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Internet-of-Things (IoT): Layered Framework and Diverse Algorithms for Node MCU ESP8266 with Sensors

Kamna Singh

Ajay Kumar Garg Engineering College, Ghaziabad

Abstract:

Now days, with evolving technology, internet grows rapidly. IoT i.e., Internet of things is a technology which connects everything to everything. This paper presents optimistic solutions,that how any object or anything can be connected over the network with IoT technologies and achieves a desired output. This paper proposed some algorithms which shows that how different sensors connected with physical devices and provides desired solutionsand an approach in the form of algorithm (step by step solution) to connect Node MCU ESP 8266(development board or firmware) with Arduino IDE which provide low power battery operated applications or prototyping of IoT devices.It also provides a comparative analysis between NodeMCU development board and Arduino UNO microcontroller board. These are the development boards to generate IoT based applications. Internet of Things (IoT) connects any of the physical objects to internet via sensors. Different scientist's researches about its IoT architecture. There are so many industries are followed different types of IoT layered model. Conventional model consists three layers while other industries followed seven-layer IoT layered model. IoT (Internet of Things) field is rapidly growing field, its application includes almost every field. Depending upon different applications areas of internet of Things, it works accordingly as per it has been developed.But it has not a standard defined architecture of working which is strictly followed universally. The architecture of IoT depends upon its functionality and implementation in different sectors. Still, there is a basic process flow based on which IoT is built. This paper proposes a five-layer IoT layered architecture with their underlying technologies and distinct algorithms to connect sensors with NodeMCU and Arduino IDE with the comparative study of microcontroller board Node MCU and Arduino UNO.

Keywords:*Layered Architecture ofInternet of Things, Arduino UNO, Node MCU,IR Sensor, Ultrasonic Sensor, DHT11*

Introduction:

In the coming days IoT will be most necessary technology, as everything going to connect with internet via Internet of things. The Internet of Things (IoT) is a concept reflecting a connected set of anyone, anything, anytime, anyplace, any service, and any network. The IoT is a megatrend in next-generation technologies that can impact the whole business spectrum and can be thought of as the interconnection of uniquely identifiable smart objects and devices [21].Nowadays, the Internet of Things (IoT) network, is increasingly becoming a ubiquitous connectivity between different advanced applications such as smart cities, smart homes, smart grids, and many others. The emerging network of smart devices and objects enables people to make smart decisions through machine to machine (M2M) communication. Most real-world security and IoT-related challenges are vulnerable to various attacks that pose numerous security and privacy challenges. Therefore, IoT offers efficient and effective solutions. intrusion detection system (IDS) is a solution to address security and privacy challenges with detecting different IoT attacks [20].

IoT provides a technology-based applications which connects and communicates physical devices or physical objects with other physical objects via internet. There are four main components of IoT i.e., Sensors, Connectivity, Data Usage and User Interface. The first component is sensors, Sensor is a device which produces some physical characteristics after sensing its surrounded environment. Such as temperature sensor and pressure sensor produce observed result of pressure or temperature by its surrounded environment. Second component is connectivity, with sensor and web, there are some protocols and technologies used to resolve this issue. Some IoT enabled technologies are BLE(low power Bluetooth),RFID(Radio frequency identification), LPWAN (low power wide area network).Third component is the data usage i.e., all the pertinent data are on cloud storage and need some processing on it, therefore physical objects which is connected with the internet via development board(Node MCU or Arduino UNO) to Arduino IDE.In other words we can say that IoT hardware (sensor and development kit) interacts with IoT software(e.g.,Arduino IDE) with the help of internet and data processing will be done using cloud storage. Fourth component of IoT is user interface; it defines how and when the user gets the alert messages. Internet of things uses different wireless technologiesto connect anything to anything and produces desired output and compare it with the predefined output.

Following are the brief description of Arduino Uno and NodeMCU development board specifications.

1.1 Arduino UNO

Arduino UNO is a microcontroller board based on 8-bit ATmega328P microcontroller.it has 14 digital pins and 6 analog pins. Analog pins accept analog inputs such as temperature, pressure etc. analog variables represent continuous or physical quantity. Arduino UNO microcontroller board operating voltage is 5 Vand range of the input voltage is 6-20 V. therefore this development board is useful for low voltage devices and suitable for IoT enabled devices.

1.2 Node MCU

Node MCU is a software that comes installed in a ESP 8266 and uses the Lua programming language but the ESP 8266 that comes with Node MCU can be programmed. Here node represents node as physical objects which is connected with the sensor and MCU refer as microcontroller unit.It consists of circuit board(with 30 digitalpin and 1 analog pin), which can be programmed byreadymade software .Node MCU board size is 49mm*26mm and pin spacing is 0.9’’(or 22.6 mm) , clock speed is 80 MHz. its temperature range is -40Cto -125 C. there are total 12 pins, 11 digital pins and 1 analog pin.

