TO PREDICT WHETHER PARAMETERS MONITORING SYSTEM WITH LIVE FEED ON CLOUD(IOT)

A PROJECT REPORT SUBMITTED TO

SRM INSTITUTE OF SCIENCE & TECHNOLOGY

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

AWARD OF THE DEGREE OF

MASTER OF COMPUTER APPLICATIONS

BY

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(Deemed to be **University** *u/s 3 of UGC Act, 1956)*

DEPARTMENT OF COMPUTER APPLICATIONS

COLLEGE OF SCIENCE AND HUMANITIES

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Chennai, Tamilnadu

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BONAFIDE CERTIFICATE

This is to certify that the project report titled "To Predict whether parameters monitoring system with live feed on cloud (iot)" is a bonafide work carried out by Shalini R (RA2232014010079), Basil VP (RA2232014010086), Premkumar R (RA2232014010098) under my supervision for the award of the Degree of Master of Computer Applications. To my knowledge the work reported herein is the original work done by these students.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

Declaration of Association of Research Project with SDG Goals

This is to certify that the research project entitled ----------

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This study has clearly shown the extent to which its goals and objectives have been met in terms of filling the research gaps, identifying needs, resolving problems, and developing innovative solutions locally for achieving the above-mentioned SDG on a National and/or on an International level.

Signature of the Student

Guide and Supervisor

Head of the Department

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With profound gratitude to the ALMIGHTY, We take this chance to thank the people who helped us to complete this project.

We take this as a right opportunity to say THANKS to our parents who are there to stand with us always with the words “YOU CAN”.

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ABSTRACT

This project aims to develop an innovative solution for real-time weather monitoring using Internet of Things (IoT) technology. The system leverages a network of weather sensors to collect, transmit, and store weather data on a cloud platform, providing users with a live feed of current weather conditions. The key components of this project Include an array of weather sensors distributed across a designated area, a central data hub that aggregates sensor data and a cloud-based platform for data storage and accessibility. Sensor: A network of weather sensors is strategically placed to capture essential weather parameters such as temperature, humidity and feed. These sensors continuously collect data, ensuring the accuracy and reliability of weather measurements. Real-Time Visualization: The cloud platform offers real-time visualization of weather conditions through user-friendly dashboards. Users can monitor weather parameters as they change in real time, environmental monitoring, contributing to enhanced decision-making and safety in weather dependent scenarios. Weather Monitoring System Data Analysis: Advanced data analysis techniques are applied to the collected data, enabling users to gain insights into weather trends, anomalies, and predictive information. This data analysis can support decision-making processes in various applications. The system can be configured to send alerts and notifications to users or relevant authorities in the event of extreme weather conditions or when predefined thresholds are exceeded, improving safety and preparedness. For instance, this can include automated irrigation or storm shutter control.

I INTROCTION

Weather monitoring system deals with detecting and gathering various weather parameters at different locations which can be analysed or used for weather forecasting. The aim of this system is achieved by technologies such as Internet of Things(IOT) and Cloud. The idea of internet of things is to connect a device to the internet and to other required connected devices. Using Internet the information from the IOT device can easily be transferred to the cloud and then from the cloud to the end user. Weather Monitoring is an essential practical implementation of the concept of Internet of Things, it involves sensing and recording various weather parameters and using them for alerts, sending notifications, adjusting appliances accordingly and also for long Term analysis. Also we will try to identify and display trends in parameters using graphical representation. The devices used for this purpose are used to collect, organize and display information. It is expected that the internet of things is going to transform the world by monitoring and controlling the phenomenon of environment by using sensors/devices which are able to capture, process and transmit weather parameters. Cloud is availability of computer system resources like data storage, computing power without direct active management of user. The data captured is transmitted to the cloud so that the data could be further displayed. Besides this, the system consists of components such as Arduino UNO board which is a microcontroller board consisting of 14 digital pins, a USB connection and everything used to support microcontroller; DHT11 is Temperature and humidity sensor which is used for detecting these mentioned parameters; WIFI module is used to convert the data collected from the sensors and then send it to the web server. So, in this way weather conditions of any location can be monitored from any remote location in the world. A web page is created which can have access to the cloud and display and organize the required results

RELATED WORK

IOT has become a great area of interests for institutes, big tech companies and obviously users or customers also .Many IOT based concepts have gained so much attention like Smart wearable devices, smart home, smart city etc. Almost all the applications based on Internet of things include devices like transducers and sensors attached to the microcontroller with a wireless/wired flow of data to a remote cloud service or a local data storage which converts the raw data to a significant information which can further used in many areas. While working on this project we came across some works that International Journal of Advanced Science and Technology have been accomplished in making smart applications using either Raspberry Pi boards or arduino board which are economical. Most of the applications were built using these boards for example smart city and other automation projects. In [1], it was said that for a smart city “Places can be equipped with sensors and monitor environmental conditions, cyclists or athletes can find the most "healthy" trips and the city can respond by adjusting the traffic orby planting more trees in some areas. The data will be accessible to all citizens to promote the creation of applications using real-time information for residents. ”So we can say that this weather monitoring system will be helpful in some smart city projects also. In [2] the authors chose a single sensor i.e. composite DHT11 sensor for reading both temperature and humidity. Earlier people staying at home and busy in their household works or people who work in offices had no idea about the environmental parameters outside their home or office. People have no idea if the temperature outside is quite low or high or normal or if it is raining or not or the value of the humidity in the environment. According to [3] the monitoring systems can provide self-protection to our environment such as protecting public health from the pollution or at least reducing the effects of pollution on the public. It will notify us whenever the temperature is lower than it should be or is higher than normal.

HARDWARE & SOFTWARE SETUP

A. Components required: Hardware

1)Microcontroller

2) ESP8266 based wifi module Nodemcu

3) Temperature and Humidity Sensor(DHT11)

4) Barometric Pressure Sensor(BMP180)

5) LDR

6) Raindrop Module

7) Mobile phone to receive Email and SMS B. Software

- Arduino IDE
- Amazon AWS for Cloud

SYSTEM ARCHITECTURE
MICROCONTROLLER/ARDUINO

The implemented system consists of a microcontroller (ESP8266) which is the most essential component in this device. The sensors can be operated by the microcontroller to get the data from them and it processes the analysis with sensor data from them and it processes the analysis with the sensor data and updates it into the internet through WIFI module. Arduino/Genuine Uno is a microcontroller board based on the ATMEGA328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, 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.
WIFI MODULE

The Arduino Uno which we have used is integrated with a WiFi module called Arduino Uno WiFi. The board is based on the ATmega328P with an ESP8266 WiFi module consolidated TCP/IP protocol stack.In order to establish communication with the ESP8266 WiFi module, microcontroller needs to use some AT commands

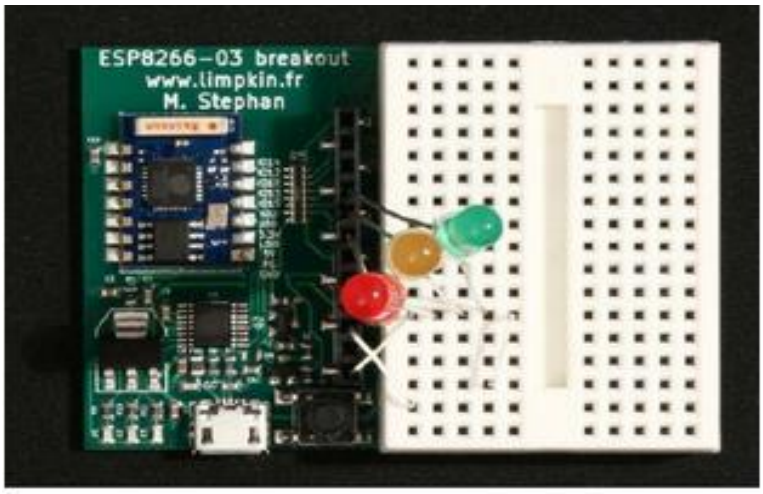


Fig.1 Simple Arduino Microcontroller Board

WIFI MODULE :

The Arduino Uno which we have used is integrated with a WiFi module called Arduino Uno WiFi. The board is based on the ATmega328P with an ESP8266 WiFi module consolidated TCP/IP protocol stack. In order to establish communication with the ESP8266 WiFi module, microcontroller needs to use some AT Commands.

Fig.2 Wifi Module

SENSORS:

The system consists of a temperature and humidity sensor (DHT 11) and Barometric Pressure Sensor (BMP180). These 2 sensors will measure the primary environmental parameters like temperature, humidity and the CO levels. These sensors will give the Analog voltage as an input to the microcontroller board as each analog voltage corresponds to a particular weather factor, then the microcontroller will convert this Analog voltage into digital data.

TEMPERATURE AND HUMIDITY SENSOR (DHT 11)

The DHT11 is a sensor used for measuring humidity and temperature. It gives temperature and humidity as serial data output. It can work on 3.5 to 5.5V operating voltage. It can have 5% accuracy for humidity readings and ±2°C accuracy for temperature readings. It contains 4 pins and is factory calibrated therefore International Journal of Advanced Science and Technology it is very easy to set up. Also, it is a low cost sensor. It is suitable for 20-80% humidity readings with 5% accuracy. It senses the temperature of the surroundings. It is a 4 pin device. There should be a connection of 10k resistor between pin 1 and pin 2.Pin 1 is connected to the 3.3V.Pin 4 is connected to GND. Pin 2 is the output pin which gives input to then node mcu pin D4.P3 is off no use and hence, left empty.

Fig.3DHT11 Sensor

BAROMETRIC PRESSURE SENSOR (BMP180):

Fig.4 BMP

BMP 180 is a part of BMPXXX family which are used for measuring atmospheric or barometric pressure. It is cheap and convenient to use. It measures the barometric pressure which is nothing but air-weight or weight of the air in simple words. It provides the information in digital output. It has also inbuilt temperature sensor with it as we know that temperature affects the pressure therefore along with its temperature sensor it gives temperature compensated output. It has very low power consumption(3 micro Amperes). It can work on Operating voltage ranging from 1.3V to 3.6V.Also,one of the reasons for using the BMP180 sensor in our device is that it is capable of communicating with high speeds.

LDR (Light-Dependent Resistor)

An LDR is a light dependent resistor which works on the principle that it has a variable resistor in it which changes its resistance according to the intensity of the light. It is widely used in many light sensing or light detecting circuit for example in some smartphone it is attached with camera so that the camera can adjust its shutter speed according to the intensity of the light. Its resistance decreases with the increase in light intensity. It is built of a high resistance semiconductor.

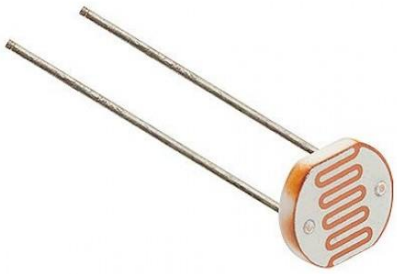


Fig.5 LDR

Raindrop Module :

It is used for the detection of rain. It can also be used to detect the intensity of rainfall. It has both digital outputs as well as analog output. It has two further sub components that are control board and rain board.It has a potentiometer for adjusting the sensitivity. This module measures the moisture through analog output pin and when the threshold of moisture exceeds too much it provides a digital output. Its operating voltage is 5V.Its main advantage is that is easy to plug and use and also it has a very good accuracy.

Fig.6 RainDrop Module

Arduino IDE:

The main software that we used for programming our microcontroller board is Arduino IDE. It is written in C++ and C. It provides an inbuilt library which provides us many output and input procedures. Also it is an open source software. It uses avrdude as a default uploading tool to flash the user code to arduino codes. The programs which are written in arduino ide are known as sketches. These are written in the editor and are saved with the extension. ino. It has a console which displays output including error messages and some other information. This IDE supports the C and C++ languages by using some special rules structuring the code.

RESULTS :

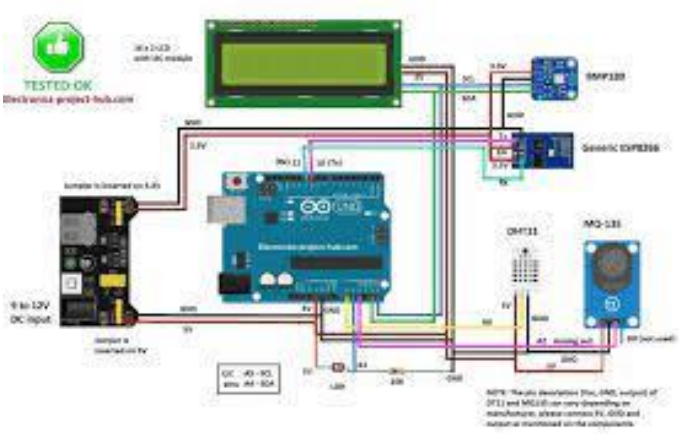
After the sensor measurements are uploaded to the cloud, the values are analysed and then it is notified whenever any of the parameter's the specific value is out of its

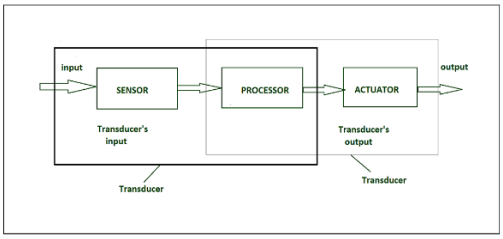
normal range. Also a graph is plotted to show the trends.

