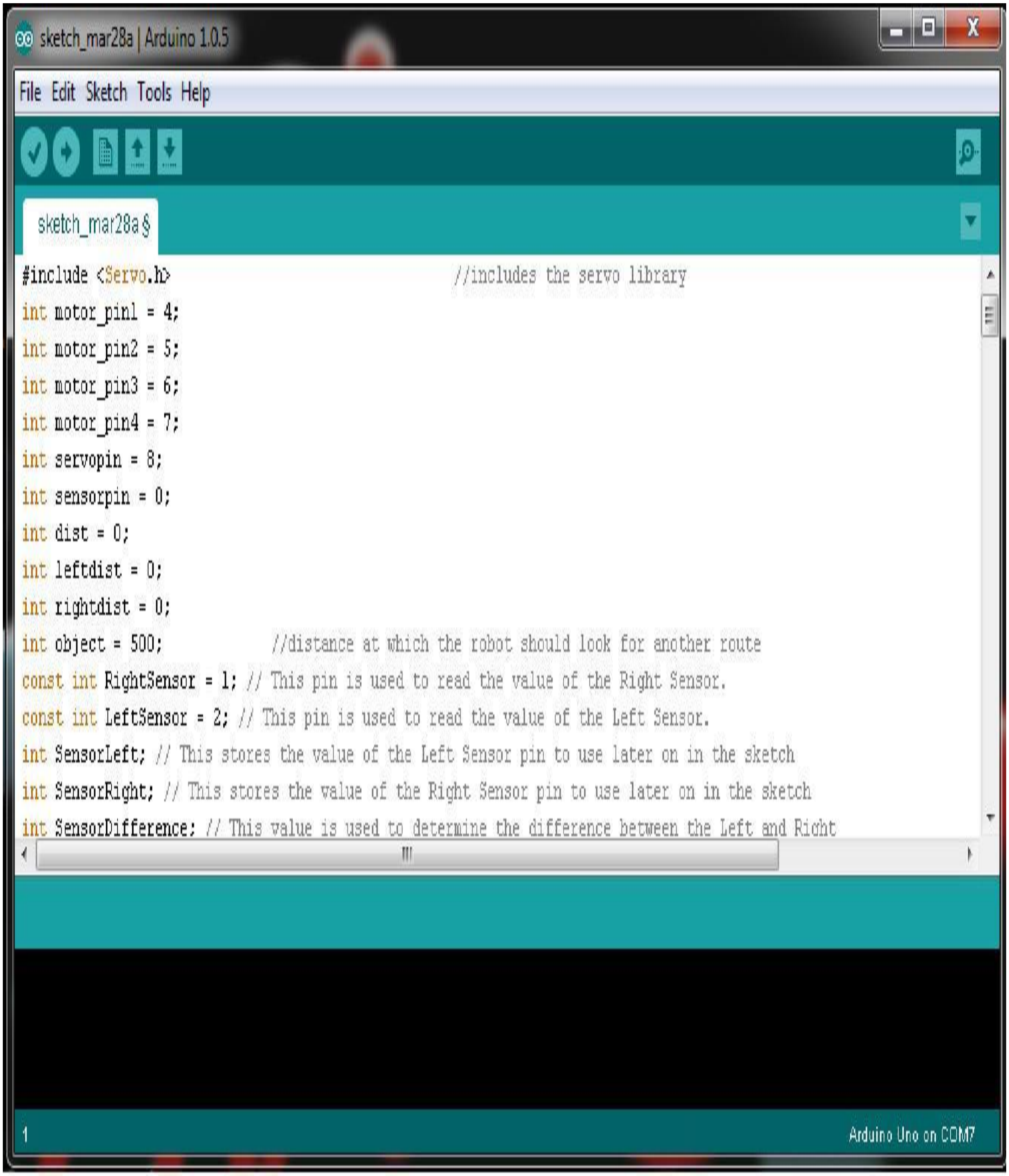


Fig:4.5: Sketch is used to write the piece of code that is to be uploaded to arduino

