

IOT BASED DRINKING WATER QUALITY MONITORING SYSTEM

Submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering in
Electronics and Communication.

By

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DEPARTMENT ELECTRONIC AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600 119.

April – 2022.



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafied work of MADDUKURI SRAVANTHI(38130118), JABBIREDDY KEERTHI(38130085) who carried entitled" Water Quality monitoring system using IOT" under our supervision from July to December 2021

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DECLARATION

We JABBIREDDY KEERTHI (38130085), MADDUKURI SRAVANTHI (38130118) here by declare that the Project Report entitled “IOT based water quality monitoring system” done by us under the guidance of Dr. M. Subramoniam., Associate Professor, Department of Electronics and Communication Engineering is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in ELECTRONICS AND COMMUNICATION ENGINEERING.

DATE: 09/04/2022

Place: Chennai

Signature of Candidate

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We would like to express our sincere and deep sense of gratitude to our Project Guide Dr.M.Subramoniam., Associate Professor, Dept of Electronics and Communication Engineering for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of us project work. We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Electronics and Communication Engineering who were helpful in many ways for the completion of the project.

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ABSTRACT

In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. In this paper we present a design and development of a low-cost system for real time monitoring of the water quality in IOT (internet of things).

The system consist of several sensors is used to measuring physical and chemical parameters of the water. The parameters such as PH, and prototype setup for temperature of the water can be measured. The measured values from the sensors can be processed by the controller. The NodeMCU model can be used as a core controller and the NodeMCU is act as a server to send data to cloud. Finally, the sensor data can be viewed on internet using cloud.

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CHAPTER 1

Introduction

1.1 Introduction:

Currently drinking water is very prized for all the humans. In recent times water levels are very low and water in the lakes are going down. So its too important to find the solution for water monitoring & control system. IoT is a solution. In recent days, development in computing and electronics technologies have triggered Internet of Things technology. Internet of Things can be describe as the network of electronics devices communicating among them by the help of a controller.

The IoT is a collection of devices that work together in order to serve human tasks in a efficient manner. It combine computational power to send data about the environments. These devices can be in form of sensors, appliances, embedded systems, and data analysis microchips. This paper present a low cost water monitoring system, which is a solution for the water wastage and water quality. Microcontrollers and sensors are used for that system. Ultrasonic Sensor is used to measuring water level. The other parameters like pH, TDS, and Turbidity of the water can be calculated using different corresponding sensors. This system use the flow sensor which can measure the water flow and if the necessary quantity of water flow through the pipe then water flow can be stopped automatically.

The calculated values from the sensors can be processed by the Microcontrollers and uploaded to the internet through the Wi-Fi module (ESP 8266). Analysis we can do by this process, how much water is used in certain time, in a day or in a month. Alerts messages and data generated by the sensors are transmitted over the Internet to a cloud server and can be received by user terminal owned by consumers. The data which is obtained from the sensors can be shown on the internet and provides facilities for screening the data on mobile phones or web application.

1.2 Literature survey:

1. Real Time Water Quality Monitoring System

Water pollution is one of the biggest fears for the green globalization. To prevent the water pollution, first we have to estimate the water parameters like pH, turbidity, conductivity etc, as the variations in the values of these parameters point towards the presence of pollutants.

Limitations:

- It is done by using embedded system
- There is no integration with internet

2. Monitoring of Turbidity, PH & Temperature of Water Based on GSM

The traditional method of testing Turbidity, PH & Temperature is to collect samples manually and then send them to laboratory for analysis.

Limitations: The proposed system is done by using GSM technology

3. MONITORING SYSTEM OF AQUICULTURE WITH AUTOMATIC CONTROL SYSTEM USING ARM 7

The importance of water quality in Aquaculture and design an environmental factor monitoring system with Automatic control system.

- The is done by using automation

4. A Water-Quality Dynamic Monitoring System Based on Web-server-embedded Technology for Aquaculture

Water-quality monitoring technology has been taken a great attention in aquaculture because of increasing aquatic products and impact of food safety vicious incidents. In order to meet the technology requirements of water-quality monitoring in multi-parameter, dynamic, and networked monitoring, a water-quality dynamic monitoring system was developed to monitor multi-parameter water-quality.

Limitations: It is done by using embedded system.

Smart Water Management Technology with Intelligent Sensing and ICT for the Integrated Water Systems

The increasing demand for water arising from global population growth and urbanization in recent years is stressing the water supply to its limits.

Limitations: The proposed system is done by using GSM and GPRS technology.

CHAPTER 2

Conventional Methods

Existing system:

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish.

Problem statement:

Water tank monitoring systems are only provided for PC environment.

Manual operations.

We need a pc to monitor the water level.

High cost.

Low efficiency.

Complex installations.

Proposed system:

In this project, the water quality analysis in real time is implemented using the micro controller. Which consist of Nodemcu. There are various sensors are connected in Nodemcu to analyze the water quality, and assurance of purity. The following sensors like DHT11 sensor, pH sensor, level sensors are used to analyse the water quality in various stages. A very important measurement in many liquids chemical processes (industrial, pharmaceutical, manufacturing, food production, etc.) is that of pH: the measurement of hydrogen ion concentration in a liquid solution. The pH sensor is used to find the liquid is the neutral form of acid and caustic (alkaline) approximately the water will be in the scale of 7 the common pH scale extends from 0 (strong acid) to 14 (strong caustic), with 7 in the middle representing pure water (neutral). And level sensor is used measure the water content in the tank. When the water level is reaches the threshold level it will intimates to the authorised persons. These sensor Values as

data are uploaded to the defined ip address connected in the Ethernet network and also the data is transmitted to a wireless sensor network say Wi-Fi.

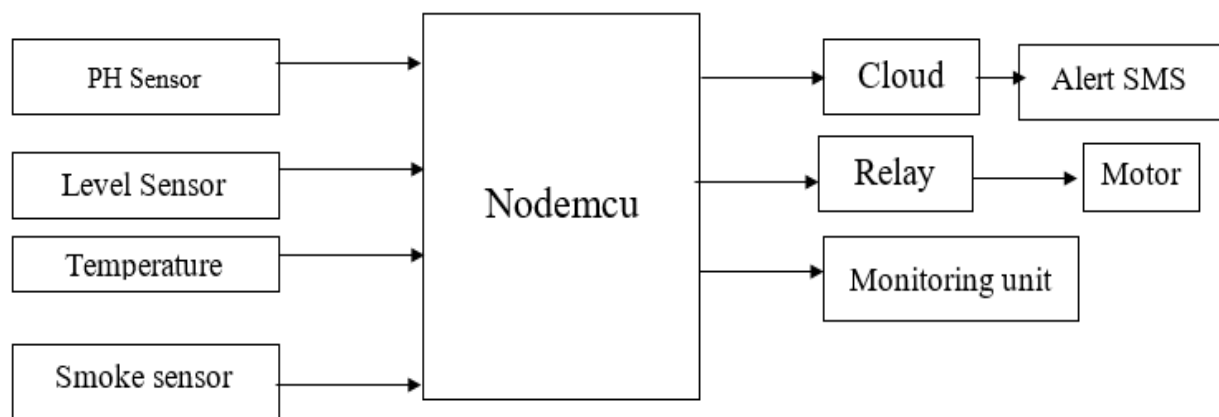
Advantages:

Easy installation.

Low maintenance.

Compact elegant design.

Block diagram:



Hardware required:

Nodemcu

PH level

Level sensor

Temperature sensor

Smoke sensor

Relay

Monitoring unit

Motor

CHAPTER 3

Proposed Methodology

IoT stands for Internet of Things, which means accessing and controlling daily usable equipment and devices using Internet.