Node MCU development board contains 2.4 GHz Antenna, ESP 12E chip, 3.3 voltage regulator,micro-USBport, CP 2102 USB to TTL converter and reset button. there are 4 power pins. Generally, node MCU operating voltage is 3.3 Volt.

1.3 Sensors:

Sensors is an equipment used to compute or measure the physical properties such as distance, pressure, humidity, temperature and provide desired accurate or sometimes approximate result. Various sensors such as automotive sensor, fluid property sensor, digital component sensor, flow sensor, force sensor, humidity sensor, mass air flow sensor, photo optic sensor, piezo film sensor, position sensor, pressure sensor, rate and inertial sensor, speed sensors, temperature sensor, torque sensors, traffic sensors, ultrasonic sensor, vibration sensor, water level sensor etc. One of the real time examples of sensors applications is in military aircraft. In the military aircraft there is a feature of an autopilot mode, in which computer is attached to the various sensors (such as position, height, speed, temperature, location etc.) and then as desired aircraft engine ill be automatically on and flaps motors, wings and other equipment will automatically be enabled.Computer takes data from sensor then it provide control signals to different ports of aircraft and then it run on autopilot mode.

1.4 Programming Node MCU ESP 8266 with Arduino IDE

The Node MCU ESP8266, development board can be easily programmed with Arduino IDE (Arduino integrated

Node MCU ESP 8266 microcontroller development board gives one more capability i.e., ithas automatically enabled Wi-Fi solution whereas Arduino UNO microcontroller board does not have inbuilt Wi-Ficapability.

I. L iterature Review:

IoT can be described as interconnection and communication between the different physical and electronic objects. all objects require connectivity. It does not required that every objects should be able to handle internet.In other words , internet capability of objects , which is connected with IoT development boardis always not necessary.[1]As IoT data is very sensitive data , so many web applications attacks possible and we have to protect our device and physical objects from it[3].IoT data is very sensitive data, so many web applications attacks possible and we have to protect our device and physical objects from it [3]. Although there are so many protocols which provides services and resolve connectivity issues between user interface and physical objects. Therefore, finding and overcoming the attacks of IoT devices is a major challenge for researchers and scientists both [4]. There is a complex relationship between user, service provider, physical object IoT enabled development board (NodeMCU or Arduino UNO), therefore identity identification is the measure challenge while developing IoT based applications. the major security measures such as authentication, integrity, confidentiality and non-repudiation required to handle security vulnerabilities.[5]. IoT based applications are connected with small devices. These devices may be electrical, electronic or mechanical devices or any other physical object. Therefore, it is required that low power technologies should be used low energy set of rules required which can be processed with very low power and provide a desire outcome. Zigbee, BLE (Blue tooth Low Energy), RFID,6loWPAN (IPv6 Low power wireless personal area network). Provides low power connectivity solutions.[6]

In 2019, Abdel Rahman H. Hussein said in his paper titled as “Internet of Things (IoT): Research Challenges and Future Applications “, that IoT can be described as interconnection and communication between the different physical and electronic objects. All objects require connectivity. It does not require that every object should be able to handle internet. Methodology used as Processing, Analysis and Management of Data.

N. Sathiyanathan, Selvakumar. S, P. Selvaprasanth 2019, in their paper, titled as “Survey method A Brief Study on IoT Applications”, explores the security and privacy issues of IoT as IoT has no unified architecture and less protection. Therefore, different types of attacks can be possible such as denial of service attack, malicious code injection, threatening different parts of the IoT architecture. They provide Percentage of evaluation factors of IoT applications by survey method, e.g., security only 5% work done.[4]

April, 2018, Falguni Jindal, Rishabh Jamar, Prathamesh Churi,in their paper” Future and Challenges of Internet of Things”, They describes the IoT information life cycle . In the first phase data is generated or collected by the sensors, are initialized and then to produce information In the second phase information which comes to the sensors are transferred to the cloud servers. Survey method used in business sector. As IoT data is very sensitive data, so many web applications attacks possible and we have to protect our device and physical objects from it.[3]

Mahmoud Elkhodr, Seyed Shahrestani and Hon Cheung, Emerging wireless Technologies in the Internet Of things: a Comparative Study, Author provides a complex relationship between user, service provider, physical object. IoT enabled development board (NodeMCU or Arduino UNO), methodology used Different IoT protocols and security mechanism analysed. Outcome is therefore identity identification is the measure challenge while developing IoT based applications.

AmathulHadiShakara, Md. TareqHasan,in their paper titled as “Solutions of common challenges in IoT, focuses on the IoT architecture problem”, they said that the IoT environment should be capable of interconnecting large number of technologies objects through the internet. Methodology used as Review and analysing techniques applied. Author concluded that there is a need of elastic and adjustable layered architecture [9].