5. Compile and upload the Sketch to Arduino board

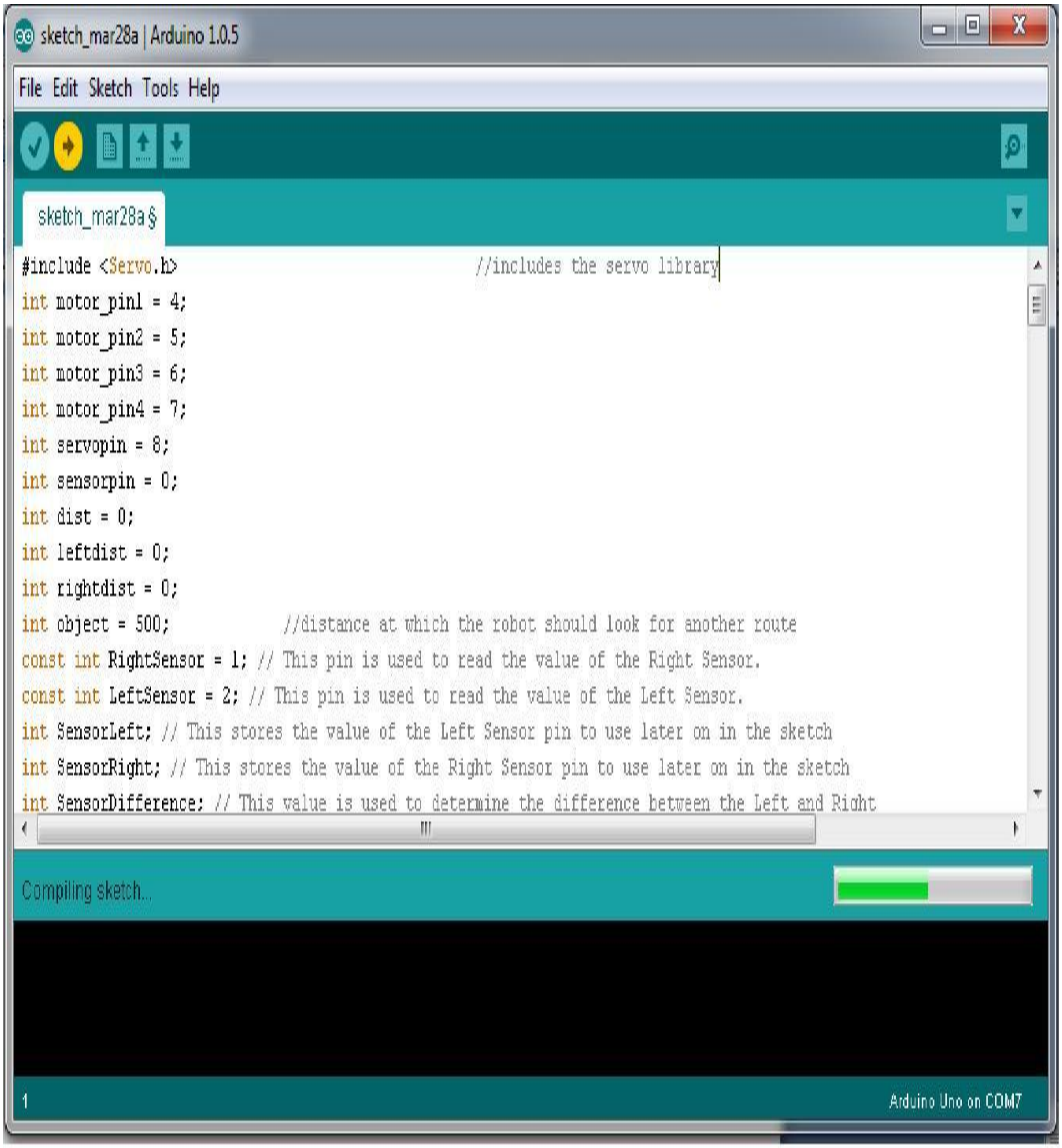


Fig:4.6: Uploading the sketch to arduino

4.4.NODE MCU

Node MCU 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. The Node MCU Development Board can be easily programmed with Arduino IDE since it is easy to use. Programming with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the Node MCU board itself. You can check this Getting_started with Arduino Nano to prepare your Arduino IDE for Node MCU. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. 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 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.

ESP8266 Arduino

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

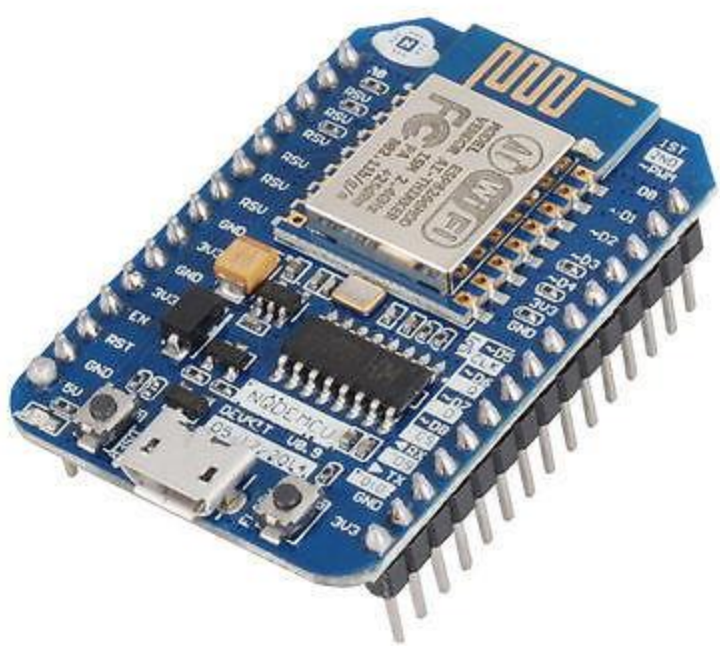


Fig:4.7: Wifi module

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 wifi enabled chip. The **ESP8266** is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol.

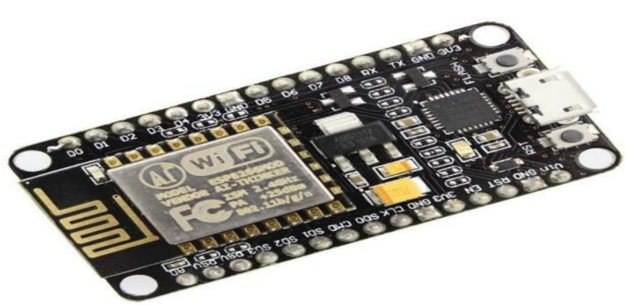


Fig.4.8 Wifi Module Version 1

Starting with NodeMCU

NodeMCU Development board is featured with wifi 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.

Coding 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 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.

The difference in using ESPlorer and Arduino IDE

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

i. Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106

ii. Operating Voltage: 3.3V

iii. Input Voltage: 7-12V

iv. Digital I/O Pins (DIO): 16

v. Analog Input Pins (ADC): 1

vi. UARTs: 1

vii. SPIs: 1

viii. I2Cs: 1

ix. Flash Memory: 4 MB

x. SRAM: 64 KB

xi. Clock Speed: 80 MHz

xii. USB-TTL based on CP2102 is included onboard, Enabling Plug n Play

xiii. PCB Antenna

xiv. Small Sized module to fit smartly inside your IoT projects

4.5. MOTION SENSOR

A PIR detector is a motion detector that senses the heat emitted by a living body. These are often fitted to security lights so that they will switch on automatically if approached. They are very effective in enhancing home security systems. The sensor is passive because, instead of emitting a beam of light or microwave energy that must be interrupted by a passing person in order to “sense” that person, the PIR is simply sensitive to the infrared energy emitted by every living thing. When an intruder walks into the detector’s field of vision, the detector “sees” a sharp increase in infrared energy. A PIR sensor light is designed to turn on when a person approaches, but will not react to a person standing still. The lights are designed this way. A moving person exhibits a sudden change in infrared energy, but a slower change is emitted by a motionless body. Slower changes are also caused by gradual fluctuations in the temperature of the environment. If the light were sensitive to these slower changes, it would react to the sidewalk cooling off at night, instead of the motion of a burglar.

If you have a PIR light, you may notice that it is more sensitive on cold days than on warm days. This is because the difference in temperature between the ambient air and the human body is greater on cold days, making the rise in temperature easier for the sensor to detect. This has drawbacks, though; if the sensor is too sensitive, it will pick up things you don't want it to such as the movement of small animals. Passive infrared sensor is an electronic device, which measures infrared light radiating from objects in its field of view. PIRs are often used in the construction of PIR-based motion detectors.

Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. All objects emit what is known as black body radiation. This energy is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term 'Passive' in this instance means the PIR does not emit energy of any type but merely accepts incoming infrared radiation. Infrared radiation enters through the front of the sensor, known as the sensor face.

At the core of a PIR is a solid state sensor or set of sensors, made from approximately 1/4 inches square of natural or artificial pyroelectric materials, usually in the form of a thin film, out of gallium nitride (GaN), caesium nitrate ($CsNO_3$), polyvinyl fluorides, derivatives of phenylpyrazine, and cobalt phthalocyanine. (See pyroelectric crystals.) Lithium tantalate ($LiTaO_3$) is a crystal exhibiting both piezoelectric and pyroelectric properties.The sensor is often manufactured as part of an integrated circuit and may consist of one (1), two (2) or four (4) 'pixels' of equal areas of the pyroelectric material.

Pairs of the sensor pixels may be wired as opposite inputs to a differential amplifier. In such a configuration, the PIR measurements cancel each other so that the average temperature of the field of view is removed from the electrical signal; an increase of IR energy across the entire sensor is self-cancelling and will not trigger the device. This allows the device to resist false indications of change in the event of being exposed to flashes of light or field-wide illumination. It minimizes common-mode interference; this allows the device to resist triggering due to nearby electric fields. However, a differential pair of sensors cannot measure temperature in that configuration and therefore this configuration is specialized for motion detectors.In a PIR-based motion detector, the PIR sensor is typically mounted on a printed circuit board, which also contains the necessary electronics required to interpret the signals from the chip.

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

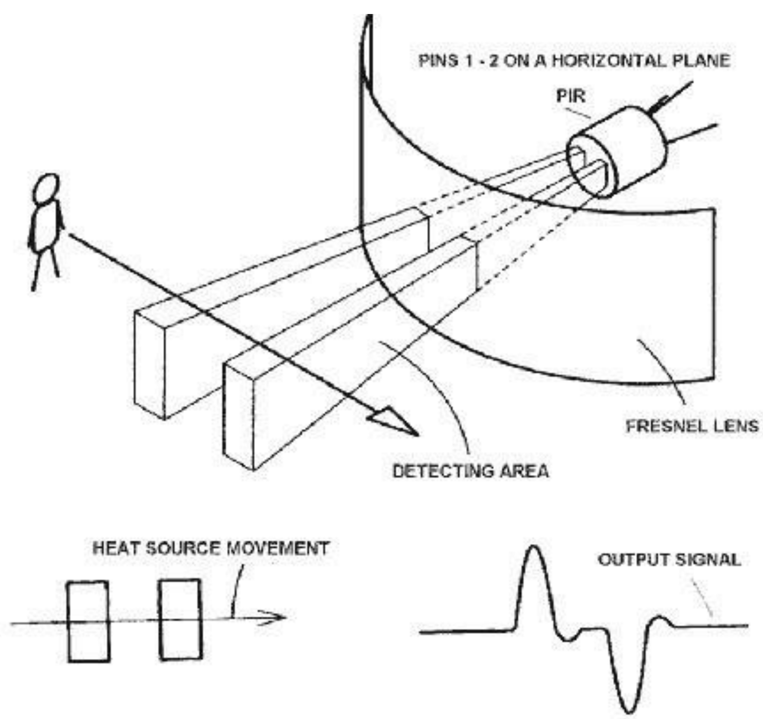


Fig.4.9 Working of a PIR sensor.

4.5.1 The PIR Sensor

The IR sensor itself is housed in a hermetically sealed metal can to improve noise/temperature/humidity immunity. There is a window made of IR-transmissive material (typically coated silicon since that is very easy to come by) that protects the sensing element. Behind the window are the two balanced sensors.

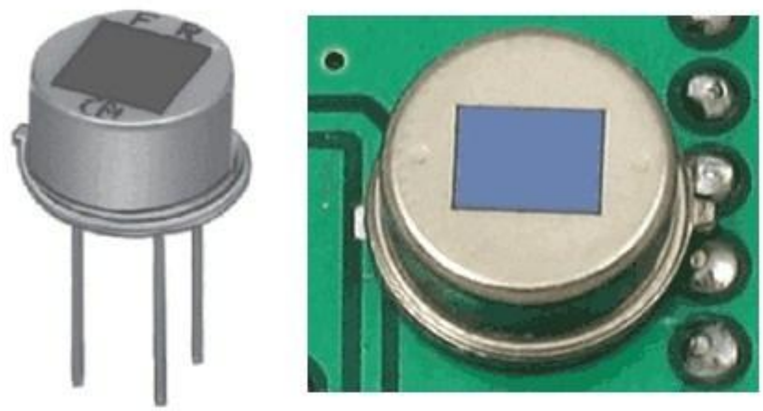


Fig.4.10 IR sensor in the PIR

4.5.2.Lenses

PIR sensors are rather generic and for the most part vary only in price and sensitivity. Most of the real magic happens with the optics. This is a pretty good idea for manufacturing: the PIR sensor and circuitry is fixed and costs a few dollars. The lens costs only a few cents and can change the breadth, range, sensing pattern, very easily.

In the diagram up top, the lens is just a piece of plastic, but that means that the detection area is just two rectangles. Usually we'd like to have a detection area that is much larger. To do that, we use a simple lens such as those found in a camera: they condenses a large area (such as a landscape) into a small one (on film or a CCD sensor). For reasons that will be apparent soon, we would like to make the PIR lenses small and thin and moldable from cheap plastic, even though it may add distortion.

Fig:4.11: Connecting PIR and knowing the pins

Most PIR modules have a 3-pin connection at the side or bottom. The pinout may vary between modules so triple-check the pinout! It's often silkscreened on right next to the connection (at least, ours is!) One pin will be ground, another will be signal and the final one will be power. Power is usually 3-5VDC input but may be as high as 12V. Sometimes larger modules don't have direct output and instead just operate a relay in which case there is ground, power and the two switch connections.

The output of some relays may be 'open collector' - that means it requires a pullup resistor. If you're not getting a variable output be sure to try attaching a 10K pullup between the signal and power pins.