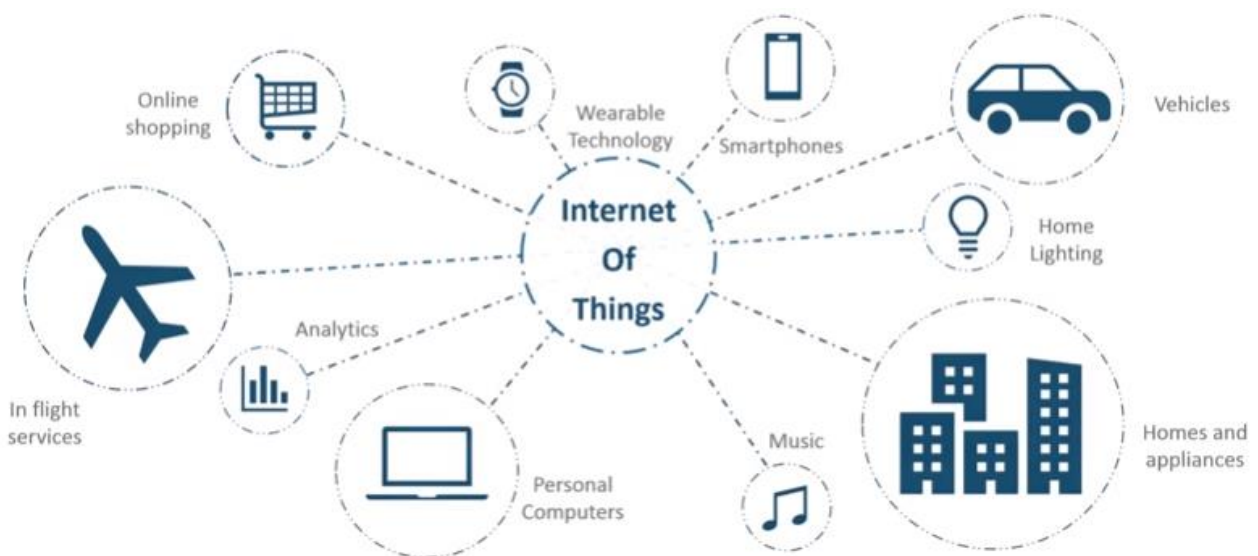
Our IoT tutorial includes all topics of IoT such as introduction, features, advantage and disadvantage, ecosystem, decision framework, architecture and domains, biometric, security camera and door unlock system, devices, etc.

What is an Internet of Things (IoT)

Let's us look closely at our mobile device which contains GPS Tracking, Mobile Gyroscope, Adaptive brightness, Voice detection, Face detection etc. These components have their own individual features, but what about if these all communicate with each other to provide a better environment? For example, the phone brightness is adjusted based on my GPS location or my direction.

Connecting everyday things embedded with electronics, software, and sensors to internet enabling to collect and exchange data without human interaction called as the Internet of Things (IoT).

The term "Things" in the Internet of Things refers to anything and everything in day to day life which is accessed or connected through the internet.



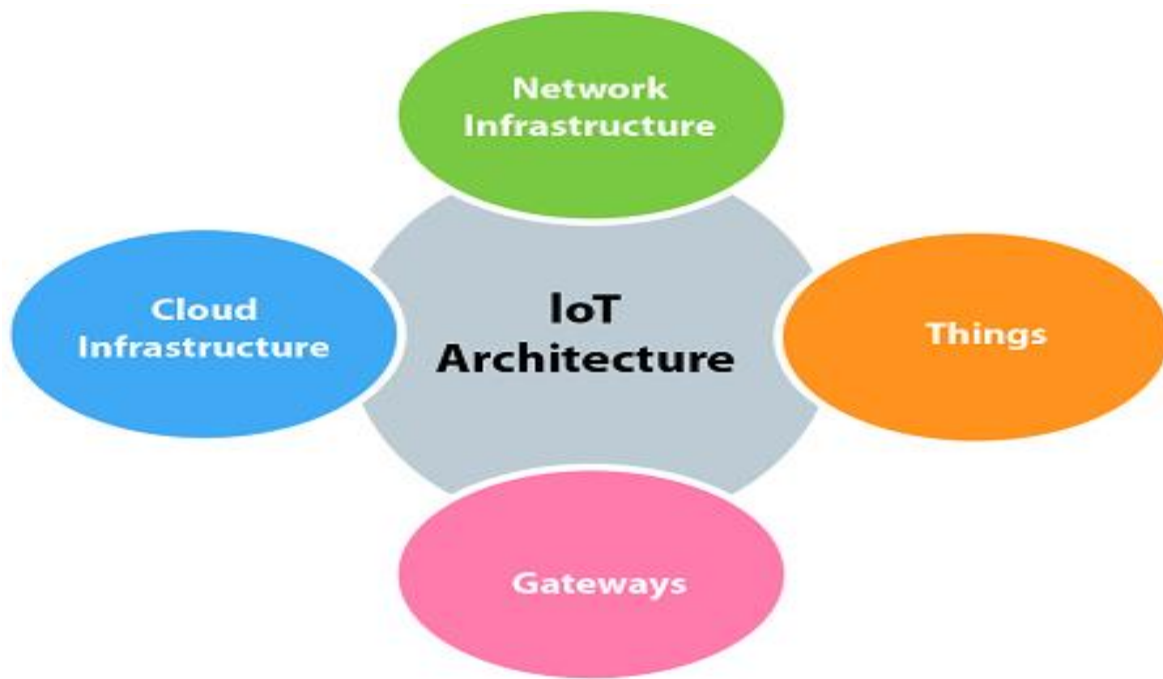
IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

As we have a platform such as a cloud that contains all the data through which we connect all the things around us. For example, a house, where we can connect our home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since we have a platform, we can connect our car, track its fuel meter, speed level, and also track the location of the car.



How does Internet of Thing (IoT) Work?

The working of IoT is different for different IoT echo system (architecture). However, the key concept of there working is similar. The entire working process of IoT starts with the device themselves, such as smartphones, digital watches, electronic appliances, which securely communicate with the IoT platform. The platforms collect and analyze the data from all multiple devices and platforms and transfer the most valuable data with applications to devices.



Features of IOT:

The most important features of IoT on which it works are connectivity, analyzing, integrating, active engagement, and many more. Some of them are listed below:

Connectivity: Connectivity refers to establish a proper connection between all the things of IoT-to-IoT platform it may be server or cloud. After connecting the IoT devices, it needs a high-speed messaging between the devices and cloud to enable reliable, secure and bi-directional communication.

Analyzing: After connecting all the relevant things, it comes to real-time analyzing the data collected and use them to build effective business intelligence. If we have a good insight into data gathered from all these things, then we call our system has a smart system.

Integrating: IoT integrating the various models to improve the user experience as well.

Artificial Intelligence: IoT makes things smart and enhances life through the use of data. For example, if we have a coffee machine whose beans have going to end, then the coffee machine itself order the coffee beans of your choice from the retailer.

Sensing: The sensor devices used in IoT technologies detect and measure any change in the environment and report on their status. IoT technology brings passive networks to active networks. Without sensors, there could not hold an effective or true IoT environment.

Active Engagement: IoT makes the connected technology, product, or services to active engagement between each other.

Endpoint Management: It is important to be the endpoint management of all the IoT system otherwise, it makes the complete failure of the system. For example, if a coffee machine itself order the coffee beans when it goes to end but what happens when it orders the beans from a retailer and we are not present at home for a few days, it leads to the failure of the IoT system. So, there must be a need for endpoint management.