FUTURE SCOPE

The proposed IoT and cloud based weather monitoring system can be further modified to many more features. We can also add a GPS device in the design so that the location of the surrounding will also be mailed or messaged to the user along with the surrounding parameters, like temperature, humidity, pressure, light intensity etc. We can add various other sensors for measuring various other weather parameters like solar radiation, visibility etc. The system can also be modified such that whenever a message is sent from a particular phone number or email id to the server, all the environmental parameters can be sent as notification or as a message to mobile phone or email id. Also, this weather monitoring system can be used in smart city projects and many other automation projects.

VR DIAGRAMS





II What is Internet of Things (IoT)

III Definition, history and features of IoT.

This chapter describes some important highlights in the history of the IoT (Internet Of things). Nowadays, the internet-based information architecture allows the Exchange of services and goods between all elements, equipment and objects Connected to the network. The IoT refers to the networked interconnection of those Everyday objects, which are often equipped with some kind of intelligence. In this Context, Internet can be also a platform for devices to communicate electronically And share information and specific data with the world around them. So, IoT can be Seen as a real evolution of what we know as Internet by adding more extensive Interconnectivity, a better perception of the information and more comprehensive Smart services. For the most part, the Internet was used for connection-oriented Application protocols like HTTP (Hypertext Transfer Protocol) and SMTP (Simple Mail Transfer Protocol). However, nowadays a large number of smart devices Communicate between themselves and to other control systems. This concept is Known as M2M (Machine-to-Machine communications).

IoT (Internet of things) is an emerging global Internet-based technical architecture Facilitating the exchange of goods and services in global supply chain networks has An impact on the security and privacy of the involved stakeholders.

Some highlights in the IoT history are the following:

• The term Internet of Things was first used by Kevin Ashton in 1999 that was Working in the field of networked RFID (radio frequency identification) and Emerging sensing technologies.

• However, IoT was “born” sometime between 2008 and 2009 .

• In 2010, the number of everyday physical objects and devices connected to the Internet was around 12.5 billion. Nowadays there are about 25 billion of devices Connected to the IoT. More or less a smart device per person .

• The number of smart devices or “things” connected to the IoT is expected to Increase to a further 50 billion by 2020.

The IoT introduces a step change in individuals’ quality of life by offering a lot of New opportunities to data access, specific services in education, security, health care Or transportation among others. On the other hand, it will be a key to increase Enterprises’

productivity by offering a widely distributed, locally intelligent Network of smart devices and new services that can be personalized to customer Needs. The IoT brings benefits from improved management and tracking of assets and products, it increases the amount of information data and allows the Optimization of equipment and use of resources that can be translated into costs Saving. Moreover, it offers the opportunity to create new smart interconnected Devices and explore new business models.

IV IPv6 Introduction

When we use the Internet for any activity, be it e-mail, data transmission, web Browsing, downloading files, images or videos or any other service or application, Communication between different network elements and our own computer, laptop Or smart phone, uses a protocol: The IP (Internet protocol) which specifies the Technical format of packets and the addressing scheme for computers to Communicate over a network.IPv6 (Internet protocol version 6) is the most recent version of the IP, the Communications protocol that provides an identification and location system for Computers on networks and routes traffic across the Internet. In order to connect any device to Internet it's necessary to provide an IP address to The device. The first version of an Internet Protocol publicly used was IPv4 (Internet Protocol version 4). This protocol was created by the Defense Advanced Research Projects Agency (DARPA). DARPA is an agency of the U.S. Department of Defense responsible for the development of emerging technologies mainly for Military applications created in 1958. IPv4 included an addressing system that used Numerical identifiers consisting of 32 bits. The use of addresses with a length of 32 Bits limits the total number of possible addresses to a number of approximately 4.3 Billion addresses for devices connected to internet around the world. The number Of devices connected to Internet will be soon bigger than the number of addresses Provided by IPv4.

For this reason, and in anticipation of the situation, the agency Responsible for standardization of Internet protocols: The IETF (Internet Engineering Task Force) has been working in a new IP version from 1998: The IPv6, the successor protocol that is intended to replace IPv4 was first formally Described in Internet standard document RFC 2460 [3].

IPv6 uses a 128-bit address format, allowing 2128, or approximately 3.4 1038

Addresses, approximately 8 1028 times as many as IPv4. While increasing the pool Of addresses is one of the most important benefits of IPv6, there are other important Technological changes in IPv6 that will improve the IP protocol:

easier Administration, better multicast routing, a simpler header format and more efficient Routing, built-in authentication and privacy support among others.

IPv6 will coexist with the older IPv4 for some time. The deployment of IPv6 will Be made gradually in an orderly coexistence with IPv4. Client devices, network

Equipment, applications, content and services are to be adapted to the new Internet.

Fig. 1. IPv6 Header Format [3]

Structure of IPv6 Header	
Version	4-bit Internet Protocol version number = 6.
Traffic Class	8-bit traffic class field.
Flow Label	20-bit flow label.
Payload Length	16-bit unsigned integer. Length of the IPv6 payload, i.e., the rest of the packet following this IPv6 header, in octets.
Next Header	8-bit selector. Identifies the type of header immediately following the IPv6 header. Uses the same values as the IPv4 protocol field
Hop Limit	8-bit unsigned integer. Decremented by 1 by each node that forwards the packet. The packet is discarded if Hop Limit is decremented to zero.
Source Address	128-bit address of the originator of the packet
Destination Address	Address 128-bit address of the intended recipient of the packet (possibly not the ultimate recipient, if a routing header is present).

The new features introduced with the IPv6 protocol are basically the following : A New header format, an efficient and hierarchical addressing and routing Infrastructure, a much larger address space and stateless and both firewall address Configuration, IP security, extensibility, a better Quality of Service (QoS) support And a new protocol for neighboring node interaction. The IPv6 protocol has solved some of the security problems found in IPv4 networks By adding the IPsec (IP security) as mandatory. As a result, IPv6 is more efficient. IPsec enhances the original IP protocol by providing authenticity, integrity, Confidentiality and access control to each IP packet through the use of two

Protocols: AH (authentication header) and ESP (encapsulating security Payload).Moreover, the expansion of the number of bits in the address field to 128 Bits offered by IPv6 creates a

significant barrier for attackers wanting to conduct Comprehensive port scanning. On the other hand, it is possible to bind a public Signature key to an IPv6 address: CGA (Cryptographically Generated Address).

IPv6 offers also improvements on mobility security. Despite that the MobileIP Internet protocol is available in both IPv4 and IPv6, in IPv6 it was built into the Protocol instead of being added as a new function in IPv4. This means that any IPv6 Node can use a mobile IP both as required. Mobile IPv6 uses two extensions Headline: A routing header for registration and a headline target to data delivery Between mobile nodes and their corresponding fixed nodes.

IoT Applications

In this chapter, some important applications related to the IoT field are described. Main elements of the IoT architecture are introduced and the expected evolution of The IoT market is presented.

V IPV4 Introduction

The IoT can be seen as a combination of sensors and actuators providing and Receiving information that is digitalized and placed into bidirectional networks able To transmit all data to be used by a lot of different services and final users .

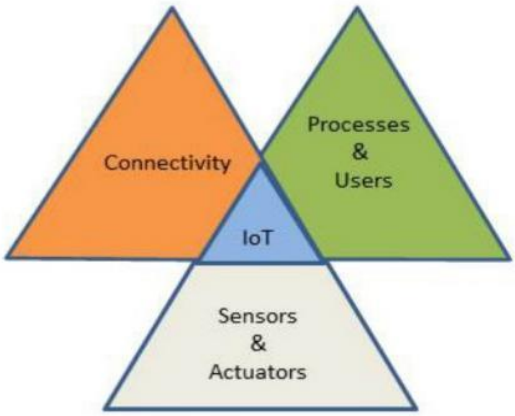


Fig. 2. The IoT Concept.

Multiple sensors can be attached to an object or device in order to measure a broad Range of physical variables or phenomena and then transmit all data to the cloud.The sensing can be understood as a service model.

Nowadays, state of the art devices such as conventional house items as refrigerators Or televisions comprise communication and sensing capabilities. These capabilities Will be

constantly increasing by incorporating smarter communication and sensing Tools.

The architecture of IoT systems can be divided into four layers: Object sensing Layer, data exchange layer, information integration layer, and application service Layer [5].

Smart devices can be already connected through traditional Internet. However, the IoT incorporates enables the interconnection among the sensing layer which reduces the requirements on the capability Of those devices and them. Sensor data Consumers communicate with sensors or sensor owner's through the information Integration layer that is responsible of all the communication and transactions.

Meanwhile, new requirements and challenges to data exchange, information Filtering and integration, definition of new services to users, as well as the Complexity of the network architecture Moreover, the use of cloud technologies is Exponentially growing. New infrastructure platforms and software applications are Offered in the frame of the IoT.

Some of the major advantages and benefits of the IoT will be the creation of innovative services with improved performance and Value added solutions along with the reduction of data acquisition costs of existing Services and the opportunity to create new revenue streams in a context of a Sustainable business model.

These applications can be oriented to consumers,Business, commercials, and survey activities, industrial and scientific community By harnessing the application developers.

Four-layer architecture of IoT	
Object Sensing Layer	Sensing the physical objects and obtaining data.
Data Exchange Layer	Transparent transmission of data through communication networks.
Information Integration Layer	Processing of the uncertain information acquired from the networks, filtering undesired data and integratation of main information into usable knowledge for services and final users.
Application Service Layer	Provides content services to users.

IoT market

The IoT is an emerging global Internet-based technical architecture facilitating the Exchange of goods in a global supply-chain network [1]. As the technology trend Shifts towards providing faster data rates and lower latency connectivity the Internet Is expected to double in

size every 5.3 years and cloud computing can play a key Role in that growing. Cloud computing is one of the enabling platforms to support IoT. Most

"things" of the real world will be integrated into the virtual world by Enabling anytime, anywhere full connectivity.

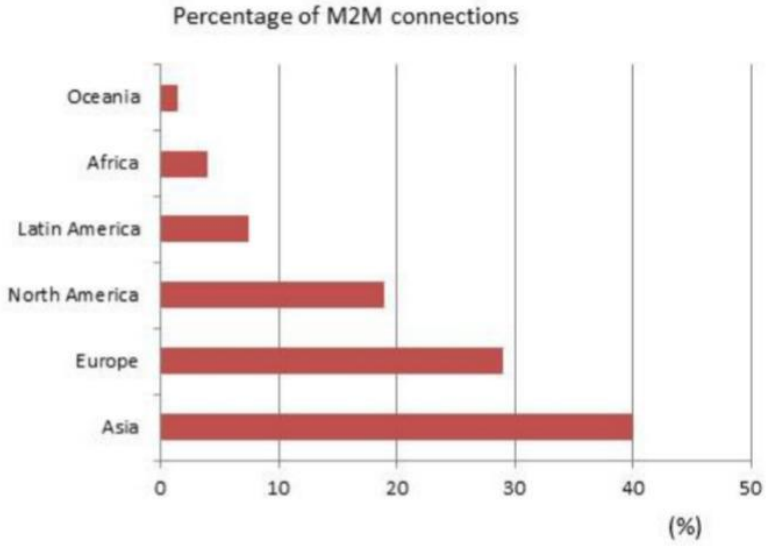


Fig. 1. Percentage of M2M connections [2].

Cloud computing is a model for enabling access to a shared pool of configurable Computing resources by allowing users to take benefit from all existing

Technologies, without the need for deep knowledge about or expertise with each one Of them.

In 2010, the number of everyday physical objects and devices connected to the Internet was around 12.5 billion. This number is expected to double to 25 billion in 2015 as the number of more smart devices per person increases, and to a further 50 Billion by 2020

Connected World.	
31 %	Phones.
29%	Notebook.
10%	Smart Phones.
8%	Smart TV.
5%	Tablets.
5%	Game Players.
5%	Media Players.
5%	eReaders.
3%	Others.