An easy way of prototyping with PIR sensors is to connect it to a breadboard since the connection port is 0.1" spacing. Some PIRs come with header on them already, the one's from adafruit have a straight 3-pin header on them for connecting a cable

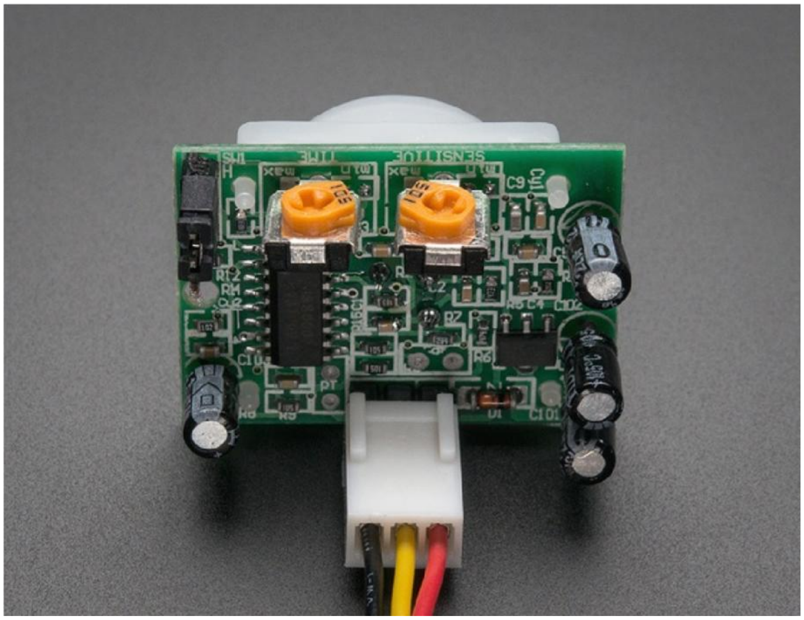


Fig: 4.12:Pins of PIR

For our PIR's the red cable is + voltage power, black cable is - ground power and yellow is the signal out. Just make sure you plug the cable in as shown above! If you get it backwards you won't damage the PIR but it won't work.

Fig:4.13:Connecting circuit to a PIR

Now when the PIR detects motion, the output pin will go "high" to 3.3V and light up the LED! Once you have the breadboard wired up, insert batteries and wait 30-60 seconds for the PIR to 'stabilize'. During that time the LED may blink a little. Wait until the LED is off and then move around in front of it, waving a hand, etc, to see the LED light up! Retriggering There's a couple options you may have with your PIR. First up we'll explore the 'Retriggering' option. Once you have the LED blinking, look on the back of the PIR sensor and make sure that the jumper is placed in the L position as shown below.

4.5.2 OPERATION OF PIR SENSOR:

A few mechanisms have been used to focus the distant infrared energy onto the sensor surface. The window may have Fresnel lenses molded into it. Alternatively, sometimes PIR sensors are used with plastic segmented parabolic mirrors to focus the infrared energy; when mirrors are used, the plastic window cover has no Fresnel lenses molded into it. A filtering window (or lens) may be used to limit the wavelengths to 8-14 micrometers, which is most sensitive to human infrared radiation (9.4 micrometers being the strongest).

The PIR device can be thought of as a kind of infrared ‘camera’, which remembers the amount of infrared energy focused on its surface. Once power is applied to the PIR the electronics in the PIR shortly settle into a quiescent state and energize a small relay. This relay controls a set of electrical contacts, which are usually connected to the detection input of an alarm control panel. If the amount of infrared energy focused on the sensor changes within a configured time period, the device will switch the state of the alarm output relay. The alarm output relay is typically a "normally closed (NC)" relay; also know as a "Form B" relay.

A person entering the monitored area is detected when the infrared energy emitted from the intruder's body is focused by a Fresnel lens or a mirror segment and overlaps a section on the chip, which had previously been looking at some much cooler part of the protected area. That portion of the chip is now much warmer than when the intruder wasn't there. As the intruder moves, so does the hot spot on the surface of the chip. This moving hot spot causes the electronics connected to the chip to de-energize the relay, operating its contacts, thereby activating the detection input on the alarm control panel. Conversely, if an intruder were to try to defeat a PIR perhaps .

By holding some sort of thermal shield between himself and the PIR, a corresponding 'cold' spot moving across the face of the chip will also cause the relay to de-energize unless the thermal shield has the same temperature as the objects behind it.

Manufacturers recommend careful placement of their products to prevent false alarms. They suggest mounting the PIRs in such a way that the PIR cannot 'see' out of a window. Although the wavelength of infrared radiation to which the chips are sensitive does not penetrate glass very well, a strong infrared source (a vehicle headlight, sunlight reflecting from a vehicle window) can overload the chip with enough infrared energy to fool the electronics and cause a false (non-intruder caused) alarm. A person moving on the other side of the glass however would not be 'seen' by the PIR.

They also recommended that the PIR not be placed in such a position that an HVAC vent would blow hot or cold air onto the surface of the plastic, which covers the housing's window. Although air has very low emissivity (emits very small amounts of infrared energy), the air blowing on the plastic window cover could change the plastic's temperature enough to, once again, fool the electronics.

PIRs come in many configurations for a wide variety of applications. The most common used in home security systems has numerous Fresnel lenses or mirror segments and has an effective range of about thirty feet. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PIR. There are also PIRs designed with reversible orientation mirrors, which allow either broad coverage (110° wide) or very narrow 'curtain' coverage.

PIRs can have more than one internal sensing element so that, with the appropriate electronics and Fresnel lens, it can detect direction. Left to right, right to left, up or down and provide an appropriate output signal.

4.6. 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. . 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. 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.

4.7 TEMPERATURE SENSOR (LM35)

4.7.1.FEATURES DESCRIPTION

i .Calibrated Directly in ° Celsius (Centigrade)

ii. Linear + 10 mV/°C Scale Factor

iii.0.5°C Ensured Accuracy (at +25°C) LM35 has an advantage over linear temperature

iv. Rated for Full −55°C to +150°C Range

v. Suitable for Remote Applications

vi. Low Cost Due to Wafer-Level Trimming

vii. Less than 60-µA Current Drain

viii. Low Self-Heating, 0.08°C in Still Air

ix. Non-linearity Only ±¼°C Typical

x. Low Impedance Output, 0.1 Ω for 1 mA Load

4.7.2.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.