Advantages of IoT:

Internet of things facilitates the several advantages in day-to-day life in the business sector. Some of its benefits are given below:

Efficient resource utilization

Minimize human effort

Save time

Enhance Data Collection

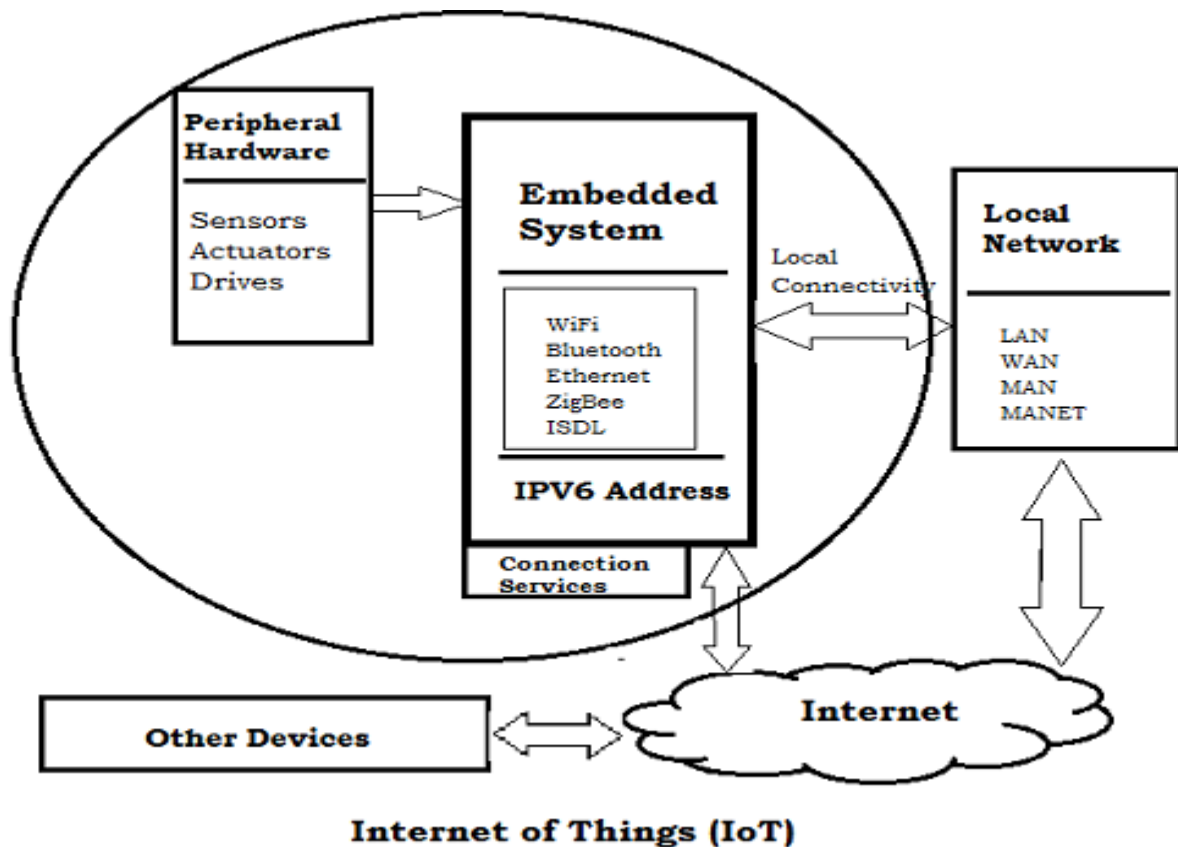
Improve security

Disadvantages of IoT:

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

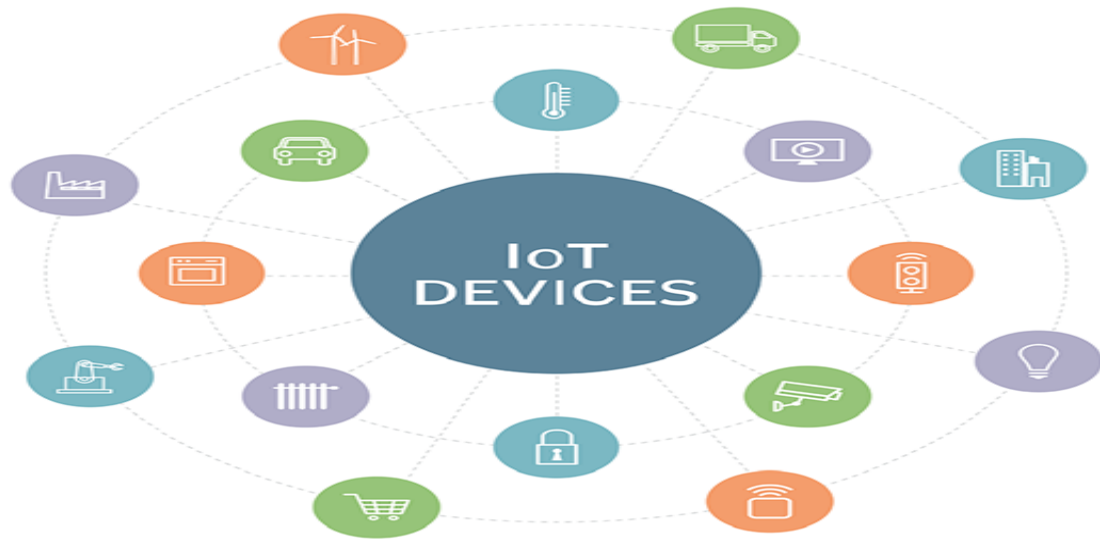
Embedded Devices (System) in (IoT)

An embedded device system generally runs as a single application. However, these devices can connect through the internet connection, and able communicate through other network devices.



IoT Devices:

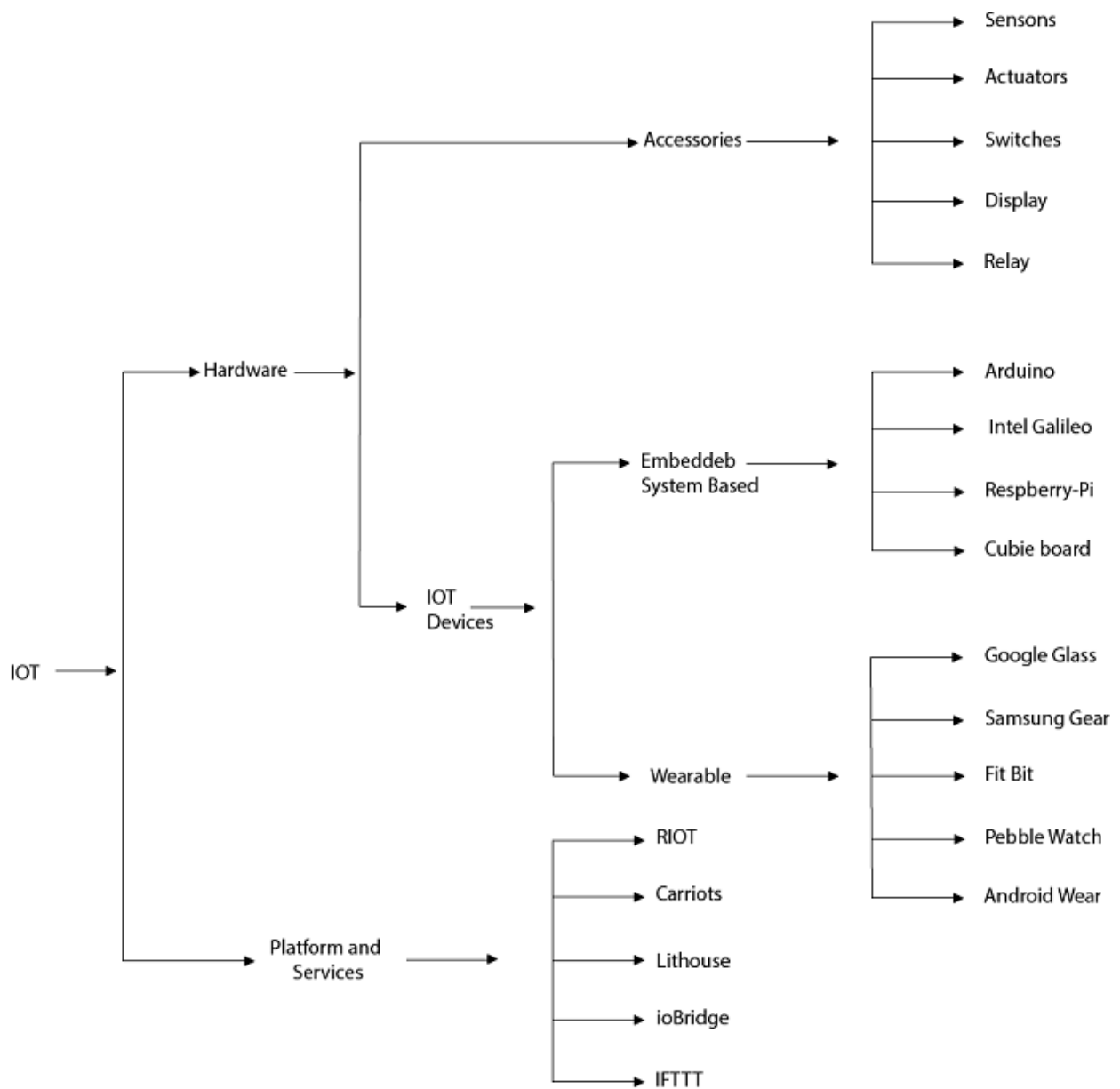
Internet of Things Devices is non-standard devices that connect wirelessly to a network with each other and able to transfer the data. IoT devices are enlarging the internet connectivity beyond standard devices such as smartphones, laptops, tablets, and desktops. Embedding these devices with technology enable us to communicate and interact over the networks and they can be remotely monitored and controlled.



