

HOME AUTOMATION USING IoT & Node MCU

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

BY

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DECLARATION BY THE SCHOLAR

This is to declare that the work entitled “**Home Automation Using IoT & Node MCU**” in partial fulfillment of the requirement for the degree of **Bachelor of Technology in Computer Science & Engineering and Information Technology**, Jaypee University of Information Technology, Waknaghat, is completely an authenticated report of the work carried out from August 2017 to April 2018 under the complete guidance of **Dr. Ruchi Verma**, Assistant Professor Senior Grade.

The contents that are constituted in this report, has not been submitted for the fulfillment of any other degree or diploma.

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This is to certify that the above declaration by the candidate is true to the best of my knowledge.

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LIST OF ABBREVIATIONS

ABBREVIATIONS	EXPANDED FORM
1. IoT	Internet of Things
2. MCU	Micro Controller Units
3. Wi-Fi	Wireless Fidelity
4. Arg	Arguments
5. IDE	Integrated Development Environment
6. LED	Light Emitting Diode
7. RAM	Random Access Memory
8. IT	Information technology

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ABSTRACT

As we know that now a days , technology is emerging day to day and there's a huge revolution in this field. It has always providing new opportunities worldwide for every individual.

This system is proposed with the only fact that all the devices in the home are controlled automatically by the help of remote sensor that is connected to a central host PC.

The connection between the web server and the MCU is maintained by wireless technology , that is Wi-Fi.

The hardware and software components used are routers, solid state relay switches, ESP8266 Microcontroller , Arduino IDE are connected to each other with the help of IoT platform.

CHAPTER -1
INTRODUCTION

MOTIVATION

In day to day life, we see that our whole living is dependent on technology and is mainly computer based. This is clearly seen in many areas of our daily home appliances. Mainly all types of systems that are used for communication means, including the landline phones, mobile phones and lets not forget the world wide web(Internet). All such systems are based on electronics and only run on programs that are specially designed with all kinds of required equipment. In the field of entertainment also if we talk about movies or books , then we can find them all in digital formats nowadays.

Also, this is a fact that cannot be ignored that computer based devices are more reliable as compared to mechanical or electronic devices.

In order to provide more security to our homes and also to make our homes more modernized we need a special kind of computer controlled home automation system. Such system, that has a complete hold over each and every activity happening inside or just outside the house.

There are lots of such devices designed to meet these needs and I parallel they also notify the owner of the house about each movement taking place in presence and absence of the owner or family.

The main focus of our project is to provide a home automation system that is specially designed and is completely advanced. The system is completely dependent on Wi – Fi Technology and also a Web Server is must for its working.

Through this system all the devices at home can be switched ON/OFF easily and with the help of sensors all the information can be collected or read in a PC (Personal Computer) with the help of Wi-Fi Technology.

The most common term used here is Automation. This term is very famous in the field of electronics. The need to apply automation everywhere in our daily life has lead to many inventions and has given rise to great innovations among the existing inventions. This is all because the nature of the automation is user-friendly and is adaptable to all kinds of surroundings. This system is a great replacement to the appliances like switches at home that can undergo sparking in case of thunderstorms or lightening etc. Also to avoid unnecessary accidents due to fire some situations. Keeping the benefits of Wi-Fi in mind an advanced system for the automation of homes was implemented to control all appliances in house using Wi-Fi (wireless fidelity) .

OBJECTIVE OF THE PROJECT

The objective of this project is to develop a system that is completely automated and works on Wi-Fi technology. Each and every module is connected to a host that is the central PC(personal computer).

Every appliance at home is connected to a personal remote controller. The system will notify the owner of the house about each and every happening that is taking place inside the house, like , switching ON/OFF the fan or heating up the geyser etc.

The user/owner will be notified with the help of an SMS.

Every appliance is remote controlled and the complete control is highly automated.