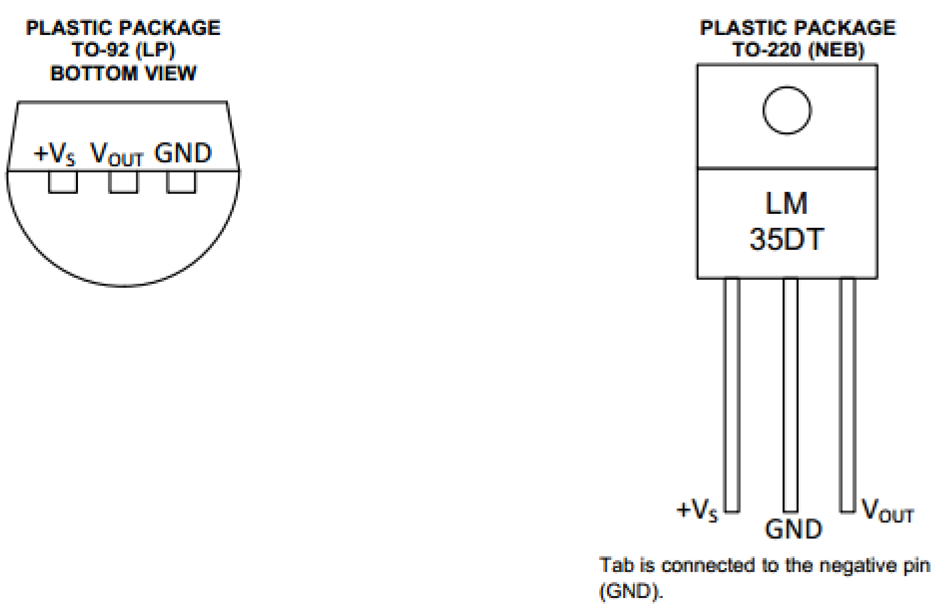


Fig.4.14: LM35 PIN DESCRIPTION

4.8. VIBRATION SENSORS

The piezoelectric sensor is used for flex, touch, vibration and shock measurement. Its basic principal, 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. 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.

4.9.1Working of Vibration Sensors

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.

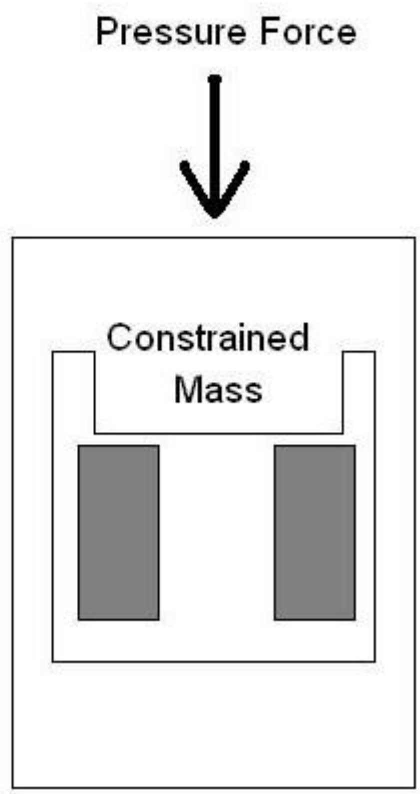


Fig:4.15.A constrained mass is allowed to deform the crystal sensor in one axis. This configuration is good for force and pressure.

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.

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.

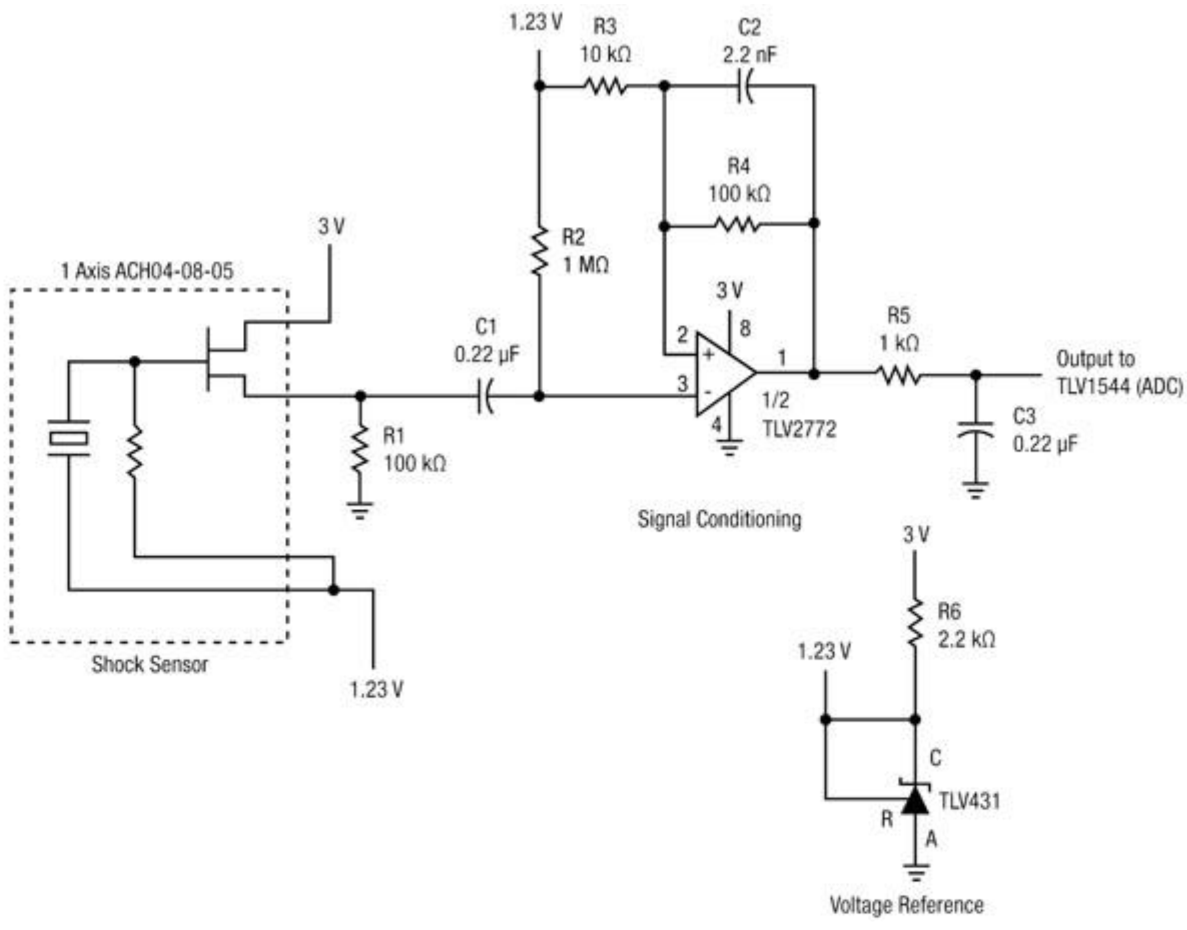


Fig:4.16:OP amps such as the TI TLV2772 feature high input impedances to help minimize current from the potentially high-voltage inputs from the piezoelectric sensors.