There are large varieties of IoT devices available based on IEEE 802.15.4 standard. These devices range from wireless motes, attachable sensor-boards to interface-board which are useful for researchers and developers.

IoT devices include computer devices, software, wireless sensors, and actuators. These IoT devices are connected over the internet and enabling the data transfer among objects or people automatically without human intervention.

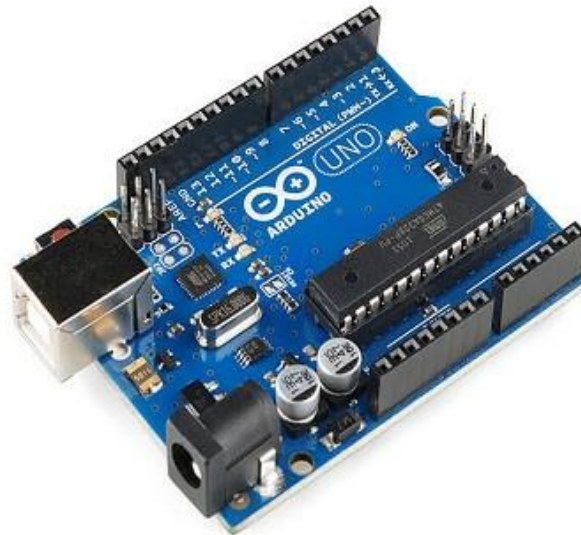
Some of the common and popular IoT devices are given below:



IoT Devices and Technologies

Arduino Device:

Arduino devices are the microcontrollers and microcontroller kit for building digital devices that can be sense and control objects in the physical and digital world. Arduino boards are furnished with a set of digital and analog input/output pins that may be interfaced to various other circuits. Some Arduino boards include USB (Universal Serial Bus) used for loading programs from the personal computer.



Intel Galileo:

The Intel Galileo Gen 2 Board includes the parts such as Intel Quark SoC processor, 256MB RAM, multiple ports and supports for Arduino device.



Samsung Gear Fit:

A Samsung Gear Fit device is a dustproof, water-resistant with fitness tracker features, a curved display, and long-lasting battery. This device receives alerts about emails and text messages, and it integrates with Samsung's S Health app.



Sensor:

A sensor is a device that reads the surrounding temperature, humidity, light, air quality control etc. There are different types of sensors available that reads different types of data. The sensors transmit these data over the networks or through which it is connected.



Bluetooth Low Energy (BLE) Intelligent Beacon:

A Bluetooth low energy beacon device is used to track the object located at a real time. Many companies use it to track the location of employees, assets, patients, and more in real time. This service primarily focuses on manufacturing, retail, and healthcare services.



Properties of IoT Devices:

Some of the essential properties of IoT devices are mention below:

Sense: The devices that sense its surrounding environment in the form of temperature, movement, and appearance of things, etc.

Send and receive data: IoT devices are able to send and receive the data over the network connection.

Analyze: The devices can able to analyze the data that received from the other device over the internet networks.

Controlled: IoT devices may control from some endpoint also. Otherwise, the IoT devices are themselves communicate with each other endlessly leads to the system failure.

Major IoT Boards in Market

There are several IoT boards available in the market to build the project. Some of the major IoT Boards are described below:

Raspberry Pi:

Raspberry Pi is a much popular device used in building IoT project. The recently launched Raspberry Pi 3 includes built-in Wi-Fi and Bluetooth making the most compact and standalone computer. It provides a powerful environment to install a variety of programming packages such as Python, Node.js, LAMP stack, Java and much more. Using 40 GPIO pins, and four USB ports you can connect many peripherals and accessories to the Pi.



Arduino:

Arduino boards are the microcontrollers and microcontroller kit for building digital devices that can sense and control objects in the physical and digital world. Arduino boards are furnished with a set of digital and analog input/output pins that may be interfaced to various other circuits. Some Arduino boards include USB (Universal Serial Bus) to load programs from the personal computer.



ESP8266:

The ESP8266 is a low-cost Wi-Fi microchip with 32-bit microcontroller capability, standard digital peripheral interfaces. There are different types of ESP8266 boards available for different needs. The primary goal of this board is to deal with the built-in Wi-Fi through AT commands if used as device module, but you can 'program' using Arduino board however it also reads and controls input/output, digital and analog.

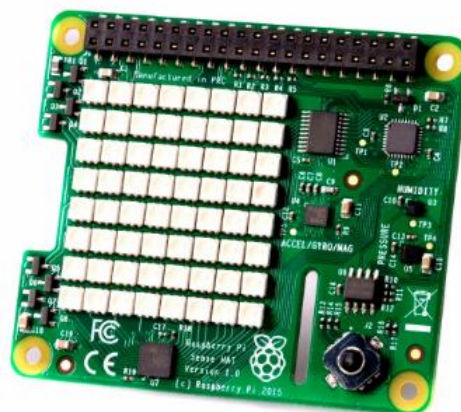


Sense HAT 8x8 RGB LED matrix:

Raspberry Pi Sense HAT is an integrated sensor that can measure humidity, temperature, acceleration, and pressure. The 8x8 LED matrix displays data read from

Raspberry Pi Sense HAT sensors. The Sense HAT has an 8×8 RGB LED matrix includes the following sensors:

- Gyroscope
- Accelerometer
- Magnetometer
- Temperature
- Barometric pressure
- Humidity



Bluetooth Module HC-05:

Bluetooth Module HC-05 device is a 6 pins Bluetooth device that is used for wireless communication. Usually, this device connects small devices like mobile phones, PDAs and TVs using a short-range wireless connection to exchange data. It communicates with the microcontroller using the serial port (USART).

Pin Description:

EN: It is the enable pin, when it is connected to 3.3V then model is enabled.

+5V: This is the supply pin for connecting +5V.

GND: It is the ground pin.

TX: It is the transmitter pin of the UART communication.

RX: It is the receiver pin of UART communication.

STATE: It indicates whether the module is connected or not. It acts as a status indicator.



IoT – Platform:

As in IoT, all the IoT devices are connected to other IoT devices and application to transmit and receive information using protocols. There is a gap between the IoT device and IoT application. An IoT Platform fills the gap between the devices (sensors) and application (network). Thus, we can say that **an IoT platform is an integrated service that fulfills the gap between the IoT device and application and offers you to bring physical object online.**



There are several IoT Platforms available that provides facility to deploy IoT application actively. Some of them are listed below:

Amazon Web Services (AWS) IoT platform: Amazon Web Service IoT platform offers a set of services that connect to several devices and maintain the security as well. This platform collects data from connected devices and performs real-time actions.