Amine Rghioui and AbedlmajidOumnad (2017), studied in his paper titled as “Internet of Things: Visions, Technologies, and Areas of Application that Currently, a large number of smart objects and different types of devices are interconnected and communicate using the internet protocol. With an increase in the deployment of smart objects, the internet of things should have a significant impact on human life in the near future. methodology used as Applying RFID technologies. Research outcome is as This paper includes IoT research challenges such as technology challenges and security challenges[2]. The Protocols that can be used to connect IoT based system is suitably defines with the help of IoT Architecture.

According to [25], this has become even more evident, as different governments around the world have shown an interest in the IoT concept by providing more funding in the field that is meant to facilitate further research.

Although there are so many protocols which provides services and resolve connectivity issues between user interface and physical objects. Actually, till now, Internet of Things have not any common architecture or standard architecture that’s why some security vulnerability occurs in different layers in IoT architecture. Even though there are layered architecture which contains 4 or 5 layers but still it is not universally accepted. Therefore, finding and overcoming the attacks of IoT devices is a major challenge for researchers and scientists both.[4]

There is a complex relationship between user, service provider, physical object and IoT enabled development board (NodeMCU or Arduino UNO), therefore identity identification is the measure challenge while developing IoT based applications. The measure security measures such as authentication, integrity, confidentiality and non-repudiation required to handle security vulnerabilities.[5]

IoT based applications are connected with small devices. These devices may be electrical, electronic or mechanical devices or any other physical object. Therefore, it is required that low power technologies should be used. low power, low energy set of rules required which can be processed with very low power and provide a desire outcome. Zigbee, BLE (Blue tooth Low Energy), RFID,6loWPAN (IPv6 Low power wireless personal area network). Provides low power connectivity solutions.[6]

2.1 IoT applications

Nowadays, devices like smartphones, vehicles, industrial systems, cameras, toys, buildings, home appliances, industrial systems and countless others can all share information over the Internet. Regardless of their sizes and functions, these devices can accomplish smart reorganizations, tracing, positioning, control, real-time monitoring and process control. IoT application includes various fields such as energy consumption, agriculture automation, smart traffic management, smart cities, smart home, security, industry, smart lightening, business, education and health care.

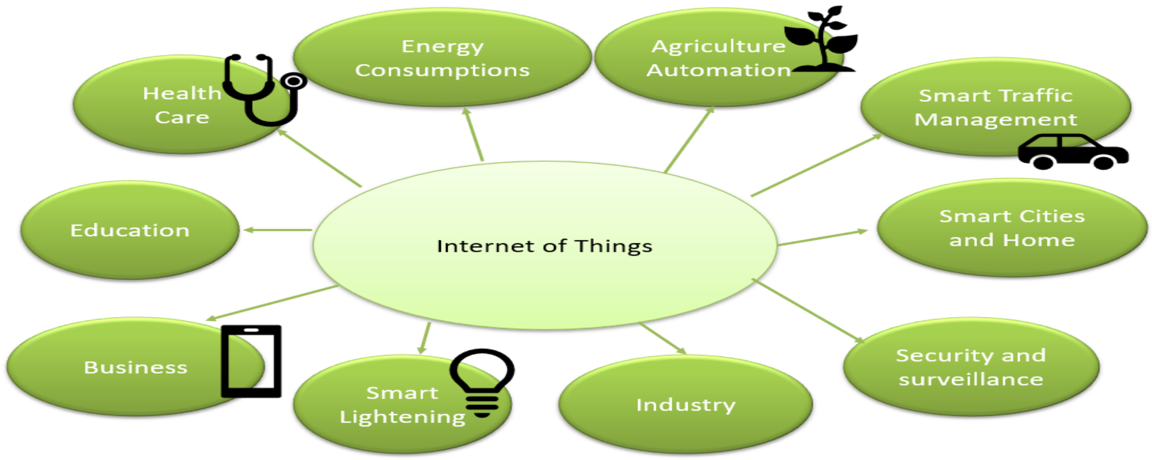

Figure 1. Applications of Internet of Things

Comparative study of different IoT architecture

Mohammad Ali Jabraeil Jamali, Bahareh Bahrami, Arash Heidari,Parisa Allahverdizadeh,Farhad Norouzim, in their paper titled as "Towards the Internet of Things", published in Springer, June 2019, proposes IoT architecture which contains 4 layers . first layer is the sensor layer which contains all IoT devices and sensors which collects data from their surroundings. second layer defines all cloud services such as IaaS (infrastructure as a service), PaaS (platform as a service) and SaaS (software as a service.) Application layer consists all services provided by IoT technology. It includes Smart transport, e-governance, healthcare, public safety, smart building.