Asia currently has the most M2M connections because of the big effort carried out In some countries as Japan and China. However, American and European Technology companies are making an important progress on IoT and they will bring To a market growing in these countries. With the important emergence of the IoT, New regulatory approaches to ensure the privacy and security of users and data must To be defined.

VI IOT APPLICATIONS

The number of applications and services that can provide IoT is practically Unlimited and can be adapted to many fields of human activity by facilitating and Enhancing their quality of life in multiple ways. This chapter gives a short list of Applications and services based on IoT. However, it is just a limited description in Order to understand all possible new applications and services that IoT could Provide. An estimated value about $19 trillion by 2020 is expected to be achieved By IoT applications and services.

IoT Applications and services:

• Connected intelligent buildings: Improvements in efficiency (energy Management and saving) and security (sensors and alarms). Domotic Applications including smart sensors and actuators to control home appliances.

Health and education services at home. Remote control of treatments for Patients. Cable/satellite services. Energy storage/generation systems.

Automatic shutdown of electronics when not in use. Smart thermostats. Smoke Detectors and alarms. Access control applications. Smart door locks. Sensors Built into building

infrastructure to guide first responders and assistances. Safety For all family members. • Smart cities and transportation: Integration of security services. Optimization Of public and private

Fig. 1. Example of IoT applications: Smart cities.

transportation. Parking Sensors. Smart management of Parking services and traffic in real time. Smart management of traffic lights Depending on traffic queues. Locate cars that have overstayed Smart energy Grids. Security (cameras, smart sensors, information to citizens). Water Management. Parks and Gardens irrigation. Smart garbage cans. Pollution and Mobility controls. Get immediate feedback and opinions from citizens. Smart Governance. Voting Systems. Accident monitoring, emergency actions *Coordination*.

• Education: Linking virtual and physical classrooms to make learning more Efficient and accessible, e-learning. Access services to virtual libraries and Educational portals. Interchange of reports and results in real time. Lifelong Learning. Foreign languages learning. Attendance management.

• Consumer electronics: Smart phones. Smart TV. Laptops, computers and Tablets. Smart refrigerators, washers and dryers. Smart home theatre systems.

Smart appliances. Pet collar sensors. Personalization of the user experience. Autonomous product operation. Personal locators. Smart glasses.

• Health: Monitoring of chronic diseases. Improvement of the quality of care and Quality of life for patients. Activity Trackers. Remote diagnostic. Connected Bracelets. Interactive belts. Sport and fitness monitoring. Intelligent tags for Drugs. Drug usage tracking. Biochips. Brain-computer interfaces. Monitoring Eating habits.

• Automotive: Smart Cars. Traffic control. Advance information about what is Broken. Wireless monitoring of tire pressure of car. Smart energy management And control. Self-diagnosis. Accelerometers. Position, presence and proximity Sensors. Analysis of the best way to go in real time. GPS tracking. Vehicle speed Control. Autonomous vehicles using IoT services.

• Agriculture and environment: Measurement and monitoring of environmental

Pollution (CO_2, noise, contaminant elements presents in ambient). Forecasting

Climate changes based on smart sensors monitoring. Passive RFID tags attached

To agriculture products. Sensors in pallets of products. Waste management. Nutrition calculations.

• Energy services: accurate data on energy consumption. Smart metering. Smart Grids. Analysis and prediction of energy consumption behaviours and patterns.

Forecasting future energy trends and needs. Wireless sensors networks. Energy Harvesting and recycling.

• Smart Connectivity: Data management and service provisioning. Use of social Media and social networking. Access to email, voice and video services. Interactive group communication. Real time streaming. Interactive gaming. Augmented reality. Network security monitoring. Wearable user interfaces. Affective computing. Biometric authentication methods. Consumer telematics.

M2M communication services. Big data analysis. Virtual reality. Cloud Computing services. Ubiquitous computing. Computer vision. Smart antennas.

• Manufacturing: Gas and flow sensors. Smart sensors of humidity, temperature, Motion, force, load, leaks/levels. Machine vision. Acoustic and vibration Sensing.

Compound applications. Smart control of robots. Control and Optimization of fabrication processes. Pattern recognition. Machine Learning. Predictive Analytics. Mobile logistics. Warehouse management. Prevent Overproduction. Efficient logistics.

• Shopping: Intelligent shopping. RFID and other electronic tags and readers. Barcodes in retail. Inventory control. Control of geographical origin of food and Products. Control food quality and safety

VII Enabling Technologies

Successful application of the IoT concept into the real world is possible thanks to Advancements in underlying technologies. In this section the most relevant enabling Technologies will be stated with the aim to provide a picture of the role they will Likely play in the IoT.

1 Energy

Power and energy storage technologies are enablers for the deployment of IoT Applications. Energy issues, in all its phases, from harvesting to conservation and Usage, are central to the development of the IoT. These technologies have to provide High power-density energy generation and harvesting solutions which, when used With today's low power nanoelectronics, will enable us to design self-powered Intelligent sensor-based wireless identifiable device. There is still a need to research And develop solutions in this area (nanoelectronics, semiconductor, sensor Technology, micro systems integration) having as an objective ultra low power Devices, and more efficient and compact energy storage like batteries, fuel cells, And printed/polymer batteries, as current devices seem inadequate considering the Processing power needed and energy limitations of the future. In addition, system Integration will increase efficiency of current systems, and will provide a number Of solutions for the future needs.

2 Sensors

Sensors are one of the key building blocks of the Internet of Things. As ubiquitous Systems, they can be deployed everywhere. They can also be implanted under Human skin, in a purse or on a T-shirt. Some can be as small as four millimetres in Size, but the data they collect can be received hundreds of miles away. They Complement human senses and have become indispensable in a large number of Industries, from health care to construction. Sensors have the key advantage that They can anticipate human needs based on information collected about their context. Their intelligence multiplied by numerous networks allows them not only to report About external environment, but also to take action without human intervention. Miniaturized silicon chips are designed with new capabilities in smaller form Factors and better processing performance and efficiency. Costs are falling, Following the Moore's Law. The cost of bandwidth has also declined and similarly The processing costs, enabling more devices to be not just connected, but smart Enough to know what to do with all the new data they are generating or receiving. Capabilities such as context awareness and inter-machine communication are Considered a high priority for the IoT. Additional priorities are the

integration of Memory and processing power, the capacity of resisting harsh environments, and An affordable security. Furthermore, the development of ultra low power Processors/microcontrollers cores designed specifically for mobile IoT devices and A new class of simple and affordable IoT-centric smart systems will be an enabling Factor. The solutions in this respect will range from micro programmed finite state Machines to the use of microcontrollers. The choice is a trade-off between Flexibility, programmability, silicon area, and power consumption. The devices Require some form of non-volatile storage(EEPROM/FRAM/Polymer),Independent of whether this will be laser trimmed at the time of manufacture, one Time programmable, or electrically rewritable. Rewritable non-volatile memory is Clearly preferred for achieving high throughput during production test, and allows Concurrently the benefit of user memory, programmability and storage of sensor Data.

3 Cloud computing

Cloud computing is a model for on-demand access to a shared pool of configurable Resources (e.g., computers, networks, servers, storage, applications, services, Software) that can be provisioned as Infrastructure as a Service (IaaS) or Software As a Service (SaaS). One of the most important outcomes of the IoT is an enormous Amount of data generated from devices connected to the Internet. Many IoT Applications require massive data storage, huge processing speed to enable real time Decision making, and high-speed broadband networks to stream data, audio, or Video. Cloud computing provides an ideal back-end solution for handling huge data Streams and processing them for the unprecedented number of IoT devices and Humans in real time.

4 Communication

New, smart multi frequency band antennas, integrated on-chip and made of new Materials are the communication means that will enable the devices to Communicate. On-chip antennas must be optimized for size, cost and efficiency, And could come in various forms like coil on chip, printed antennas, embedded Antennas, and multiple antenna using different substrates and 3D structures. Modulation schemes and transmission speed are also important issues to be tackled Allowing multi-frequency energy efficient communication protocols and Transmission rates. The communication protocols will be designed for Web oriented Architectures of the IoT platform where all objects, wireless devices, cameras, PCs Etc. are combined to analyze location, intent and even emotions over a network. New methods of effectively managing

power consumption at different levels of the Network design are needed, from network routing down to the architecture of Individual devices.

5 Integration

Integration of smart devices into pckaging, or better, into the products themselves Will allow a significant cost saving and increase the Eco friendliness of products. The use of integration of chips and antennas into non-standard substrates like Textiles and paper, and the development of new substrates, conducting paths and Bonding materials adequate for harsh environments and for ecologically sound Disposal will continue. System-in-Package (SiP) technology allows flexible and 3D Integration of different elements such as antennas, sensors, active and passive Components into the packaging, improving performance and reducing the tag cost.

RFID inlays with a strap coupling structure are used to connect the integrated circuit Chip and antenna in order to produce a variety of shapes and sizes of labels, instead Of direct mounting

6 Standards

IoT devices are quite diverse and measure different parameters and with different Conventions and units of measure. Though competing proprietary protocols keep Getting proposed, it is likely that open source standards will be one of the ways to Get this data to interoperate. Clearly, open standards are key enablers for the success of wireless communication Technologies and, in general, for any kind of Machine-to-Machine communication.

However, the need for faster setting of interoperable standards has been recognised An important element for IoT applications deployment. Clarification on the Requirements for a unique global identification, naming and resolver is needed.

Lack of convergence of the definition of common reference models, reference Architecture for the Future Networks, Future Internet and IoT and integration of Legacy.

VIII Challenges And Barriers Of Iot

Many challenging issues still need to be addressed. Addressing these challenges Enables service providers and application programmers to implement their services Efficiently. In the following paragraphs, we provide a brief discussion of the main Challenges faced in the development and deployment phases of the IoT .

1 Challenges Reliability

Reliability aims to increase the success rate of IoT service delivery. It has a close Relationship with availability as by reliability, we guarantee the availability of Information and services over time. Reliability is even more critical and has more Stringent requirements when it comes to the field of emergency response Applications. In these systems, the critical part is the communication network which Must be resilient to failures in order to realize reliable information distribution.

Reliability must be implemented in software and hardware throughout all the IoT Layers. In order to have an efficient IoT, the underlying communication must be Reliable, because for example by an unreliable perception, data gathering, Processing, and transmission can lead to long delays, loss of data, and eventually Wrong decisions, which can lead to disastrous scenarios and can consequently make The IoT less dependable.

Reliability refers to the proper working of the system based on its specification.

Performance

Evaluating the performance of IoT services is a big challenge since it depends on The performance of many components as well as the performance of the underlying Technologies. The IoT, like other systems, needs to continuously develop and Improve its services to meet requirements of customers. The IoT devices need to be Monitored and evaluated to provide the best possible performance at an affordable Price for customers. Many metrics can be used to assess the performance of the IoT Including the processing speed, communication speed, device form factor, and cost. Performance evaluation of the individual underlying protocols and technologies, Application layer protocols, and QoS have been reported in the literature, but the Lack of a thorough performance evaluation for IoT applications is still an open issue.

Interoperability

End-to-end interoperability is another challenge for the IoT due to the need to Handle a large number of heterogeneous things that belong to different platforms. Interoperability should be considered by both application developers and IoT Device manufactures to ensure the delivery of services for all customers regardless Of the specifications of the hardware platform that they use. For example, most of The smartphones nowadays support common communication technologies such as WiFi, NFC, and GSM to guarantee the interoperability in different scenarios. Also,

Programmers of the IoT should build their applications to allow for adding new Functions without causing problems or losing functions while maintaining integration with different communication technologies. Consequently, Interoperability is a significant criterion in designing and building IoT services to Meet requirements of customers. Beside variety of protocols, different Interpretations of the same standard implemented by different parties presents a Challenge for interoperability. To avoid such ambiguities, interoperability testing Between different products in a test-bed like ETSI Plugtests would be helpful. PROBE-IT is a research project that aims to ensure the interoperability of validated IoT solutions that conducted interoperability tests like CoAP, 6LoWPAN, and IoT Semantic interoperability.