Microsoft Azure IoT platform: Microsoft Azure IoT platform offers strong security mechanism, scalability and easy integration with systems. It uses standard protocols

that support bi-directional communication between connected devices and platform. Azure IoT platform has an Azure Stream Analytics that processes a large amount of information in real-time generated by sensors. Some common features provided by this platform are:

Information monitoring

A rules engine

Device shadowing

Identity registry

Google Cloud Platform IoT: Google Cloud Platform is a global cloud platform that provides a solution for IoT devices and applications. It handles a large amount of data using Cloud IoT Core by connecting various devices. It allows to apply BigQuery analysis or to apply Machine learning on this data. Some of the features provided by Google Cloud IoT Platform are:

Cloud IoT Core

Speed up IoT devices

Cloud publisher-subscriber

Cloud Machine Learning Engine

IBM Watson IoT platform: The IBM Watson IoT platform enables the developer to deploy the application and building IoT solutions quickly. This platform provides the following services:

Real-time data exchange

Device management

Secure Communication

Data sensor and weather data services

Artik Cloud IoT platform: Artik cloud IoT platform is developed by Samsung to enable devices to connect to cloud services. It has a set of services that continuously connect devices to the cloud and start gathering data. It stores the incoming data from

connected devices and combines this information. This platform contains a set of connectors that connect to third-party services.

Bosch IoT Suite:

Bosch cloud IoT Suite is based on Germany. It offers safe and reliable storing of data on its server in Germany. This platform supports full app development from prototype to application development.

How IoT platform help:

IoT Platform connects sensors and devices.

IoT platform handles different software communication protocol and hardware.

IoT platform provides security and authentication for sensors and users.

It collects, visualizes, and analyzes the data gathered by the sensor and device.

NODE MCU

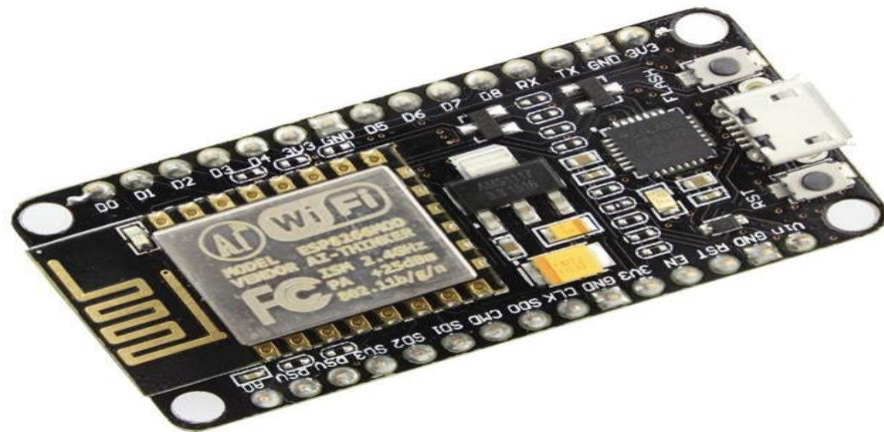
ESP8266 Arduino Core:

As Arduino.cc began developing new MCU boards based on non-AVR processors like the ARM/SAM MCU and used in the Arduino Due, they needed to modify the Arduino IDE so that it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. 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". This has become a leading software development platform for the various ESP8266-based modules and development boards, including NodeMCU's.

Introduction:

NodeMCU is an open-source LUA based firmware developed for ESP8266 Wi-Fi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with

ESP8266 Development board/kit i.e., NodeMCU Development board.



NodeMCU Development Board/kit v1.0

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

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

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

Difference in using ESPlorer and Arduino IDE

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

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

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

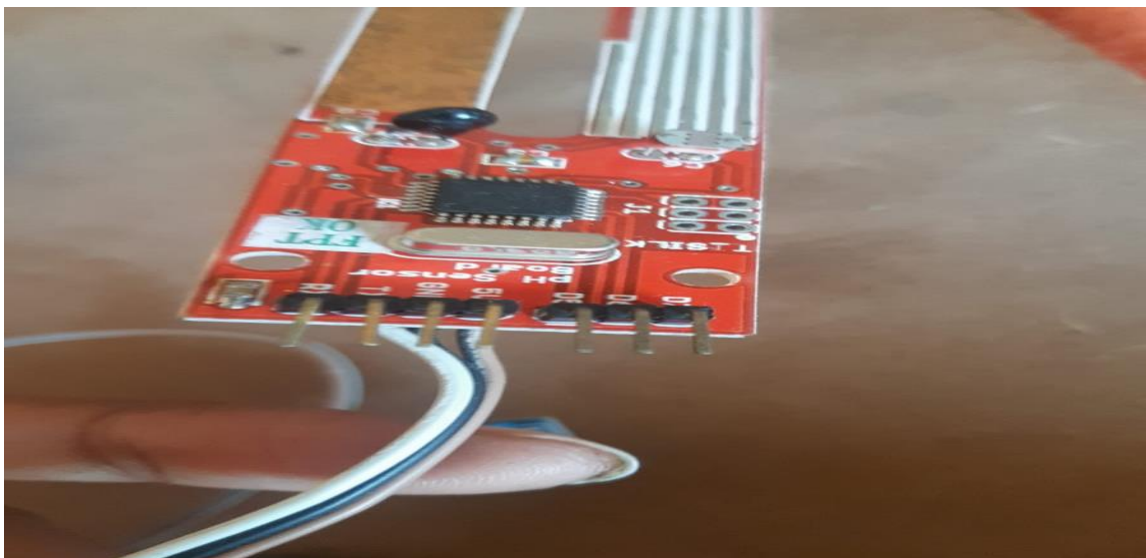
In Arduino IDE when we write and compile code, ESP8266 toolchain in background creates binary firmware file of code we wrote. And when we upload it to NodeMCU then it will flash all NodeMCU firmware with newly generated binary firmware code. In fact, it writes the complete firmware.

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 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 compile and upload/writes complete firmware, it takes more time than ESPlorer IDE.

PH SENSOR:

A pH meter is essentially a voltmeter with a high input impedance which measures the voltage of an electrode sensitive to the hydrogen ion concentration, relative to another electrode which exhibits a constant voltage. The key feature of the pH-sensitive electrode is a thin glass membrane whose outside surface contacts the solution to be tested. The inside surface of the glass membrane is exposed to a constant concentration of hydrogen ions (0.1 M HCl).



Inside the glass electrode assembly, a silver wire, coated with silver chloride and immersed in the HCl solution, is called an Ag/AgCl electrode. This electrode carries current through the half-cell reaction. The potential between the electrode and the

solution depends on the chloride ion concentration, but, since this is constant (0.1 M), the electrode potential is also constant.

The meter must be calibrated by using standards of known pH before an unknown is measured. Since the unknowns are acidic, the pH 4.00 and pH 7.00 standards should be used. An accurate pH reading depends on standardization, the degree of static charge, and the temperature of the solution.

TEMPERATURE SENSOR (LM35)



FEATURES DESCRIPTION

- Calibrated Directly in ° Celsius (Centigrade)
- Linear + 10 mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at +25°C) LM35 has an advantage over linear temperature
- Rated for Full -55°C to +150°C Range
- Suitable for Remote Applications
- Low Cost Due to Wafer-Level Trimming
- Less than 60-μA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Nonlinearity Only $\pm\frac{1}{4}^{\circ}\text{C}$ Typical
- Low Impedance Output, 0.1 Ω for 1 mA Load

DESCRIPTION

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. Low cost is assured by trimming and calibration at the water 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.