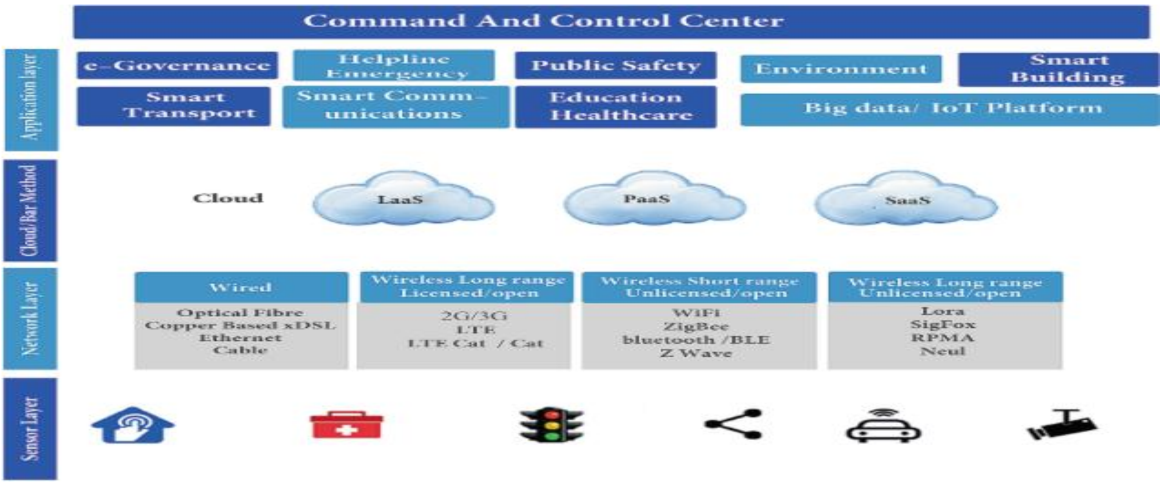

Figure 2: IoT Layered Architecture [33]

[III] Proposed Layered Framework of Internet of Things (IoT)

After studying so many research this paper concludes that there should be unique architecture of Internet of things is required which should be universally accepted. As there are so many industries proposes their own model which consists three layers to seven-layer IoT model. This paper suggests a five-layer IoT layered architecture / IoT model. following figure 4 describes the layered IoT model along with layer name.

This paper proposes a layered architecture is given below.

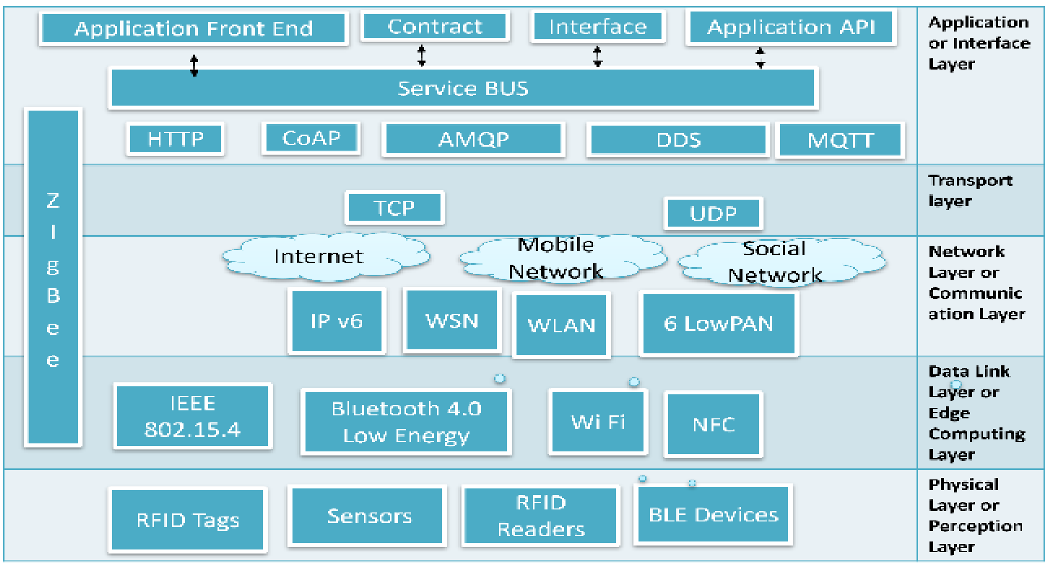

Figure 3: Proposed IoT layered Framework

3. Proposed Architecture

In the proposed architecture there are 5 layers in the IoT referencing Model.

1. Physical Layer
2. Data link layer
3. Network Layer
4. Transport layer
5. Application layer

3.1 **Physical Layer**: this layer is also called as perception layer. the main responsibility of the perception layer is that connectivity with sensors and physical objects. Physical objects can be any of the electrical, mechanical or electronics devices. Physical layer collects all the data from various sensor which is already embedded in the sensor devices. In the IoT layered architecture, Layer 1 i.e., physical layer is responsible for transmission of signals, physical topology, selection of transmission media, synchronization of bits, data rate selection and representation of bits.