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.

4.9. Water Level Sensor

Description The Water level sensor is a solid state, continuous (multi-level) fluid level sensor for measuring levels in water, non-corrosive water based liquids and dry fluids (powders). The Water level sensor is manufactured using printed electronic technologies which employ additive direct printing processes to produce functional circuits.

Theory of Operation The Water level sensor's envelope is compressed by hydrostatic pressure of the fluid in which it is immersed resulting in a change in resistance which corresponds to the distance from the top of the sensor to the fluid surface. The Water level sensor provides a resistive output that is inversely proportional to the level of the liquid: the lower the liquid level, the higher the output resistance; the higher the liquid level, the lower the output resistance.

Specifications Sensor Length: 14.1" (358 mm) Resolution: < 0.01"(0.25 mm) Thickness: 0.015" (0.381mm) Actuation Depth: Nominal 1" (25.4 mm) Width: 1.0" (25.4 mm) Reference Resistor (Rref): 2250 , ±10% Active Sensor Length: 12.4" (315 mm) Connector: Crimpflex Pins Sensor Output: 2250 empty, 400 full, ±10% Temperature Range: 15°F - 150°F (-9°C - 65°C) Resistance Gradient: 150 /inch (59 /cm), ±10% Power Rating: 0.5 Watts (VMax = 10V)

Connection and Installation Connect to the Water level by attaching a 4 pin connector with pre-soldered wires to the Crimpflex pins. Do not solder directly to the Crimpflex pins. The inner two pins (pins 2 and 3) are the sensor output (Rsense). The outer pins (pins 1 and 4) are the reference resistor (Rref) which can be used for temperature compensation. Suspend the Water level sensor in the fluid to be measured.

To work properly the sensor must remain straight and must not be bent vertically or longitudinally. For best results install the sensor inside a section of 1-inch diameter PVC pipe. Double sided adhesive tape may be applied to the upper back portion of the sensor to suspend the sensor in the container to be measured. However, the liquid must be allowed to interact freely with both sides of the sensor. The vent hole located above the max line allows the Water level to equilibrate with atmospheric pressure. The vent hole is fitted with a hydrophobic filter membrane to prevent the Water level from being swamped if inadvertently submerged.

4.10. SOFTWARE REQUIREMENTS:

4.10.1Internet of things

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the 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" and for these purposes a "thing" is "an object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communication networks". The IoT allows objects to be sensed or controlled remotely across existing network infrastructure,creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of about 30 billion objects by 2020. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications.

The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities. "Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring.

These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens, or refrigerators/freezers that use Wi-Fi for remote monitoring. As well as the expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems

4.10.2Applications

According to Gartner, Inc. (a technology research and advisory corporation), there will be nearly 20.8 billion devices on the Internet of things by 2020. ABI Research estimates that more than 30 billion devices will be wirelessly connected to the Internet of things by 2020. As per a 2014 survey and study done by Pew Research Internet Project, a large majority of the technology experts and engaged Internet users who responded—83 percent—agreed with the notion that the Internet/Cloud of Things, embedded and wearable computing (and the corresponding dynamic systems will have widespread and beneficial effects by 2025. As such, it is clear that the IoT will consist of a very large number of devices being connected to the Internet. In an active move to accommodate new and emerging technological innovation, the UK Government, in their 2015 budget, allocated £40,000,000 towards research into the Internet of things. The former British Chancellor of the Exchequer George Osborne, posited that the Internet of things is the next stage of the information revolution and referenced the inter-connectivity of everything from urban transport to medical devices to household appliances.

The ability to network embedded devices with limited CPU, memory and power resources means that IoT finds applications in nearly every field. Such systems could be in charge of collecting information in settings ranging from natural ecosystems to buildings and factories, thereby finding applications in fields of environmental sensing and urban planning. On the other hand, IoT systems could also be responsible for performing actions, not just sensing things. Intelligent shopping systems, for example, could monitor specific users' purchasing habits in a store by tracking their specific mobile phones. These users could then be provided with special offers on their favorite products, or even location of items that they need, which their fridge has automatically conveyed to the phone. Additional examples of sensing and actuating are reflected in applications that deal with heat, water, electricity and energy management, as well as cruise-assisting transportation systems. Other applications that the Internet of things can provide is enabling extended home security features and home automation. The concept of an "Internet of living things" has been proposed to describe networks of biological sensors that could use cloud-based analyses to allow users to study DNA or other molecules. However, the application of the IoT is not only restricted to these areas. Other specialized use cases of the IoT may also exist. An overview of some of the most prominent application areas is provided here.

4.10.3.Media

In order to hone the manner in which things, media and big data are interconnected, it is first necessary to provide some context into the mechanism used for media process. It has been suggested by Nick Couldry and Joseph Turow that practitioners in media approach big data as many actionable points of information about millions of individuals. The industry appears to be moving away from the traditional approach of using specific media environments such as newspapers, magazines, or television shows and instead tap into consumers with technologies that reach targeted people at optimal times in optimal locations. The ultimate aim is of course to serve, or convey, a message or content that is (statistically speaking) in line with the consumer's mindset.

For example, publishing environments are increasingly tailoring the messages (advertisements) and content (articles) to appeal to consumers that have been exclusively gleaned through various data-mining activities. The media industries process big data in a dual, interconnected manner.