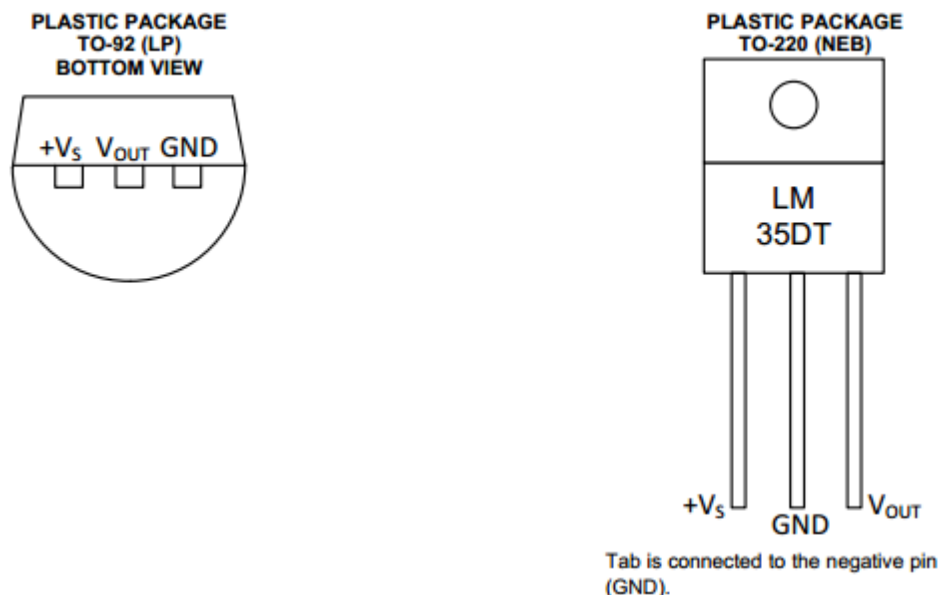


Figure. View of Temperature sensor

Gas sensor:

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.

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

Filtering out the suspended particles so that only gaseous elements are able to pass to insides of the sensor.

Protecting the insides of the sensor.

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

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

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

The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor.

The top of the gas sensor is removed off to see the internal 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.

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.

Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example, a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.



Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



The relay's switch connections are usually labeled COM, NC and NO:

COM = Common, always connect to this, it is the moving part of the switch.

NC = Normally Closed, COM is connected to this when the relay coil is off.

NO = Normally Open, COM is connected to this when the relay coil is on.

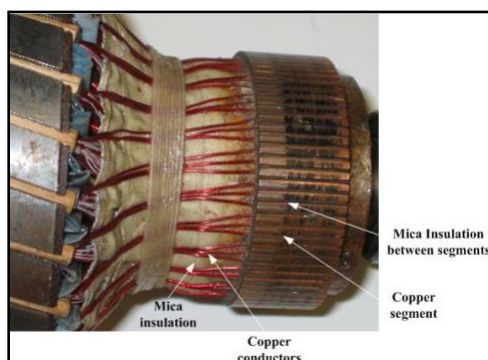
DC MOTORS

A. General Information

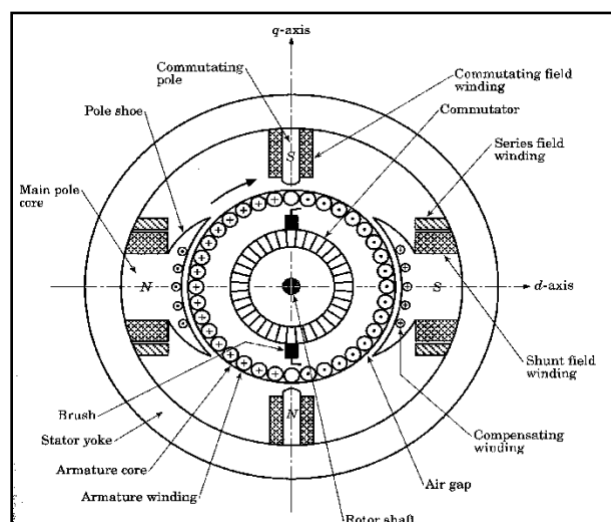
A DC motor is used to drive a mechanical load. In this lab, a separately excited DC generator provides the load. The load on the motor is adjusted by varying the generator field current. By increasing the field current of the DC generator, the load on the DC motor increases and thus the armature current increases. Since the measuring equipment for shaft torque is not available in the lab it is necessary to use alternative means of characterizing the DC motor. One alternative is to plot shaft speed versus armature current since torque is directly proportional to the armature current ($T = K_a \phi_d I_a$) with a constant field current supplied to the motor. Shaft speed is also a function of the field current in a DC motor while maintaining a constant armature voltage ($E_a = K_a \phi_d \omega$) as field current is directly proportional to the direct axis flux produced in the machine.

B. Construction:

The stator of the dc motor has poles, which are excited by dc current to



produce magnetic fields. In the neutral



zone, in the middle between the poles, commutating poles are placed to reduce sparking of the commutator. The commutating poles are supplied by dc current. Compensating windings are mounted on the main poles. These short-circuited windings damp rotor oscillations. The poles are mounted on an iron core that provides a closed magnetic circuit. The motor housing supports the iron core, the brushes and the bearings. The rotor has a ring-shaped laminated iron core with slots. Coils with several turns are placed in the slots. The distance between the two legs of the coil is about 180 electric degrees. The coils are connected in series through the commutator segments. The ends of each coil are connected to a commutator segment. The commutator consists of insulated copper segments mounted on an insulated tube. Two brushes are pressed to the commutator to permit current flow. The brushes are placed in the neutral zone, where the magnetic field is close to zero, to reduce arcing. The rotor has a ring-shaped laminated iron core with slots. The commutator consists of insulated copper segments mounted on an insulated tube. Two brushes are pressed to the commutator to permit current flow. The brushes are placed in the neutral zone, where the magnetic field is close to zero, to reduce arcing. The commutator switches the current from one rotor coil to the adjacent coil, the switching requires the interruption of the coil current. The sudden interruption of an inductive current generates high voltages. The high voltage produces flashover and arcing between the commutator segment and the brush.

C. DC Motor Operation:

In a dc motor, the stator poles are supplied by dc excitation current, which produces a dc magnetic field. The rotor is supplied by dc current through the brushes, commutator and coils. The interaction of the magnetic field and rotor current generates a force that drives the motor. The magnetic field lines enter into the rotor from the north pole (N) and exit toward the south pole (S). The poles generate a magnetic field that is perpendicular to the current carrying conductors.

The interaction between the field and the current produces a Lorentz force; the force is perpendicular to both the magnetic field and conductor. The generated force turns the rotor until the coil reaches the neutral point between the poles. At this point, the

magnetic field becomes practically zero together with the force. However, inertia drives the motor beyond the neutral zone where the direction of the magnetic field reverses.

To avoid the reversal of the force direction, the commutator changes the current direction, which maintains the counterclockwise rotation. Before reaching the neutral zone, the current enters in segment 1 and exits from segment 2. Therefore, current enters the coil end at slot a and exits from slot b during this stage. After passing the neutral zone, the current enters segment 2 and exits from segment 1, this reverses the current direction through the rotor coil, when the coil passes the neutral zone. The result of this current reversal is the maintenance of the rotation.

ARDUINO IDE AND ITS PROGRAMMING:

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

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

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

2.1 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 Uno 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 literature survey

This is what the Arduino ide looks like.



The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

Arduino Pro IDE		
Developer(s)	Arduino Software	
Preview release	v0.1.2 / 14 September 2020; 4 months ago[9]	
Repository	github.com/arduino/Arduino	
		
Written in	C, C++	
Operating system	Windows, macOS, Linux	
Platform	IA-32, x86-64, ARM	
Type	Integrated development environment	
License	LGPL or GPL license	
Website	blog.arduino.cc/2020/08/24/cli-and-ide-get-better-together/	

With the rising popularity of Arduino as a software platform, other vendors started to implement custom open source compilers and tools (cores) that can build and upload sketches to other microcontrollers that are not supported by Arduino's official line of microcontrollers.

In October 2019 the Arduino organization began providing early access to a new Arduino Pro IDE with debugging and other advanced features. 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.