3.1.1 Functionalities of Physical Layer

i. Transmission of signals:
Signals can be analog and digital, which is coming from different devices. Sensors are collecting the information from their surroundings physical layer is the communication channel between devices within a specific environment.
ii. Physical topology: End devices are sensors that’s why topologies having a changing environment. IoT devices used various types of physical topology such as tree topology, BUS topology and Ring Topology.
iii. Selection of transmission Media: In the sensor network, data are stored in cloud storage, sensors are connected with physical objects and sends data to data link layer, application layer is directly connected to the cloud storage. Therefore, transmission media can be wired or wireless media.
iv. Synchronization of bits: Bit synchronization is necessary while transmitting data using IoT technology
v. Data Rate Selection: Data rate is defined as number of bits transmitted in a second. IoT devices data rate is selected by physical layer.

3.1.1.1Components of Physical Layer:

i. Sensor:Sensors is an equipment used to compute or measure the physical properties such as distance, pressure, humidity, temperature and provide desired accurate or sometimes approximate result. Various sensors such as automotive sensor, fluid property sensor, digital component sensor, flow sensor, force sensor, humidity sensor, mass air flow sensor, photo optic sensor, piezo film sensor, position sensor, pressure sensor, rate and inertial sensor, speed sensors, temperature sensor, torque sensors, traffic sensors, ultrasonic sensor, vibration sensor, water level sensor etc. One of the real time examples of sensors applications is in military aircraft. In the military aircraft there is a feature of an autopilot mode, in which computer is attached to the various sensors (such as position, height, speed, temperature, location etc.) and then as desired aircraft engine will be automatically on and flaps motors, wings and other equipment will automatically be enabled. Computer takes data from sensor then it provides control signals to different ports of aircraft and then it run on autopilot mode.

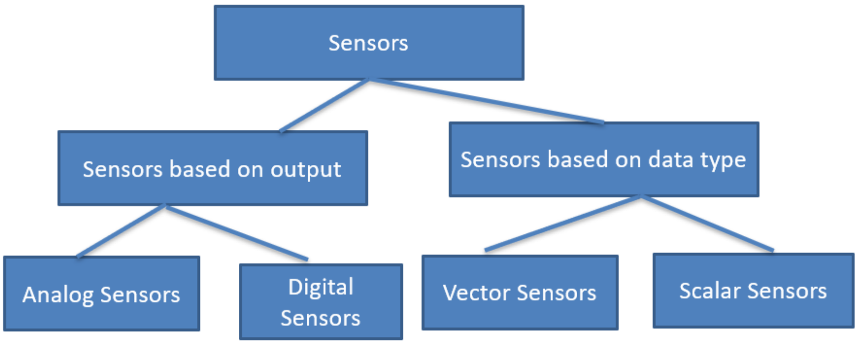

Figure 4: Sensor Classification

ii. **RFID:**It is a form of unguided communication i.e., wireless communication to identify any object, animal or human being. RFID uses electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum. It uses radio frequency to search, identify, track and communicate with items and people. it is a method that is used to track or identify an object by radio transmission uses over the web. Data digitally encoded in an RFID tag which might be read by the reader. This device work as a tag or label during which data read from tags that are stored in the database through the reader as compared to traditional barcodes and QR codes. It is often read outside the road of sight either passive or active RFID. RFID uses electromagnetic fields to track otherwise unpowered electronic tags. Compatible hardware supplies power and communicate with these tags, reading their information for identification and authentication.

iii. **BLE devices**: BLE is the Bluetooth enabled low power devices, sensors are the primarily device which is used to the collect data with the help of RFID enabled objects. BLE dramatically reduces power consumption and cost and maintains a similar connectivity range as classic Bluetooth. BLE works natively across mobile operating systems and is fast becoming a favorite for consumer electronics due to its low cost and long battery life.

.**Long-term evolution (LTE):** LTE provide broadband communication standard for mobile devices and end devices.it increases the efficiency and speed of wireless network. LTE support both multicast and broadcast architecture.

iv. **Near field communication (NFC):** Near field communication provides a set of communication protocol using electromagnetic field that allows devices to communicate each other with in the 4 cm range.NFC is generally used in for contactless mobile payments, ticketing and smart cards.

v. **Z-Wave**: physical layer in IoT layered architecture provide a mesh network using low energy radio waves to communicate from device to device.

vi. **Zigbee:** Zigbee is the technology based on IEEE 802.15.4 specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios.

3.2 Layer 2: Data Link Layer

In the IoT layered architecture, Data link layer is responsible to collect data from layer 1 i.e., from physical layer, physical layer is collecting data or information with the help of IoT enabled devices such as sensors and RFID tag, BLE devices. Data link layer transmits data into frames to network layer. Data link layer is also called as Edge computing layer because all the computation part of data analysis is done over here.