Targeting of consumers (for advertising by marketers) Data-capture Thus, the Internet of things creates an opportunity to measure, collect and analyse an ever-increasing variety of behavioural statistics. Cross-correlation of this data could revolutionise the targeted marketing of products and services. The Internet of things therefore transforms the media industry, companies and even governments, opening up a new era of economic growth and competitiveness. The wealth of data generated by this industry (i.e. big data) will allow practitioners in advertising and media to gain an elaborate layer on the present targeting mechanisms used by the industry.

4.10.4. Environmental monitoring

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area.

4.10.5.Infrastructure management

Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.

4.10.6 Enabling technologies for IoT

There are many technologies that enable IoT. Crucial to the field is the network used to communicate between devices of an IoT installation, a role that several wireless or wired technologies may fulfill:

Short-range wireless

I.Bluetooth low energy (BLE) – Specification providing a low power variant to classic Bluetooth with a comparable communication range.

ii. Light-Fidelity (Li-Fi) – Wireless communication technology similar to the Wi-Fi standard, but using visible light communication for increased bandwidth.

Iii. Near-field communication (NFC) – Communication protocols enabling two electronic devices to communicate within a 4 cm range.

iv. QR codes and barcodes – Machine-readable optical tags that store information about the item to which they are attached.

v. Radio-frequency identification (RFID) – Technology using electromagnetic fields to read data stored in tags embedded in other items.

vi. Thread – Network protocol based on the IEEE 802.15.4 standard, similar to ZigBee, providing IPv6 addressing.

Vii. Layer Security (network protocol)|TLS – Network security protocol.

Viii. Wi-Fi – Widely used technology for local area networking based on the IEEE 802.11 standard, where devices may communicate through a shared access point.

ix. Wi-Fi Direct – Variant of the Wi-Fi standard for peer-to-peer communication, eliminating the need for an access point.

x. Z-Wave – Communication protocol providing short-range, low-latency data transfer at rates and power consumption lower than Wi-Fi. Used primarily for home automation.

xi. ZigBee – Communication protocols for personal area networking based on the IEEE 802.15.4 standard, providing low power consumption, low data rate, low cost, and high throughput.

Medium-range wireless

I. HaLow – Variant of the Wi-Fi standard providing extended range for low-power communication at a lower data rate.

II. LTE-Advanced – High-speed communication specification for mobile networks. Provides enhancements to the LTE standard with extended coverage, higher throughput, and lower latency.

Long-range wireless

I. Low-power wide-area networking (LPWAN) – Wireless networks designed to allow long-range communication at a low data rate, reducing power and cost for transmission.

II. Very small aperture terminal (VSAT) – Satellite communication technology using small dish antennas for narrow band and broadband data.

Wired

I. Ethernet – General purpose networking standard using twisted pair and fiber optic links in conjunction with hubs or switches.

II. Multimedia over Coax Alliance (MoCA) – Specification enabling whole-home distribution of high definition video and content over existing coaxial cabling.

III. Power-line communication (PLC) – Communication technology using electrical wiring to carry power and data. Specifications such as HomePlug utilize PLC for networking IoT devices.

CHAPTER: 5

RESULT

We were able to successfully control the sensors. We saw the updates on the website about the sensors getting on and off with live updates to admin. The Dashboard has number of users connected to the system and who has the access privilege to a particular switch. The Home automation was successful in showing the unit Bill and the amount of voltage consumed by a particular user. The Live Graphical representation of Number of user connected versus time, Voltage versus time, Amount of bill till now versus time. Tasker is working correctly. Three task with different dates and time were spotted working on given time. Last date and time of use of particular switch was recorded and displayed on website at the time of testing.