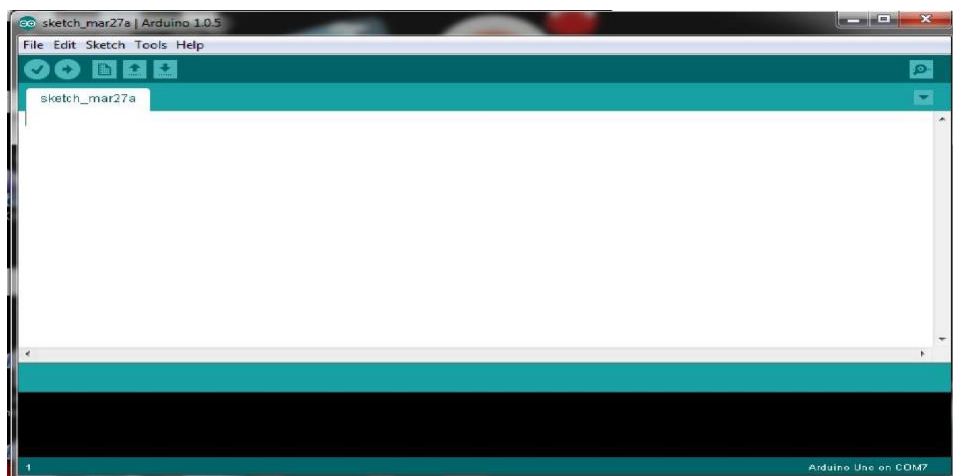
An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put 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 Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz 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.

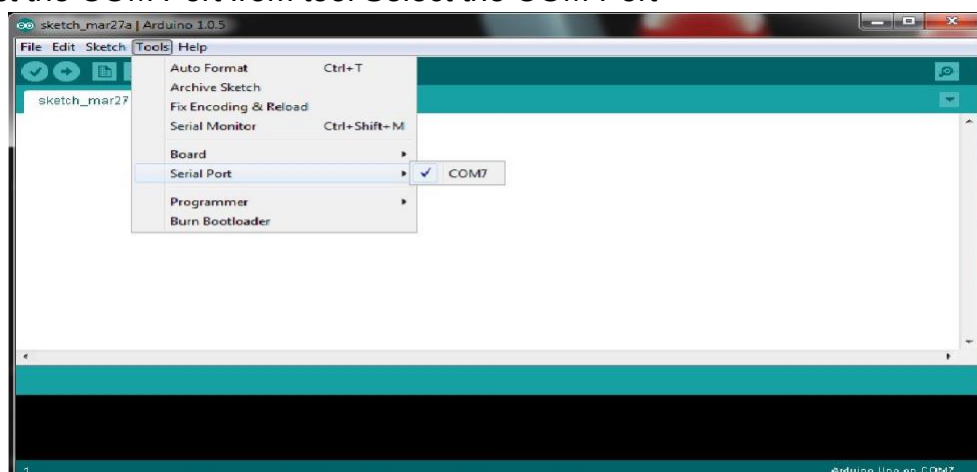
ARDUINO SOFTWARE:

1. Open Arduino IDE as shown below

Open Arduino

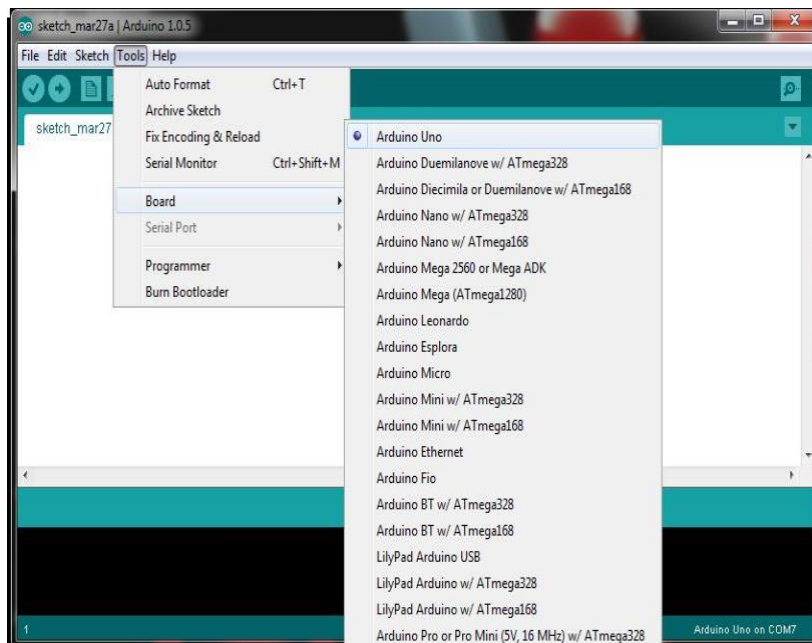


2. Select the COM Port from tool Select the COM Port



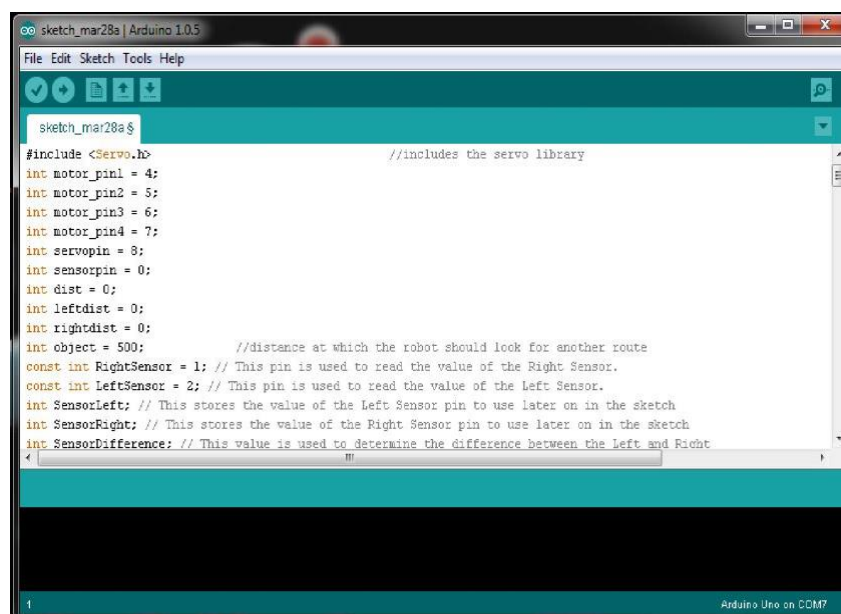
3. Select the required Arduino board from Tools as shown below