Management

The connection of billions or trillions of smart devices presents service providersWith daunting issues to manage the Fault, Configuration, Accounting, Performance And Security (FCAPS) aspects of these devices. This management effort Necessitates the development of new light-weight management protocols to handle The potential management nightmare that will potentially stem from the deployment Of the IoT in the coming years. Managing IoT devices and applications can be an Effective factor for growing the IoT deployments. For example, monitoring the M2M communication of the IoT objects is important to ensure all times Connectivity for providing on demand services. The Light-weight M2M (LWM2M) Is a standard that is being developed by the Open Mobile Alliance to provide Interface between M2M devices and M2M Servers to build an application agnostic Scheme for the management of a variety of devices. It aims to provide M2Mapplications with remote management capabilities of machine-to-machine devices, Services, and applications. The NETCONF Light protocol is an Internet Engineering Task Force (IETF) effort for the management of constrained devices Provides mechanisms to install, manipulate, and delete the configuration of network

Devices. It is capable of managing a broad range of devices from resource-Constrained to resource-rich devices. The independently developed MASH IoT Platform is an example of a platform that facilitates the management (monitoring, Control, and configuration) of IoT assets anywhere in real-time using an IoT Dashboard on smartphones. Maintaining compatibility across the IoT layers also Needs to be managed to enhance connectivity speed and to ensure service delivery.

The Open Mobile Alliance (OMA) Device Management working group is Specifying protocols and mechanisms for the management of mobile devices and Services in resource constrained environments.

Manufacturing

Manufacturing challenges must be convincingly solved. Costs must be lowered to Less than one cent per passive RFID tag, and production must reach extremely high Volumes, while the whole production process must have a very limited impact on The environment, be based on strategies for reuse and recycling considering the Overall life-cycle of digital devices and other products that might be tagged or Sensor-enabled.

2 Barriers

But there are also existing barriers for the IoT, especially in the field of regulations, Security and safety. Main goal is to better protect the privacy of people and force Companies to establish secure ways to manage data and information [8, 9].

Absence of Governance

One major barrier for the widespread adoption of the Internet of Things technology Is the absence of governance. Without an impartial governing authority it will be Impossible to have a truly global IoT, accepted by states, companies, trade Organizations and the common people. Today there is not a unique universal Numbering scheme: EPC global and the Ubiquitous Networking Lab propose two Different, non-compatible ways of identifying objects and there is the risk to have Them competing in the coming future over the global market. There is also the need Of keeping governance as generic as possible, as having one authority per Application field will certainly lead to overlap, confusion and competition between Standards. Objects can have different identities in different contexts so having Multiple authorities would create a kind of multi-homing, which can lead to Disastrous results.

Privacy and Security

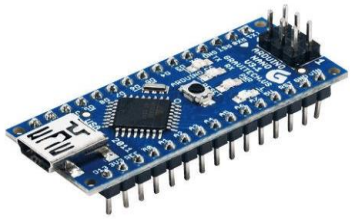
In order to have a widespread adoption of any object identification system, there is A need to have a technically sound solution to guarantee privacy and the security of The customers. While in many cases the security has been done as an add-on feature, It is the feeling that the public acceptance for the Internet of Things will happen Only when the strong security and privacy solutions are in place. In particular, Attacks have to be intercepted, data authenticated, access controlled and the privacy Of customers (natural and legal persons) guaranteed.

IX Future of IoT

It is possible to identify, for the years to come, four distinct macro-trends that will Shape the future of internet technologies, together with the explosion of ubiquitous Devices that constitute the future Internet of Things.

1. The first one, sometimes referred as “exaflood” or “data deluge”, is the Explosion of the amount of data collected and exchanged. As current networks Are ill-suited for this exponential traffic growth, there is a need by all the actors To re-think current networking and storage architectures. It will be imperative to Find novel ways and mechanisms to find, fetch, and transmit data. One relevant Reason for this data deluge is the explosion in the number of devices collecting And exchanging information as envisioned as the Internet of Things becomes a Reality.
2. The energy required to operate the intelligent devices will dramatically Decrease. Already today many data centers have reached the maximum level of Energy consumption and the acquisition of new devices has necessarily to Follow the dismissal of old ones. Therefore, the second trend can be identified Covering all devices and systems from the tiniest smart dust to the huge data Centers: the search for a zero level of entropy where the device or system will Have to harvest its own energy.
3. Miniaturization of devices is also taking place amazingly fast. The objective of A single-electron transistor is getting closer, which seems the ultimate limit, at Least until new discoveries in physics.
4. Another important trend is towards autonomic resources. The ever growing Complexity of systems will be unmanageable, and will hamper the creation of New services and applications, unless the systems will show self-* properties, Such as self-management, self-healing and self-configuration.

As a general trend, as it becomes less expensive to integrate technology into Physical objects, we will see more application and adoption of IoT.



Thomas Braunl, July **2015** Getting Started with Arduino Nano

Introduction to Arduino Nano

Arduino Nano Every is a tiny powerful board that is based on the ATMega4809 AVR processor.

The Arduino Nano Every is almost similar to the Arduino Nano board with the addition of a more powerful processor like Atmega4809.

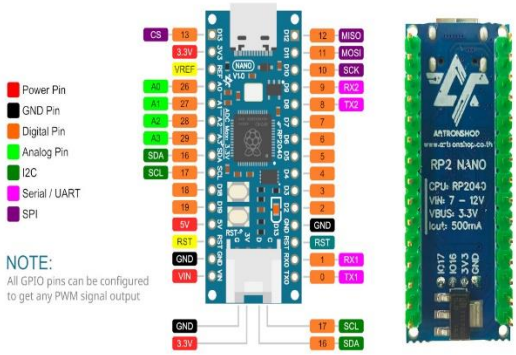
- This board comes with more program memory compared to Arduino Uno and RAM is 200% bigger, helping you create a lot of variables.
- If you've used Arduino Nano earlier for your project, you'll come to know the Arduino Nano Every board is a pin-equivalent substitute of Arduino Nano. The difference lies in the addition of a micro-USB connector and a more powerful processor.
- Arduino Nano Every is available in two versions: with or without headers, helping you incorporate this board into hard-to-reach places including wearables.
- No components are available on the B-side, this gives you the ability to solder the board directly into your main PCB design, reducing the height of the entire project.
- It carries a crystal oscillator with a clock speed of around 20MHz which is necessary to synchronize all internal functions of the board
- The SRAM memory is 6KB while the flash memory and EEPROM memories are 48KB and 256bytes respectively.
- The flash memory is the location where the Arduino program (sketch) is stored. While SRAM is used to generate and manipulate variables when it starts running. And the EEPROM is a non-volatile memory which means data stays stored inside the board even if the board power is removed.

Arduino Nano Every Datasheet

While working with this board, it's better to look into the datasheet of the board that features the main characteristics of the board. Click the link below to download the datasheet of Arduino Nano Every.

Arduino Nano Every Pinout

The following figure shows the pinout diagram of Arduino Nano Every.



There is a built-in LED at pin 13 and it also features one power LED that turns on when the board is supplied with power.

Arduino Nano Every Pin Description

Still reading? Perfect. I hope you've read the brief intro of this Every board. In this section, we'll highlight the description of each pin incorporated on the board. Let's get started.

Digital Pins

20 digital I/O pins are incorporated on this device which you can use as an input or output based on the requirements. These pins are either in a HIGH state or LOW state. When they are LOW they receive V0 and when they are HIGH they receive 5V.

Analog Pins

The number of analog pins incorporated on the board is 8. These are analog pins which projects they can receive any number of values in contrast to Digital pins that only receive two values i.e. HIGH or LOW

PWM Pins

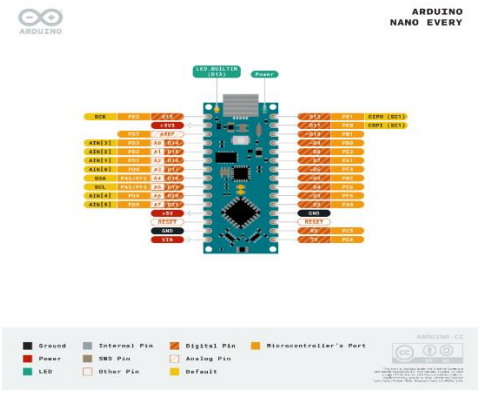
The number of PWM pins incorporated on the board is 5. The board creates analog results with digital means when these pins are activated.

I2C Pins

This board incorporates a two-wire communication protocol which is known as I2C protocol. It carries two lines i.e. SCL and SDA.

SPI Pins

This device comes with SPI (serial peripheral interface) pins that are mainly used to lay out the communication between the controller and other peripheral devices such as sensors or shift registers. There are two pins: MISO (Master Input Slave Output) and MOSI (Master Output Slave Input) used for SPI communication. These pins are employed to receive or send data by the controller.



UART Pins

The UART pins are used for serial communication. It carries two lines Tx and Rx. The Tx is used to transmit the serial data while Rx is used to receive the serial data.

Arduino Nano Every Features

The following are the main features of Arduino Nano Every. Operating Voltage = 5V Microcontroller = Atmega4809 Vin range = 7 to 21 V D/C current per 3.3V pin = 50mA D/C current per I/O pin = 20mA Oscillator = 20MHz EEPROM = 256bytes SRAM = 6KB Flash

Memory = 48KB LED_BUILTIN = 13 USB = 1 UART = 1 SPI = 1 I2C = 1 Digital Pins = 20 Analog Pins = 8 PWM pins = 5 Size = 18x45 mm Weight = 5g

Programming

- Arduino IDE (integrated development environment) is used to program this board. This software is used to program all kinds of Arduino boards.
- This device contains a built-in Bootloader which is used to burn the program inside the controller. Yes, you don't need a separate burner to burn and transfer the program into the controller.
- Moreover, it also carries a micro USB port which is used to connect the device with the computer. Using this port, you can test and run the program directly from the computer.

Difference between Arduino Nano Every and Arduino Nano

- The Nano carries microcontroller ATmega 328p which is the same as Uno.
- While the Nano Every and Uno WiFi Rev 2 are incorporated with a modern version of the AVR based MCU known as megaAVR_0-series, an ATmega4809.
- It carries the same AVR CPU architecture in the base of the MCU so initially, both MCUs (Atmega 328p and Atmega 4809) share the same compiler but there lies a difference in MCU peripherals configuration. So know that the previous knowledge about AVR MCU peripherals won't help here
- The Arduino Nano Every is priced lower than Arduino Nano.

Arduino Nano Every Applications

The small size of this board makes it a good pick for a number of applications. Following are some applications of this board.

- USB Trackpad
- Automatic Pill Dispenser
- USB Joystick
- Electric Bike
- Creating a wireless keyboard
- Water Level Meter
- Weather temperature

The Arduino Nano is a simple 8-bit microcontroller, ideal for beginners and simple embedded projects. It is programmed via USB and has a number of I/O pins.

It uses the Atmel AT mega 328P microprocessor chip.

1. Install the required device driver

device drivers for your Mac or PC:

Several clone versions of the Nano are around, so you may have to try several

Win: http://robotics.ee.uwa.edu.au/nano/drivers/win/

Mac: http://robotics.ee.uwa.edu.au/nano/drivers/mac/

2. Install the Arduino programming environment

Download and install the latest Arduino Software from this site:

Win or Mac: https://www.arduino.cc/en/Main/Software

The Arduino Software allows some simple programming in a reduced C-like language.

Once familiar with this system, you can also download the Atmel Studio / GNU programming tools for programming in assembly or C (Atmel is the manufacturer of the microprocessor). These are available for Windows only:

Win: http://www.atmel.com/tools/atmelstudio.aspx

Win: http://sourceforge.net/projects/winavr/files/

or: http://robotics.ee.uwa.edu.au/nano/win/

3. Connect your Arduino Nano via the USB cable to your Mac/PC

The power light should come on. (Different hardware versions use differently colored LEDs)

4. Start the Arduino Software

• Under Tools / Board select: Arduino Nano

• Under Tools / Processor select: ATMega328

•Under Port select Mac: something like /dev/cu.usbserial.ABCDEFGH

Win: correct COM port

Selecting the correct USB port can be tricky and will only work if the correct driver has been installed. Without the right port, you cannot upload software to the Nano.

5. Select an Example Program

Select menu item File / Examples / 01. Basics / Blink

The example program will occur in the editor window.

Note that each program has two functions: setup and loop. So after an initial setup at start time (e.g. power-up), every program will run in an endless loop (until you disconnect power or overwrite it). This is how all embedded systems work.

6. Compile the Example Program

Compile the program by clicking on the tick button (✓) in the top left corner of the window. A message should appear that says “Done compiling”, without any error messages.

7. Upload the Executable Program to the Nano

Click on the arrow button (è) on top, second from left. You will get the message “Uploading” with a progress bar and finally “Done uploading”. The program will be stored permanently in the Nano’s flash memory. It will remain there, even if you disconnect power and reconnect it later, until you eventually overwrite it with another program.

If you get a red error message, then check your settings (step 4) or go back to driver installation (step 1)

8. Running the Example Program

After successful upload, your program will start running immediately. In case of the Blink example, the I/O LED will start blink in a sequence of 1 sec. on, 1 sec. off.