3.3 Layer 3: Network Layer

Network layer is responsible for the transmission of data to which is coming from lower layer (i.e. physical and data link layer) to transport layer. For example, if we collect data from RFID tag and verify by RFID reader and then it sends to cloud storage and the desired destination. Network layer can also be called as communication layer. IPv6, WSN (wireless sensor network), wireless LAN and 6LowPAN.Network layer communicating device is router.

i. IP: Many IoT protocols uses IPv4 but due the rapid increase of IoT devices, now a days it uses IPv6. IPv6 is a 128-bitprotocol.therefore, total no of devices connected via IoT using IP v6 protocol is 2^{128} =340,282,366,920,938,463,463,374,607,431,768,211,456devices.

ii. LoWPAN: This protocol is a low power wireless personal area network. This IoT protocol works best with low-power devices that have limited processing capabilities.

3.4 Layer 4: Transport Layer

Transport layer is responsible for segmentation and reassembly and port addressing, for the IoT devices as IPv6 protocol is use for data transmission. error control and flow control is also responsibility of Transport layer. TCP (Transmission Control Protocol) and UDP (User datagram protocol) are the two protocols for transport layer.

TCP is the connection-oriented protocol for reliable and slow delivery as compared to UDP protocol, while UDP is the connectionless protocol for unreliable and fast Delivery of data packets.

3.5 Layer 5: Application Layer

In the layered architecture of IoT Application Layer is also called interface layer because application layer providing an interface between user data with cloud storage, it also provides an interface between transport layer segmented data and user defined services and data. The main protocols used in application layer are HTTP, CoAP, AMQP and MQTT.

Zigbee protocol provide an interface between upper layer and lower layer. Therefore, ZigBee protocol provide an interface between data link layer, network layer, transport layer and application layer. It provides interface between the user and the end devices.

i. Advanced Message Queuing Protocol (AMQP)

A software layer that creates interoperability between messaging middleware. It helps a range of systems and applications work together, creating standardized messaging on an industrial scale.

ii. Constrained Application Protocol (CoAP)

A constrained-bandwidth and constrained-network protocol designed for devices with limited capacity to connect in machine-to-machine communication. CoAP is also a document-transfer protocol that runs over User Datagram Protocol (UDP).

iii. Data Distribution Service (DDS)

A versatile peer-to-peer communication protocol that does everything from running tiny devices to connecting high-performance networks. DDS streamlines deployment, increases reliability, and reduces complexity.

iv. Message Queue Telemetry Transport (MQTT)

A messaging protocol designed for lightweight machine-to-machine communication and primarily used for low-bandwidth connections to remote locations. MQTT uses a publisher-subscriber pattern and is ideal for small devices that require efficient bandwidth and battery use.

IV. Proposed Solutionfor Sensor Connectivity with Node MCU microcontroller Board

In these proposed approaches, we are trying to connect and implement different types of sensors via Node MCU development board with Arduino IDE and create some IoT based applications. Following proposed approach is used toanalog signals by through digital pin mode using node MCU. Delay can be set as1000.

4.1Digital toAnalogwrite

Proposed algorithm shows how to connect Node MCU to internet through the computer and set analog signal in Node MCUusing IoT. This particular algorithm describes the connection between NodeMCU and Arduino IDE with initialization of digital pins and converts the input signal into analog signal.
analogWrite() function is used to generate steady square wave of the specified duty cycle until the next call occurred.

4.1.1 Algorithm for glowing LED

1. Start
2. Set digital pin mode (Node MCU) as output
3. Initialize the variable
4. Set max limit 255

(As 2^8=256(it takes 0to 255))

5. Update analog pin by digital pin by using analogWritefunction ()
6. Delay can be set as 1000

Explanation: In this proposed algorithm, first step describes the port connectivity via USB micro cable to connect Node MCU to the computer. Here syntax of the analogWriefunction is analogWrite(pin, value), user can take any of the pin from D0 to D10. And if the pin value is 0 that means LED is always off and if its value is 255, it means LED is always on. Delay 1000 means, it can wait for a second. By using this generalized algorithm, we can simply on and off the Led. The negative portion of the LED is connected with GND (ground)pin of Node MCU and positive side of LED is connected with 3.3 V pin.

.4.2 Wireless solution for IOT

IoT uses several wireless network technologies to connect with internet such as Bluetooth smart, Bluetooth low energy, Bluetooth classic, Zigbee IP, Z wave, Ant +, wireless HART, LoRa, sigfox and 6LoWPAN. All wireless networks having specific features. Universal port number for Wi-Fi is 80. Here we proposed wireless solutions to connect the things with internet.Actually, Node MCU ESP8266 microcontroller have Wi-Fi capability, with this algorithm we discuss how Wi-Fi can be enabled using above said development board.

4.2.1Algorithm to set wireless solution for IOT

To achieve a wireless solution through Node MCU and Arduino IDE, we divide the algorithm in two modules first is Initial Module an second is Set UP Module.