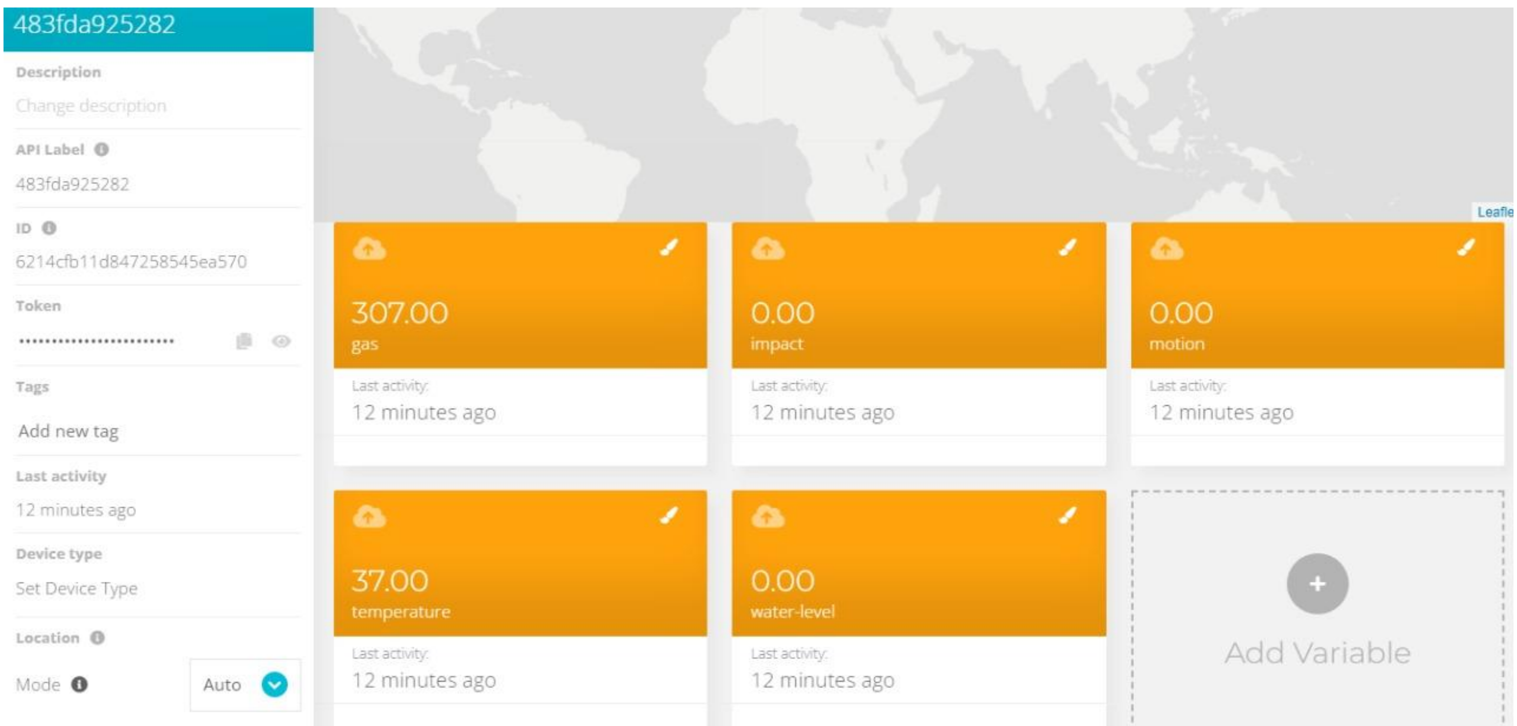


Fig: 5.1 Ubidots dashboard

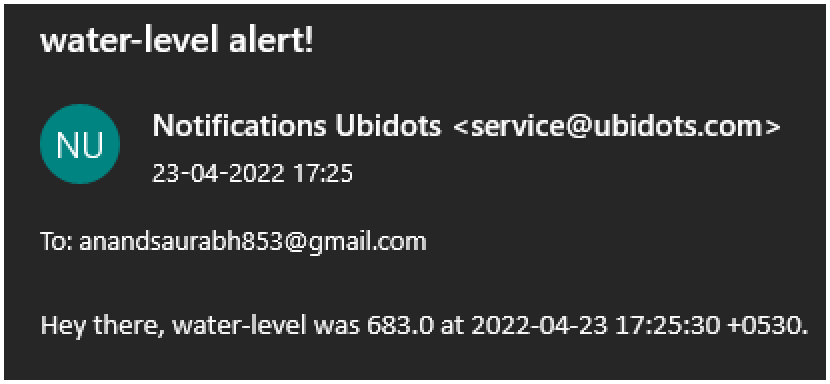


Fig: 5.2: Water level alert notification

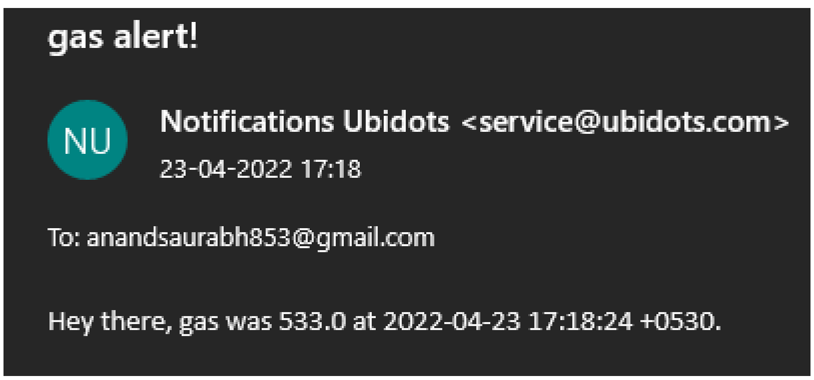
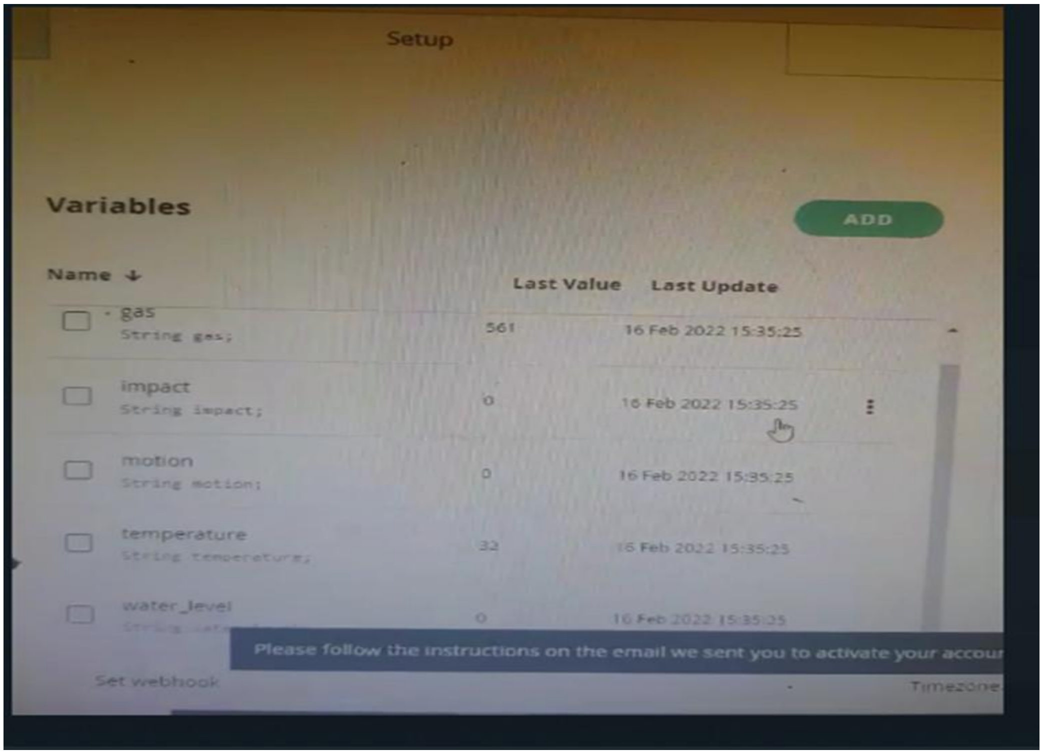


Fig: 5.4: Gas alert notification

Notification can be customized as jobs in the ubidots dashboard we can read the values of the sensor and assign a job such as message alert through sms or email. Email or sms is limited to 20 times use as these are small scale sensors and its for limited use.

Fig:5.4: Data as read by sensor



CHAPTER: 6

CONCLUSION

As the system is dependent on the user's discretion and judgeability of the situation (whether it is a guest or an intruder entering his house) the use of a camera connected to the microcontroller might help the user in taking decisions whether to activate the security system or welcome the guest .The captured picture of the guest or intruder after face detection, can be mailed to the user. The user can further forward the same photograph to the police station if he wishes.Further the system may be made more synchronised by integrating the voice call feature within the same smart phone application through which the user can even control his home appliances without any voice call being triggered to his phone.

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