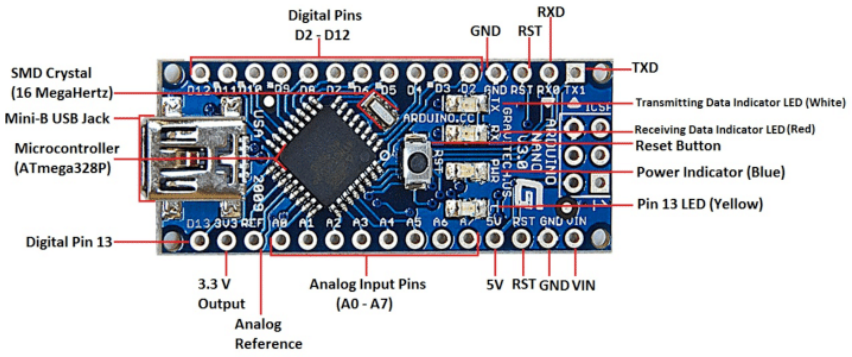
9. Write your own Programs

Start by modifying the Blink program. Change the delay times to change the blinking frequency, then make it a whole new project altogether.

10. Add Input / Output

The important next step is to add I/O to the controller. See the diagram for all available I/O lines.

For more information see: https://www.arduino.cc



ADIY MQ-135Air Quality Gas Sensor Module

Description:

The MQ-135 Gas sensor can detect gases like Ammonia (NH3), sulfur (S), Benzene (C6H6), CO2, and other harmful gases and smoke. Similar to other MQ series gas sensor, this sensor also Has a digital and analog output pin. When the level of these gases go beyond a threshold limit in The air the digital pin goes high. This threshold value can be set by using the on-board Potentiometer. The analog output pin, outputs an analog voltage which can be used to Approximate the level of these gases in the atmosphere.

The MQ135 air quality sensor module operates at 5V and consumes around 150mA. It requires Some pre-heating before it could actually give accurate results.

Features:

1. Wide detecting scope
2. Fast response and High sensitivity
3. Stable and long-life Simple drive circuit
4. Used in air quality control equipment for buildings/offices, is suitable for detecting of NH3, NOx, alcohol, Benzene, smoke, CO2, etc.
5. Size: 35mm x 22mm x 23mm (length x width x height)
6. Signal output instruction.
7. Dual signal output (analog output, and high/low digital output)
8. 0 ~ 4.2V analog output voltage, the higher the concentration the higher the voltage

Specifications:

 Operating Voltage: 2.5V to 5.0V

 Power consumption: 150mA

 Detect/Measure: NH3, Nox, CO2, Alcohol, Benzene, Smoke

 Typical operating Voltage: 5V

 Digital Output: 0V to 5V (TTL Logic) @ 5V Vcc

 Analog Output: 0-5V @ 5V Vcc

Technical details:

The MQ135 is one of the popular gas sensors from the MQ series of sensors that are commonly Used in air quality control equipment. It operates from 2.5V to 5.0V and can provide both digital And analog output.

Note that all MQ sensors have to be powered up for a pre-heat duration for the sensor to warm Up before it can start working.

This pre-heat time is normally between 30 seconds to a couple of minutes. When you power up

The module the power LED will turn on, leave the module in this state till the pre-heat duration is Completed.

Pin Configuration

VCC: It is used to connect 5V to the sensor.

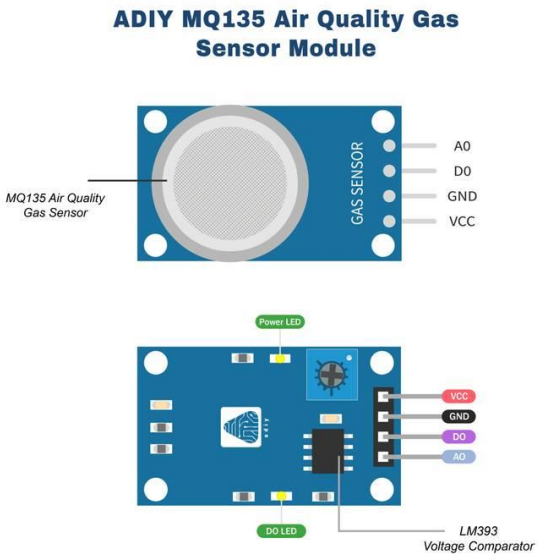
GND: It is used to connect GND to the sensor.

DO: It is a digital output Pin. From this pin, you will get digital data HIGH/LOW.

The digital output pin of the sensor can be used to detect harmful gases in the environment. The Sensitivity of the digital pin can be controlled by using the 10k potentiometer. If the gas is Detected the indicator LED D0 will turn on and the digital pin will go from logic high to logic Low (0V). The LM393 Op-Amp Comparator IC is used to compare the actual gas value with the Value set using the potentiometer. If the actual gas value increases than the set value then the Digital output pin gets low.

Because of the onboard LM393 comparator IC the MQ135 Gas sensor module can also be used Without the need of an external microcontroller. Simply power up the module and set the Sensitivity of the digital pin using the potentiometer, then when the module detects the gas the

Digital pin will go low. This digital pin can directly be used to drive a buzzer or LED with the Help of simple transistors.



AO: It is analog output Pin. From this pin, you will get analog data.

The Analog output pin of the sensor can be used to measure the PPM value of the required gas.

To do this we need to use an external microcontroller. The microcontroller will measure the Value of analog voltage and perform some calculations to find the value of Rs/Ro where Rs is the Sensor resistance when gas is present and Ro is sensor resistance at clean air.

Application:

 Used as air quality monitors.

 Used as a domestic air pollution detector.

 Used in the detection of excess or leakage of gases

DHT11 Humidity & Temperature Sensor

DHT11 Temperature & Humidity Sensor features a

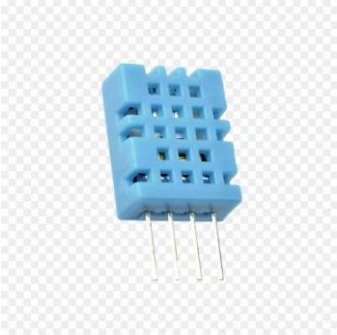
Temperature & humidity sensor complex with a

Calibrated digital signal output.

Introduction

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor Complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition Technique and temperature & humidity sensing technology, it ensures high reliability and Excellent long-term stability. This sensor includes a resistive-type humidity measurement Component and an NTC temperature measurement component, and connects to a high-Performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference Ability and cost-effectiveness.

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on



Humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, Which are used by the sensor's internal signal detecting process. The single-wire serial interface Makes system integration quick and easy. Its small size, low power consumption and up-to-20 Meter signal transmission making it the best choice for various applications, including those Most demanding ones. The component is 4-pin single row pin package. It is convenient to Connect and special packages can be provided according to users' request.

2. Technical Specifications:

OVERVIEW DETAILS :

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50 ℃	±5%RH	±2℃	1	4 Pin Single Row

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
			8 Bit	
Repeatability			±1%RH	
Accuracy	25℃		±4%RH	
	0-50℃			±5%RH
Interchangeability	Fully Interchangeable			
Measurement Range	0℃	30%RH		90%RH
	25℃	20%RH		90%RH
	50℃	20%RH		80%RH
Response Time (Seconds)	1/e(63%)25℃, 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature				
Resolution		1℃	1℃	1℃
		8 Bit	8 Bit	8 Bit
Repeatability			±1℃	
Accuracy		±1℃		±2℃
Measurement Range		0℃		50℃
Response Time (Seconds)	1/e(63%)	6 S		30 S

Detailed Specifications:

3. Typical Application (Figure 1)

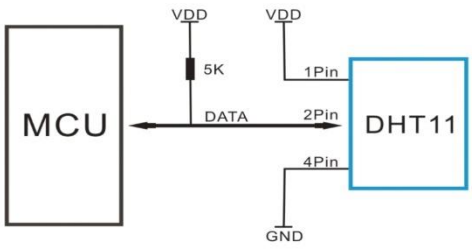


Figure 1 Typical Application

Note: 3Pin – Null; MCU = Micro-computer Unite or single chip Computer

When the connecting cable is shorter than 20 metres, a 5K pull-up resistor is recommended; When the connecting cable is longer than 20 metres, choose a appropriate pull-up resistor as Needed.

4. Power and Pin : DHT11's power supply is 3-5.5V DC. When power is supplied to the sensor, do not send any Instruction to the sensor in within one second in order to pass the unstable status. One Capacitor valued 100nF can be added between VDD and GND for power filtering.

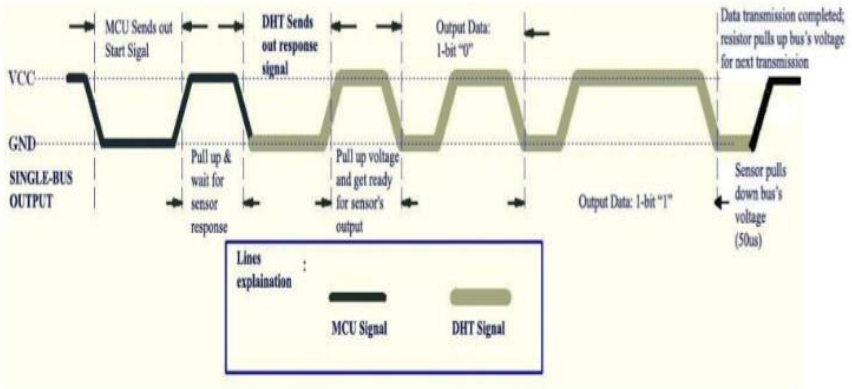
5. Communication Process: Serial Interface (Single-Wire Two-Way)

Single-bus data format is used for communication and synchronization between MCU and DHT11 sensor. One communication process is about 4ms. Data consists of decimal and integral parts. A complete data transmission is 40bit, and the Sensor sends higher data bit first.

Data format: 8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T Data + 8bit check sum. If the data transmission is right, the check-sum should be the last 8bit of "8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data".

5.1 Overall Communication Process

When MCU sends a start signal, DHT11 changes from the low-power-consumption mode to the Running-mode, waiting for MCU completing the start signal. Once it is completed, DHT11 sends a Response signal of 40-bit data that include the relative humidity and temperature information to MCU. Users can choose to collect (read) some data. Without the start signal from MCU, DHT11 Will not give the response signal to MCU. Once data is collected, DHT11 will change to the low-Power-consumption mode until it receives a start signal from MCU again.



5.2 MCU Sends out Start Signal to DHT (Figure 3, below)

Data Single-bus free status is at high voltage level. When the communication between MCU and DHT11 begins, the programme of MCU will set Data Single-bus voltage level from high to low And this process must take at least 18ms to ensure DHT's detection of MCU's signal, then MCU Will pull up voltage and wait 20-40us for DHT's response.

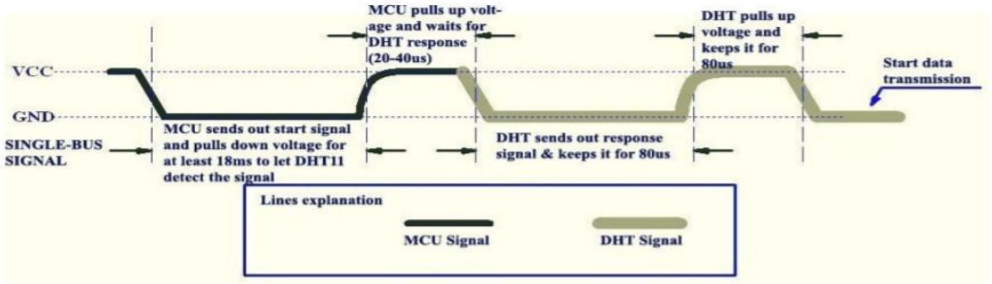


Figure 3 MCU Sends out Start Signal & DHT Responses

5.3 DHT Responses to MCU (Figure 3)

Once DHT detects the start signal, it will send out a low-voltage-level response signal, which Lasts 80us. Then the programme of DHT sets Data Single-bus voltage level from low to high and Keeps it for 80us for DHT's preparation for sending data.When DATA Single-Bus is at the low voltage level, this means that DHT is sending the response Signal. Once DHT sent out the response signal, it pulls up voltage and keeps it for 80us and Prepares for data transmission. When DHT is sending data to MCU, every bit of data begins with the 50us low-voltage-level

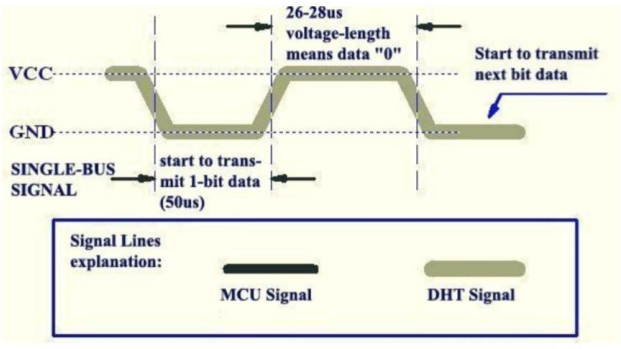


Figure 4 Data "0" Indication

and The length of the following high-voltage-level signal determines whether data bit is "0" or "1"

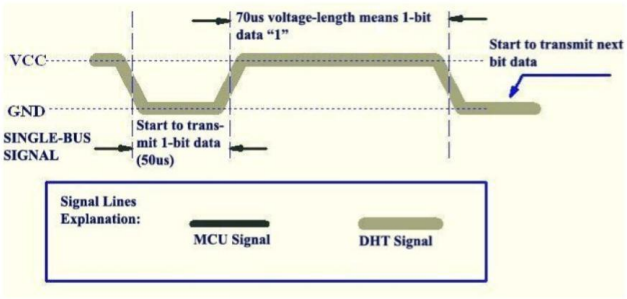


Figure 5 Data "1" Indication

If the response signal from DHT is always at high-voltage-level, it suggests that DHT is not Responding properly and please check the connection. When the last bit data is transmitted, DHT11 pulls down the voltage level and keeps it for 50us. Then the Single-Bus voltage will be Pulled up by the resistor to set it back to the free status.