Initial Module:

1. S
et Wi Fi module as an ESP 8266
2. i
) Set the input variable as a network ssidi.e., user Wi-Fi connection identification module.
ii) Set the input variable password as Wi-Fi connection security variable
3. S
imulate the Wi-Fi client with the talkback id.
4. s
et input variable talk back key identification number which is unique with time.

Setup module

1. S
et digital pin as an output with pin mode
2. i
nitialize the serial input as 9600. (i.e., The baud rate for serial input)
Connection module

1. I
s Wi-Fi connected with the connection set up
i) E
stablishing the connection with connection module.
Data transfer will be started,
Terminate the connection
ii) O
therwise, recheck the connection, goto step 2.

Explanation: As we already discuss that Node MCU having an inbuilt Wi-Ficapability. Therefore, at the starting point we have to establish a connection between Node MCU and Arduino IDE software by initialising the port module. After that call the ESP8266 header file as it is a inbuilt feature of Node MCU development kit. After that set the connection by enabling the Wi-Fi mode on then call the serial println() function. Output can be seen using serial monitor. delay can be set as 5000, means displaying of the result will be after 5 second.

4.3 Connectivity with IR Sensor:

Here we are proposing that how to connect infrared sensor with internet using node MCU.Infrared Sensor is used for object detection. If any physical object (such as human or any physical thing) comes in front of IR Sensor then it detects that physical thing.

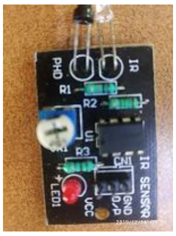

Figure 5 : IR Sensor

4.3.1 Algorithm to connect IR sensor with NodeMCU

1. start
2. set D2 pin as output in Node MCU
3. set D1 pin as input in node MCU
4. call digitalWrite function (S)
   if S=high, then set D2 pin as high
   else set D2 pin as Low

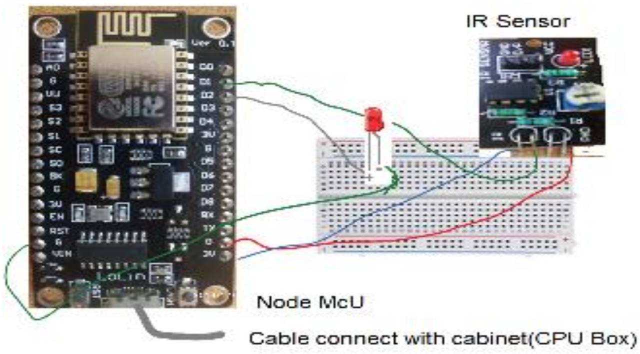

Figure 6: IR Sensor Connected with Node MCU

Explanation: Node MCU have 3.3 V, so this pin is connected with IR Sensor. Node MCU digital pin is connected with IR sensor and D2 pin is connected to LED +ve pin. The –ve pin of LED is connected with the ground in node MCU circuit board.When the Node MCU is connected with the internet through the cable then after desired output will be achieved.

4.4Algorithm for Analog input with light dependent register (LDR)

This algorithm shows how to connect light dependent resistor to internet via Node MCU board.LDR is also called photoresistors and it detects light. Light dependent resistor, resistance is inversely proportional to intensity of light.

LDR resistance = 1/ intensity of Light

It means when intensity of light decreases then resistance value of LDR sensor will increases.

.

1. start
2. initialize the serial input as 9600. (i.e., the baud rate for serial input)
3. set A0 pin as input
4. set S as analogRead with input pin A0
5. output displayed on serial monitor
6. Delay can be set as 500.

Explanation: Node MCU as only one analog pin while Arduino IDE circuit board contains 6 analog pins.

In Node MCU , when user required to read analog input , user have to use analogRead() function. And get result on serial monitor.

As we discussed earlier Node MCU circuit board has only one analogpin, here it will be connected with input.

We can also set the delay function. so that achieved output will not be displayed continuously.

4.5 Humidity and temperature sensor

DHT11 humidity and Temperaturesensor, operating voltage is 3 to 5Volt and current consumption is 2. 5mA.this sensor detects humidity and temperature of the surrounded environment and produces output on serial monitor(arduino IDE).