Select the required Arduino board

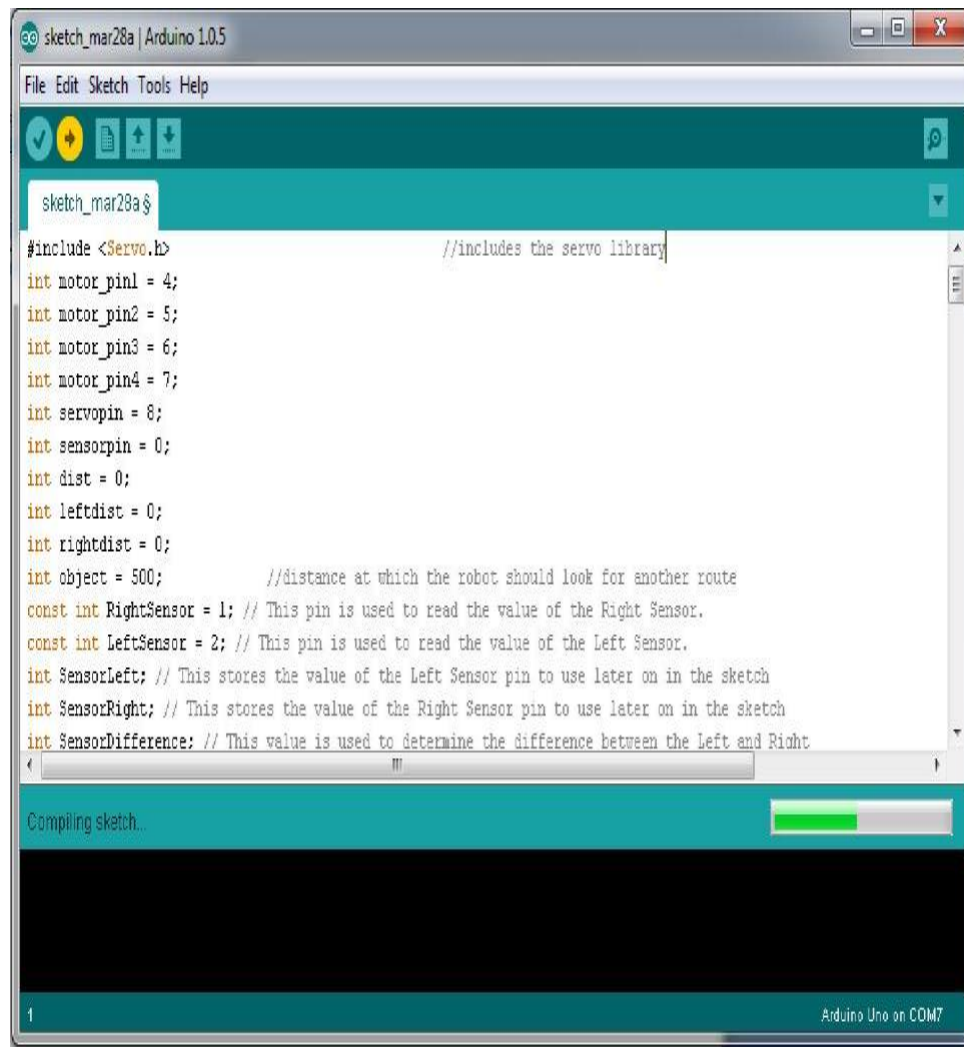


4. Write the sketch in Arduino IDE

Sketch in Arduino IDE



5. Compile and upload the Sketch to Arduino board upload the Sketch to Arduino board



UBIDOTS EXPLORER:

Introduction:

Welcome to the Ubidots REST API hardware docs. Here you would reference how to send or retrieve data from your hardware devices using our supported communication protocols: **HTTP**, **MQTT** and **TCP/UDP**.

The purpose of this section is to help you understand what happens in the backstage when communicating with Ubidots, so you can replicate this in your firmware. For this reason, we avoid the use of examples using libraries. However, if you'd like to use one of our libraries (Python, C, and more), check out our compatible devices and API clients sections.

How Ubidots Works?

Every time a device updates a sensor value in a variable, a data-point or "**dot**" is created. Ubidots stores dots that come from your devices inside variables, and these stored dots have corresponding **timestamps**.

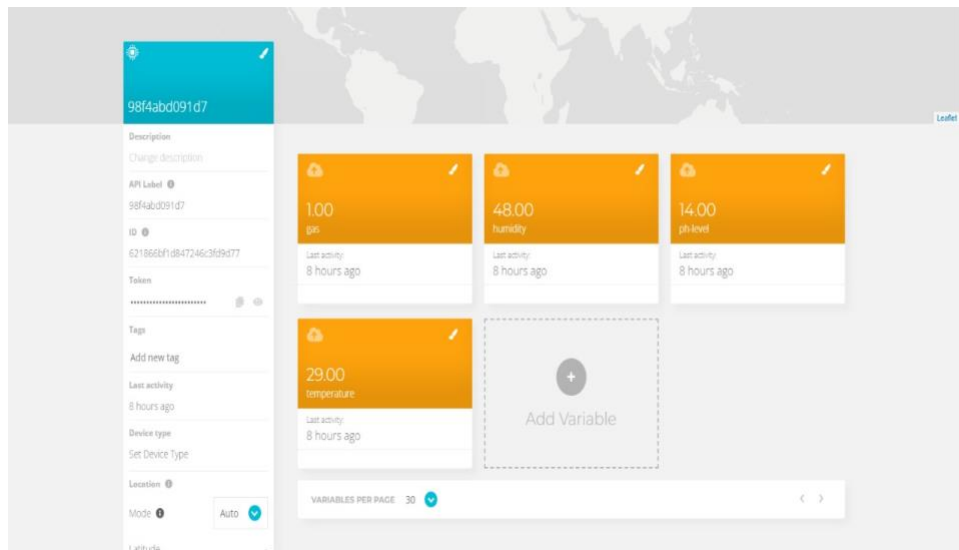
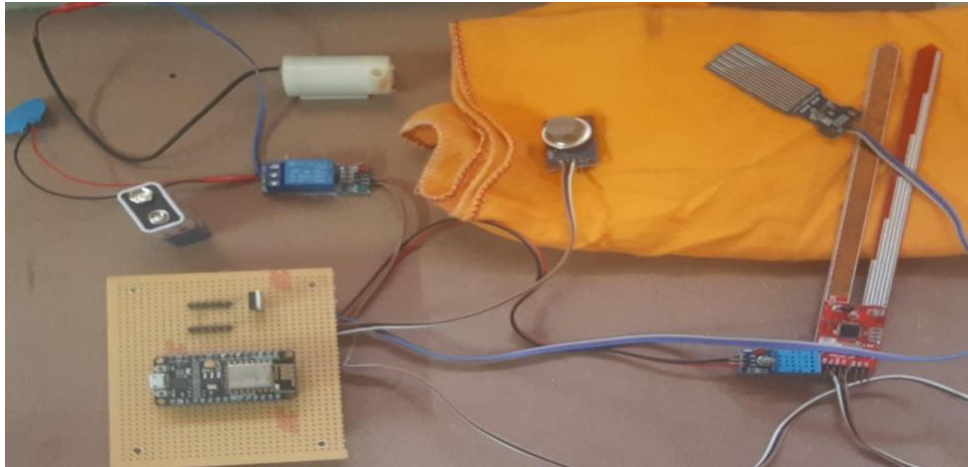
Code	Meaning
200	Ok -- Successful request.
201	Created -- Successful request + an item (device or variable) was created.
202	Accepted -- The request has been accepted for processing, but the processing has not been completed.

Code	Meaning
204	One of the fields is incorrect and the request is not saved -- Please verify it's a valid JSON string and that the fields are the ones expected by the endpoint (string, object or float).
400	Bad Request -- Error due to an invalid body in your request. Please verify it's a valid JSON string and that the fields are the ones expected by the endpoint (string, object or float).
401	Invalid API key -- Please verify your API Key.
402	Payment required -- Please verify your balance.
403	Forbidden -- This token is not valid. Please verify your token.
404	Not Found -- We couldn't find the URL you're trying to access. This might be due to a wrong device label or ID, a wrong variable label or ID, or simply a typo in the URL of the request.
405	Method Not Allowed -- This API endpoint does not accept the method used. Check our API docs to see the allowed methods.
415	Unsupported media type -- The payload is in a format not supported by this method on the target resource.
420	You have exceeded your API limits -- To upgrade your API limits contacts the Ubidots team
423	Device does not receive data because it is disabled

Code	Meaning
429	Too many requests -- Many requests sent in a given amount of time ("rate limiting")
50*	Internal Error -- We're having issues with our servers. Please check our status page.

CHAPTER 4

Result and Discussion



Connecting all the sensors to the ESP8266, the program given to NodeMCU will run in the Ubidot software through which USB cable is connected. Then, in the cloud automatically the data starts updating once everything is connected and starts sending the message about the quality of the respective water. The data read by the sensors are shown as above.

CHAPTER 5

Summary and Conclusion

Summary

The basic idea about is to measure the water quality in low cost however a normal people can afford. Water measurement plays a key role in day-to-day life. The low-cost water monitoring system, which is a solution for the water wastage and water quality.

Conclusion

Finally, we have designed in such a way that the drinking Water quality can be measured with the help of ESP 8266 microcontroller (NODE MCU). we were able to analyse the quality of the water in an accurate manner by using the system. In addition to that it is budget friendly.

References:

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5. Journal of environmental Management, vol. 88, issue 3, pp. 437-447, August 2008.
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