6. Electrical Characteristics

VDD=5V, T = 25℃ (unless otherwise stated)

	Conditions	Minimum	Typical	Maximum
Power Supply	DC	3V	5V	5.5V
Current Supply	Measuring	0.5mA		2.5mA
	Average	0.2mA		1mA
	Standby	100uA		150uA
Sampling period	Second	1		

7. Attentions of application

(1) Operating conditions

Applying the DHT11 sensor beyond its working range stated in this datasheet can result in 3%RH Signal shift/discrepancy. The DHT11 sensor can recover to the calibrated status gradually when It gets back to the normal operating condition and works within its range. Please refer to (3) of this sec on to accelerate its recovery. Please be aware that opera ng the DHT11 sensor in the Non-normal working conditions will accelerate sensor's aging process.

(2)Attention to chemical materials

Vapor from chemical materials may interfere with DHT's sensi vet-elements and debase its Sensi vity. A high degree of chemical contaminate on can permanently damage the sensor.

(1) Restoration process when (1) & (2) happen

Step one: Keep the DHT sensor at the condi on of Temperature 50~60Celsius, humidity <10%RH

For 2 hours; Step two:K keep the DHT sensor at the condi on of Temperature 20~30Celsius, humidity >70%RH for 5 hours.

(2) Temperature ect

Rela ve humidity largely depends on temperature. Although temperature compensa on Technology is used to ensure accurate measurement of RH, it is s strongly advised to keep the Humidity and temperature sensors working under the same temperature. DHT11 should be Mounted at the place as far as possible from parts that may generate heat.

(3) Lightect

Long me exposure to strong sunlight and ultraviolet may debase DHT's performance.

(6) Connection wires

The quality of connect on wires will affect the quality and distance of communicate on and high Quality shielding-wire is recommended.

Other attentions

- Welding temperature should be bellow 260Celsius and contact should take less than 10 Seconds.
- Avoid using the sensor under dew condi on.
- Do not use this product in safety or emergency stop devices or any other occasion that failure

Of DHT11 may cause personal injury.

- Storage: Keep the sensor at temperature 10-40℃, humidity <60%RH.

XI WORKING PRINCIPLE

The device has four different sensor modules in it, those are DHT11, BMP180, FC-37 and LDR. All the sensors collect surrounding environment parameters and those values are sent to the IoT cloud by using the internet from the Wi-Fi module ESP8266 built inside the device. Then when we want to see the environment parameters value we go to the respective dashboard. Talking in-depth, first when the whole system is powered on using the SMPS adapter, the first thing the device does is to try to connect to Wi-Fi nearby. The details such as the SSID and the Password for the nearby Wi-Fi is already provided in the code. The Node MCU board has an ESP8266 chip on it which can connect to any nearby Wi-Fi. After the connection is successfully established, individual sensors start to collect the surrounding environmental parameters that has been programmed to be measured. How those sensors measure the parameters that we have already discussed in the previous chapters on hardware required in the project. After that the updated data is being sent to the Arduino IoT cloud server as programmed. The respective variable data is being shown on the dashboard .But before we want to see the dashboard, we need to login to our account in which the device and dashboard is being created. We login to our account either on the website or we can download the Arduino IoT cloud remote application on our mobile or desktop then login to see the data that is being transmitted to the cloud.

SOURCE CODE

1.

```
#include <DHT.h>
#define DHTPIN            2         // Pin which is connected to the DHT sensor.
#define DHTTYPE           DHT11     // DHT 11
DHT dht(DHTPIN, DHTTYPE);
int cnt;
int t;
int h;
int mq=0;
void setup()
{
 Serial.begin(9600);
 dht.begin();
  }

void loop()
{
  h = dht.readHumidity();
  t = dht.readTemperature();
  mq=analogRead(A0);

cnt=cnt+1;
delay(1000);

if(cnt>=10)
{
Serial.print("*");
Serial.print(t);
Serial.print(",");
Serial.print(h);
Serial.print(",");
Serial.print(mq);
Serial.println("#");
cnt=0;
}
}
```

2.

```
#include <SoftwareSerial.h>
#include "DHT.h"
SoftwareSerial ESP8266(2, 3); // Rx,  Tx

long writingTimer = 17;
```

```
long startTime = 0;
long waitTime = 0;

const int sensor=A0; // Assigning analog pin A0 to variable 'sensor'
const int rain_sensor=4; // Assigning analog pin A1 to variable 'sensor'
const int DHT11_Sesnor = 5;
#define DHTTYPE DHT11
DHT dht(DHT11_Sesnor, DHTTYPE);
int humudity_value;
float tempc;  //variable to store temperature in degree Celsius
float vout;  //temporary variable to hold sensor reading
bool rain_status = 0;
unsigned char check_connection=0;
unsigned char times_check=0;
boolean error;

String myAPIkey = "8GX33VU8QE8WXEH9";  //Your Write API Key from Thingsspeak

void setup()
{
  Serial.begin(9600);
  ESP8266.begin(9600);
  pinMode(rain_sensor, INPUT);
  dht.begin();
  startTime = millis();
  delay(2000);
  Serial.println("Connecting to Wifi");
   while(check_connection==0)
  {
    Serial.print(".");
  ESP8266.print("AT+CWJAP=\"Rahul Jadhav 2.4g\",\"JadhRa@2310\"\r\n");
  ESP8266.setTimeout(5000);
 if(ESP8266.find("WIFI CONNECTED\r\n")==1)
 {
 Serial.println("WIFI CONNECTED");
 break;
 }
 times_check++;
 if(times_check>3)
 {
  times_check=0;
   Serial.println("Trying to Reconnect..");
  }
  }
}

void loop()
{
```

```
  waitTime = millis()-startTime;
  if (waitTime > (writingTimer*1000))
  {
    vout=analogRead(sensor);
    vout=(vout*500)/1023;
    tempc=vout; // Storing value in Degree Celsius
    rain_status = digitalRead(rain_sensor);
    readDTH11_Sesnor();
    writeThingSpeak();
    startTime = millis();
  }
}

void readDTH11_Sesnor()
{

  // Reading temperature or humidity takes about 250 milliseconds!
  humudity_value = dht.readHumidity();

  // Check if any reads failed and exit early (to try again).
  if (isnan(humudity_value))
  {
    Serial.println(("Failed to read from DHT sensor!"));
    return;
  }
 // Serial.print((" Humidity: "));
  //Serial.print(humudity_value);
 // Serial.print(("%"));

//  Serial.print("\n");
 // delay(100);
}

void writeThingSpeak(void)
{
  startThingSpeakCmd();
  // preparacao da string GET
  String getStr = "GET /update?api_key=";
  getStr += myAPIkey;
  getStr +="&field1=";
  getStr += String(tempc);
  getStr +="&field2=";
  getStr += String((rain_status == 0 ? 1:0));
  getStr +="&field3=";
  getStr += String(humudity_value);
  getStr += "\r\n\r\n";
  GetThingspeakcmd(getStr);
}
```

```
void startThingSpeakCmd(void)
{
  ESP8266.flush();
  String cmd = "AT+CIPSTART=\"TCP\",\"";
  cmd += "184.106.153.149"; // api.thingspeak.com IP address
  cmd += "\",80";
  ESP8266.println(cmd);
  Serial.print("Start Commands: ");
  Serial.println(cmd);

  if(ESP8266.find("Error"))
  {
    Serial.println("AT+CIPSTART error");
    return;
  }
}

String GetThingspeakcmd(String getStr)
{
  String cmd = "AT+CIPSEND=";
  cmd += String(getStr.length());
  ESP8266.println(cmd);
  Serial.println(cmd);

  if(ESP8266.find(">"))
  {
    ESP8266.print(getStr);
    Serial.println(getStr);
    delay(500);
    String messageBody = "";
    while (ESP8266.available())
    {
      String line = ESP8266.readStringUntil('\n');
      if (line.length() == 1)
      {
        messageBody = ESP8266.readStringUntil('\n');
      }
    }
    Serial.print("MessageBody received: ");
    Serial.println(messageBody);
    return messageBody;
  }
  else
  {
    ESP8266.println("AT+CIPCLOSE");
    Serial.println("AT+CIPCLOSE");
  }
```

3.

```
#define IO_USERNAME  "soiliot1199"
#define IO_KEY       "aio_NYmv82BdC0fwxI72FXdupeA9AGgQ"

#define WIFI_SSID   "project1"
#define WIFI_PASS   "project1"

#include "AdafruitIO_WiFi.h"
#if defined(USE_AIRLIFT) || defined(ADAFRUIT_METRO_M4_AIRLIFT_LITE)
#if !defined(SPIWIFI_SS) // if the wifi definition isnt in the board variant
#define SPIWIFI SPI
#define SPIWIFI_SS 10  // Chip select pin
#define NINA_ACK 9    // a.k.a BUSY or READY pin
#define NINA_RESETN 6 // Reset pin
#define NINA_GPIO0 -1 // Not connected
#endif
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS, SPIWIFI_SS, NINA_ACK,
NINA_RESETN, NINA_GPIO0, &SPIWIFI);
#else
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);
#endif
```

OUTPUT

1.

```
10:15:05.892 -> *31,63,693#
10:15:17.319 -> *31,63,682#
10:15:28.792 -> *31,63,677#
10:15:40.251 -> *31,63,675#
10:15:51.699 -> *31,63,667#
10:16:03.159 -> *31,63,663#
10:16:14.604 -> *31,63,660#
10:16:26.042 -> *31,63,655#
10:16:37.507 -> *31,63,656#
10:16:48.966 -> *31,63,654#
10:17:00.416 -> *31,63,651#
10:17:11.875 -> *31,63,651#
Ln 35, Col 2
Adafruit Circuit Playground Express
on COM5
```

2.

```
10:22:45.792 -> *31,63,626#
10:22:57.257 -> *31,63,619#
10:23:08.686 -> *31,63,623#
10:23:20.128 -> *31,63,634#
10:23:31.615 -> *31,63,637#
10:23:43.061 -> *31,63,635#
10:23:54.508 -> *31,63,630#
10:24:05.964 -> *31,63,890#
10:24:17.416 -> *31,63,860#
10:24:28.876 -> *31,63,904#
10:24:40.325 -> *31,63,858#
10:24:51.786 -> *31,63,804#
Ln 1, Col 1
Arduino Nano
on COM5
```