Figure 7: DHT 11 Humidity Sensor

4.5.1 Algorithm for Humidity and Temperature Sensor

1. Set digital pin D2 as DHT11
2. Initialize serial input with 9600 baud.

3. Initialize DHT
4. Read temperature with serial input
5. Read humidity with DHT variable with serial input
6. Delay can be set till 3000

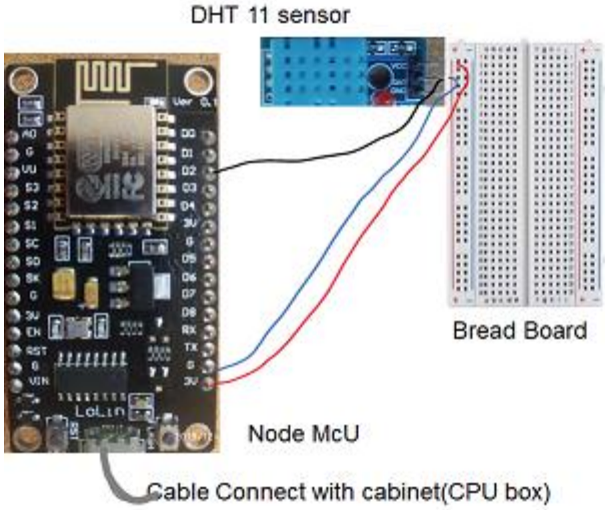

Figure 8: humidity Sensor Connected with Node MCU

Humidity and Temperature is also called DHT 11 Sensors.
Explanation: In this proposed algorithm we describe how the Humidity and Temperature sensor works. For the connection, Node MCU 3V pin is connected to the V (Voltage) pin of DHT 11 sensor. Ground of DHT11 pin is directly connected to the Node MCU ground pin using Breadboard. Digital pin D2 of Node MCU circuit board s connected to theDHT11 sensor.
Output can be display in serial monitor while connecting Node MCU to computer via cable.
Delay can also be set. Therefore, user can get the current room temperature and humidity measurement.

4.6Algorithm for Ultra sonic sensor for measuringdistance

When Sound waves emitted by ultrasonic sensor travels and reach the object and reflect to the original source, then by calculating of the total distance travels will be the actual distance from sourceobject to destination object.

4.6.1 Algorithm:

1. Initialize set up
2. Initialize serial input with 9600 baud
3. Initialize D2 pin as output and D4 pin as input
4. digitalWrite as D2 pin set as Low
5. delay can be set in microseconds
6. duration variable set as HIGH with D4 pin.
7. Distance variable set as duration/29/2
8. Call serial monitor by using Serial.println ()

Here we used air speed as 29 microsecond/cm.

V.Comparative Analysis of Node MCU and Arduino UNO Development Board

i) Node MCU ESP 8266 is an open-source firmware and Arduino UNO development board is microcontroller board based on 8 bit ATmega328P.
ii) Current consumption in deep sleep mode in NodeMCU is 0.5 µA while in Arduino UNO is 35 mA.

iii) In both the boards power supply is 7V to 12V.

iv) RAM size in node MCU is 128KB and in Arduino UNO RAM size is 2KB.

v) Node MCU uses 4MB ROM as a flash memory (which tells about program space) and in Arduino UNO flash memory size is upto 32kB.

vi) Arduino UNO have USB type B connector and in Node MCU micro-USB port.

vii) Arduino UNO board size is bigger than node MCU.

viii) In node MCU there are 11 or 13 digital I/O pin pins while in Arduino there are 14 digital I/O pin.

VI. Conclusion

This paper presents different algorithms for the connection between different types of sensors (such as IR sensor, Ultrasonic sensor, Temperature and Humidity sensor) with arduino IDE by using Node MCU. We also provide the wireless solution for IoT enabling devices.This paper also provides a brief description of Node MCU and Arduino UNO development board and explain the brief introduction of sensor and its types.In this paper we are trying to write the step wise step method to provide connectivity with IoT technology and development board Node MCU. Proposed algorithms are algorithm for glowing LED, algorithm to set wireless connection, algorithm for infrared sensor(IR Sensor), algorithm of connect light dependent resistor, algorithm for humidity and temperature Sensor(DHT11) and algorithm to connect ultrasonic sensor via Node MCU board.

There is also a comparative analysis of Node MCU ESP 8266 and Arduino UNO ATmega328P development board used for developing IoT based applications.

The application areas of IoT are quite diverse to enable it to serve different users, who in turn have different needs. The technology serves three categories of users, individuals, the society or communities and institutions. As discussed in the application section of this research paper, the IoT has without a doubt a massive capability to be a tremendously transformative force, which will, and to some extent does already, positively impact millions of lives worldwide. Paper discusses the designing a 5-layer IoT architecture with the help of web stack and combination of various architecture available as three-layer, four layer and five-layer IoT architecture.

VII.Future Scope:

For all the potential applications of IoT, there has to be proper feasibility into the different domains to ascertain the success of some applications and their functionality. As with any other form of technology or innovation, IoT has its challenges and implications that must be sorted out to enable mass adoption. Even though the current IoT enabling technologies have greatly improved in the recent years, there are still numerous problems that require attention, hence paving the way for new dimensions of research to be carried out. Since the IoT concept ensues from heterogeneous technologies that are used in sensing, collecting, action, processing, inferring, transmitting, notifying, managing, and storing of data, a lot of research challenges are bound to arise. These research challenges that require attention have consequently spanned different research areas.

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