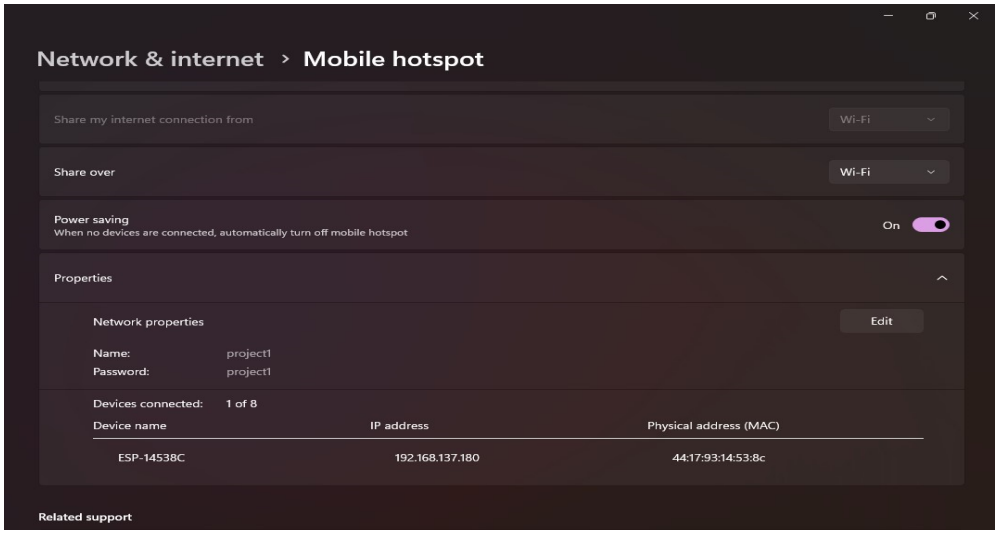
3.

```
10:27:43.188 -> *31,62,638#
10:27:54.631 -> *31,62,637#
10:28:06.073 -> *31,62,632#
10:28:17.514 -> *31,62,632#
10:28:28.990 -> *31,62,630#
10:28:40.443 -> *31,62,626#
10:28:51.885 -> *31,62,626#
10:29:03.363 -> *31,62,626#
10:29:14.814 -> *31,62,623#
10:29:26.251 -> *31,62,621#
10:29:37.694 -> *31,62,620#
Ln 19, Col Adafruit Circuit Playground Express on COM5
```

SCREENSHOTS

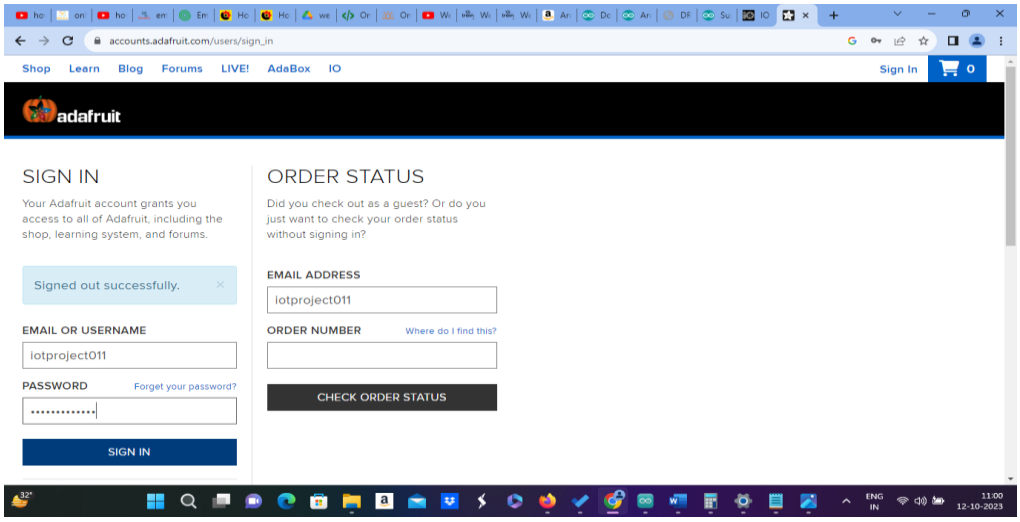
STEP : 1

HOTSPOT CONNECTING :



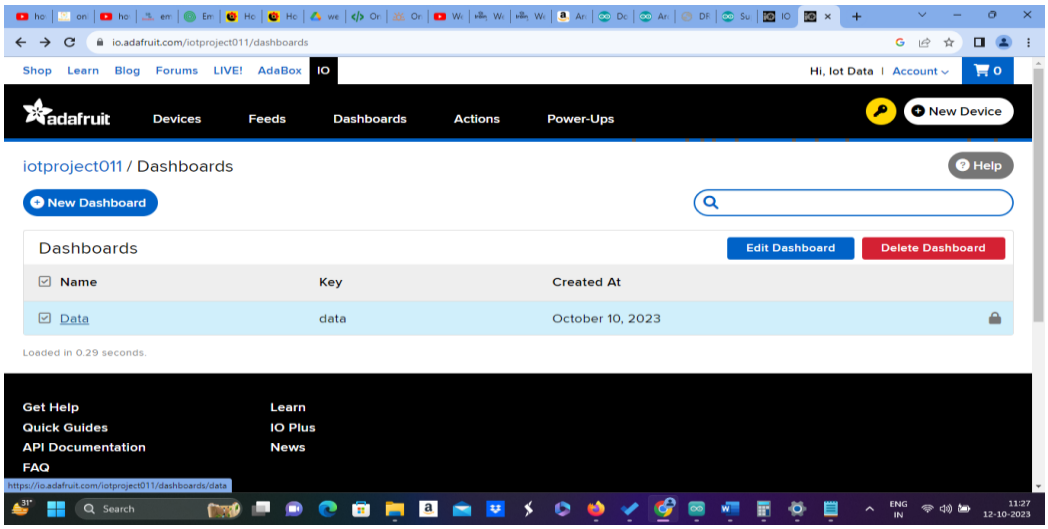
STEP : 2

SIGN TO WEBSITE :



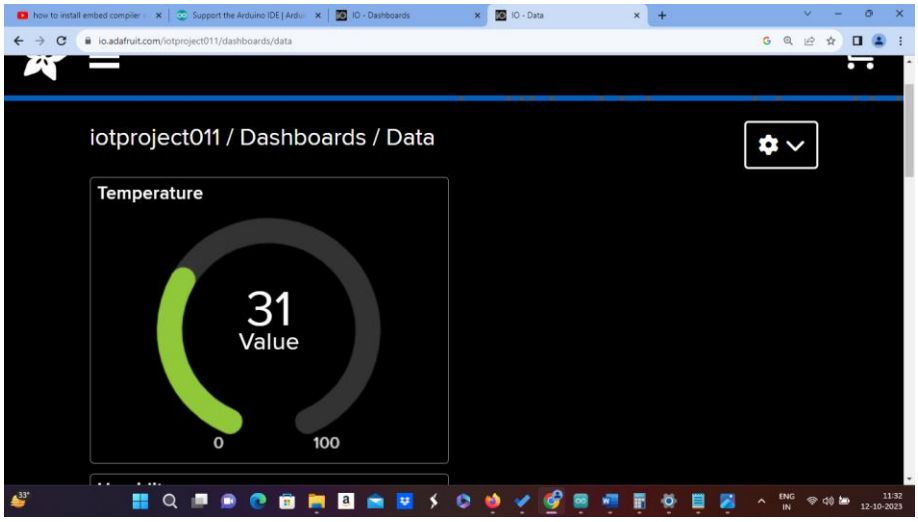
STEP:3

DASHBOARB :

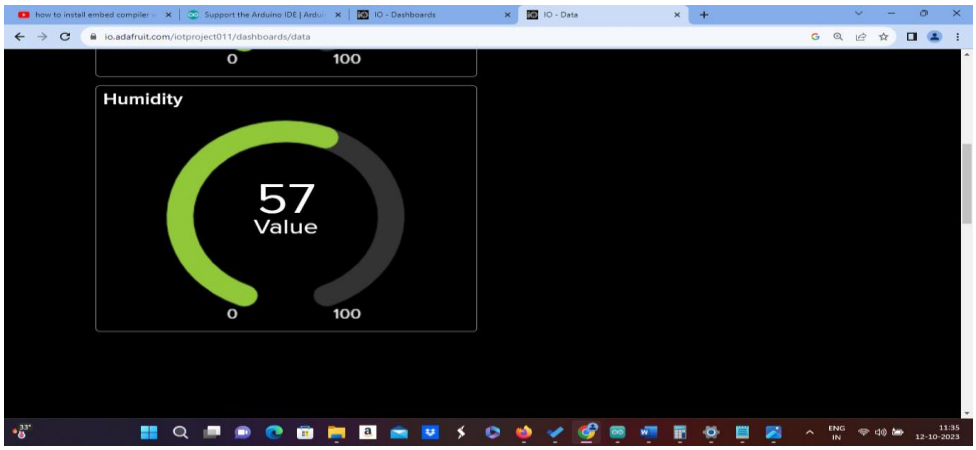


STEP : 4

TEMPERATURE VALUE :

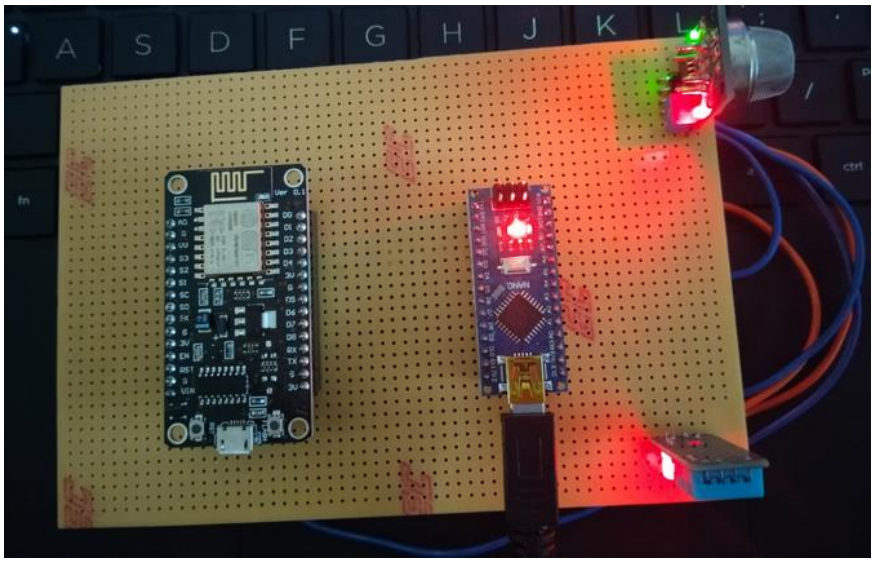


HUMIDITY VALUE :



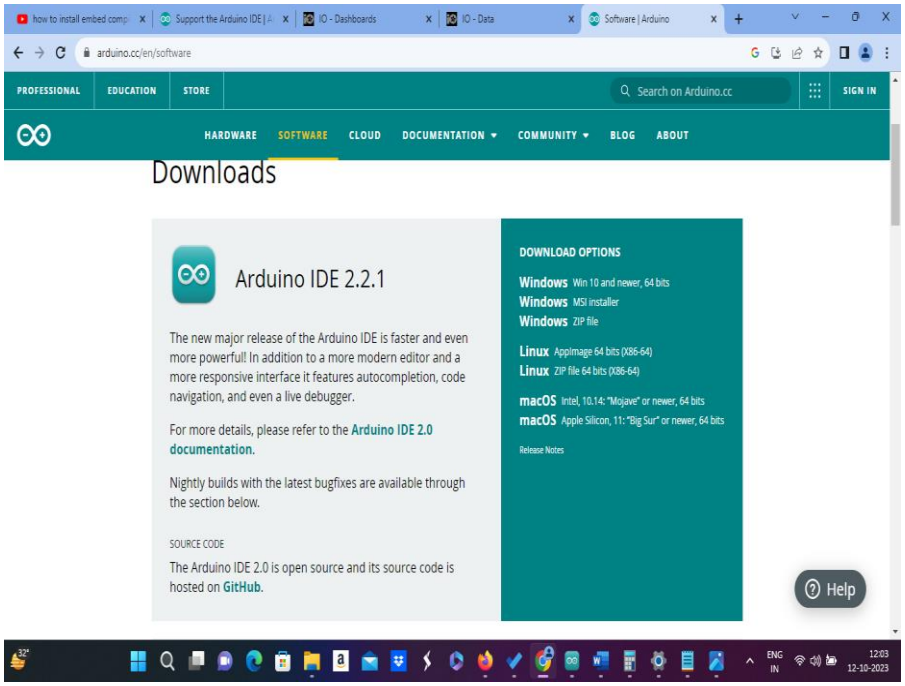
AIR QUALITY :

WHETHER PARAMETERS MONITORING SYSTEM WITH LIVE FEED ON CLOUD (IOT) PROJECT DEMO:



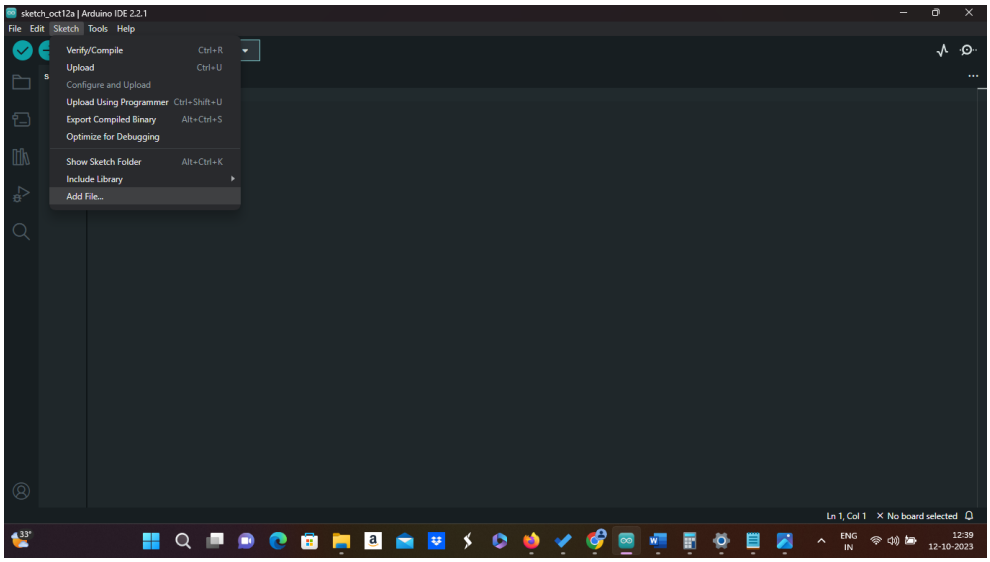
STEP : 5

DOWNLOAD ARDUINO SOFTWARE FOR CODING:

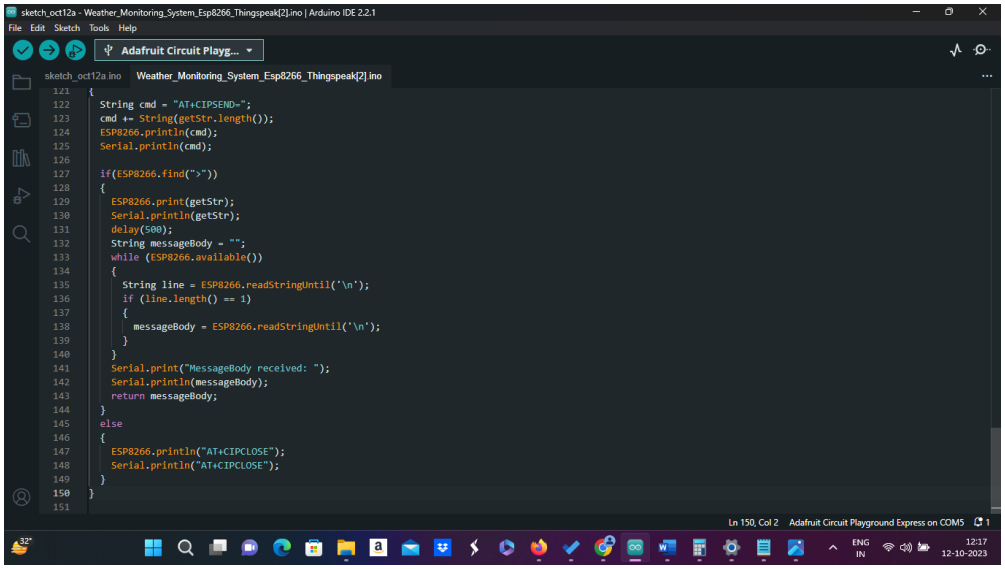


STEP : 6

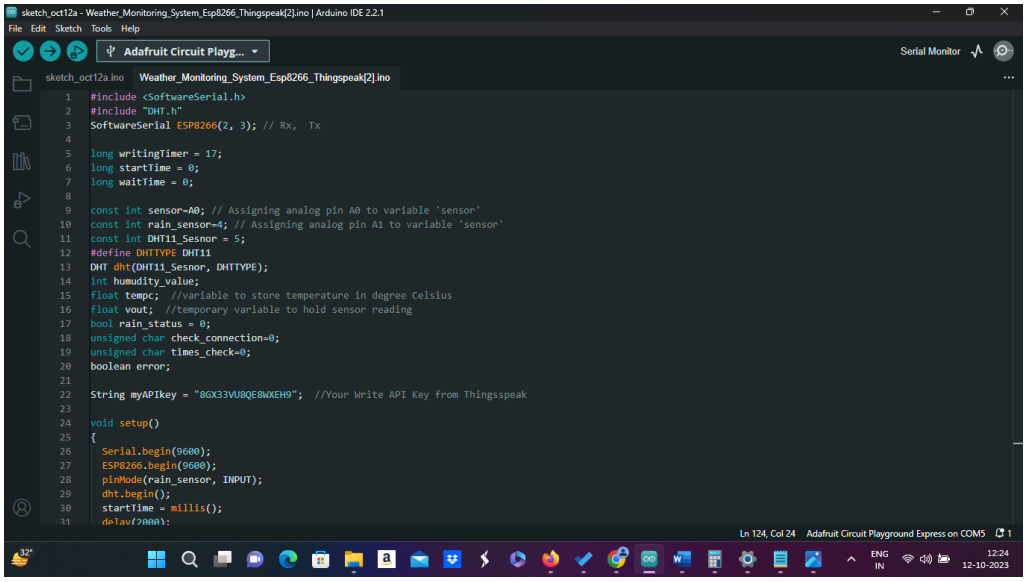
GO TO SKETCH AND CLICK ADD FILE AND INSERT A FILE IN ARDUINO SOFTWARE AND SELECT A TOOL IN ARDUINO SOFTWARE AND THEN SELECT A BOARD AND PORT RELATED TO YOUR SENSOR NAME BOARD AND TO RUN A PROGRAM SELECT A SERIAL MONITOR



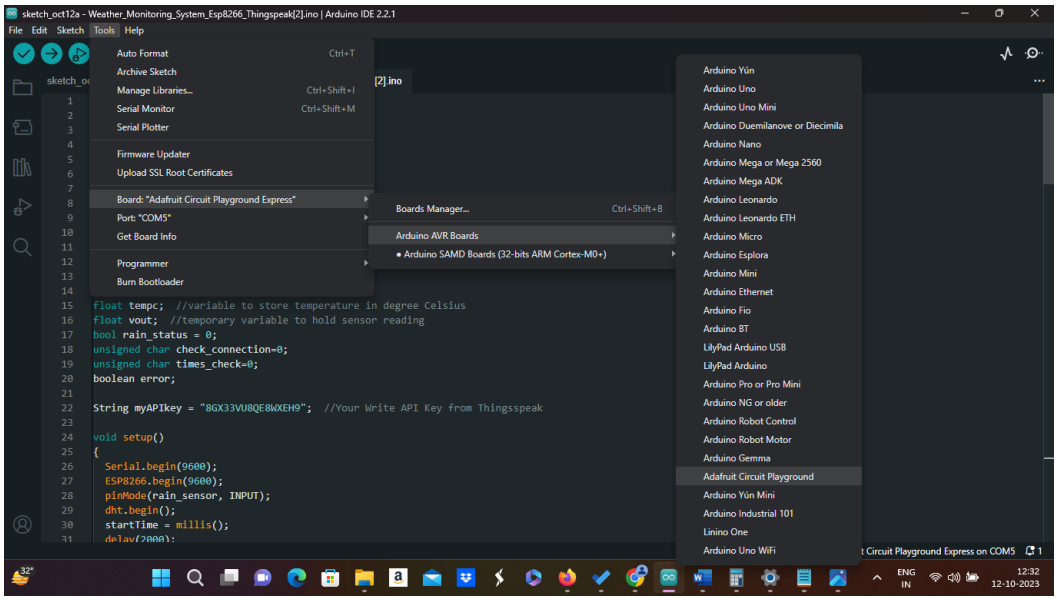
OPEN A INSERTED FILE IN ARDUINO SOFTWARE :



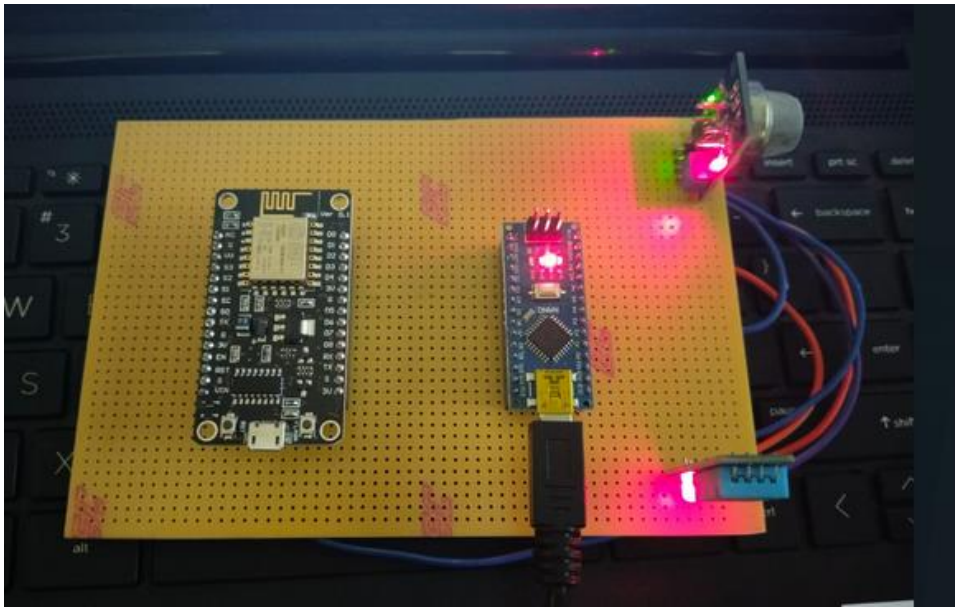
SELECT A SERIAL MONITOR TO RUN A CODE :

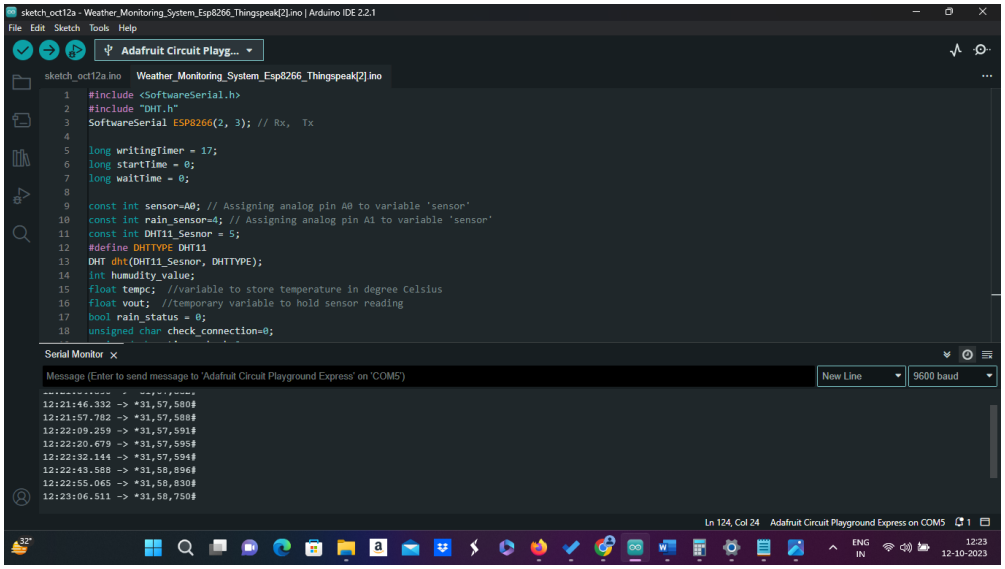


SELECT A BOARD AND PORT TO GIVE OUTPUT :



HERE IS THE OUTPUT OF WHEATHER PARAMETERS SYSTEM WITH LIVE FEED (IOT)





CONCLUSION

In conclusion, implementing a weather parameters monitoring system with live feed on the cloud offers a plethora of advantages. By leveraging cloud technology, real-time weather data can be collected, processed, and disseminated efficiently and securely. This system promotes accessibility, allowing users to access weather information from anywhere, enhancing preparedness and decision-making processes. Moreover, the cloud-based approach ensures scalability and cost-effectiveness, as it eliminates the need for extensive physical infrastructure. Additionally, the ability to analyzses historical data patterns aids in accurate weather predictions and trend analysis. Overall, this system not only enhances convenience for users but also plays a pivotal role in various sectors such as agriculture, disaster management, and environmental research, contributing significantly to informed decision-making and sustainable practices.

 This is a smart way to monitor environment and an efficient, low-cost embedded system.

 We have successfully created and deployed a IoT based device that monitors the basic environmental parameters around us and sends the data to the server successfully.

 This data has successfully been displayed on the dashboard and saved for future uses.

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