CHAPTER – 2
LITERATURE SURVEY

LITERATURE REVIEW:

Normally, when we talk about the houses that are completely automated then an image of smart home is created in one's mind. When every appliance at home is automated then we can say that we have reached the goal where home automation has become equal to smart home.

This has made the lives of individuals more luxurious and easy in any circumstances.

This specific automation is implemented on the wireless technology. An interface is definitely required to maintain that there is a proper communication between the user that's having the direct access to remote and the server.

The main focus is on the controlling device of this automation is NodeMcu. The data is read by NodeMCU and then the action for switching is decided up for all the electrical devices.

Mobile and computers play a most important role for the basic operation of home and for the automated functioning of appliances through any corner of this world globally. That's the reason we call it as a smart home. The specific system for automation that is proposed in this report is comprised of sensors, host PC's and Wi-Fi technology. These components are used for the reason being that they are easy to configure. Web server is the Arduino board in this system.

These days smart homes are so popular just because of IoT technology used these days. This technology has a main objective just to connect the internet technology with hardware devices. So, basically this was a much easier option to connect the sensors to the internet with the help of this technology and then collect the information, then it exchanges the collected data over the internet. To understand the basic conceptuality of this technology we have gone through different kinds of journals and research papers.

The main objective is to maintain the security of homes and to provide an application for this that is easy to use.

1. Node MCU

This is a application that is open source and here we are mainly talking about the MCU that is IoT platform. The scripting language used here is lua. It's implementation is done at ESP8266 SDK 0.9.5 and the project on which it is based is eLua.

There are many open sources that are used by it like lua-ejson or spiffs. A firmware is also there that runs on ESP8266 Wi-Fi SoC with a hardware that is implemented on ESP-12 module.

The production of ESP8266 is carried out by Espressif systems.

Also, Tensilica Xtensa LX106 has an integration with it.

The inauguration data for ESP8266 was October 13, in year 2014.

2. DESIGN IMPLEMENTATION

As we know that the two main components of the design are hardware and software.

The hardware components constitute of actuators, microprocessor, micro-controllers and sensors.

Now, coming upon the software components, the basic idea behind the programming used is done with keeping a fact in mind that hardware and software devices can be linked with each other better.

3. SYSTEM ARCHITECTURE

The most rapid technology that is well explanatory and is preparing our mindset so that a revolution can be initiated to in the field of computer science and IT. The advantages of IoT are mainly that it is platform independent and is quite flexible in all kinds of environment.

The appliances that are to be controlled fall in the physical layer of the architecture. Also, this layer is connected to the equipments that are used to sense the activities taking place within the system, mainly we call them sensors.

We are using the MCU as router gateway. This gateway router, protocols used for communication and the manager for devices come under the data link layer of the system architecture.

The main focus of this respective link layer is to form a connection between the home devices to be controlled by this system to the Arduino board that is used the server for internet via wireless technology.

The internet protocols used, come under the control of application layer and presentation layer respectively. The main workplace of this layer is to create a page on the internet that maintains a network between the appliances and their respective perception layers with the help of a central host computer.

4. SENSORS USED

There are various sensors used in this respective system. The motion detection sensor, IR is included. Moreover, the sensor to check the leakage in gas that is used to cook food is whether leaking or not. A virtual role is played by it, as it is used for the purpose of security and safety. The sensor used to warn against fire is also used. In order to detect the range of temperature around we have the temperature sensor. The objective is to ensure safety inside houses using this automated smart home application and it is well achieved by using these types of sensors.

5. FUNCTIONING

A third party application is being used while implementing the sensors on MCU. The application used, behaves like an open source application. Therefore, it was not at all easy creating an application, so an application named Blynk can be used instead. This connection is maintain with the help of wireless technology.

Over, switching ON the respective application the messages will start showing up the screen. We will be notified regarding each and every appliance instantly on our screens. For instance, we can assume that if home is on fire, we will be notified regarding it on our screens and with the help of fire sensor.

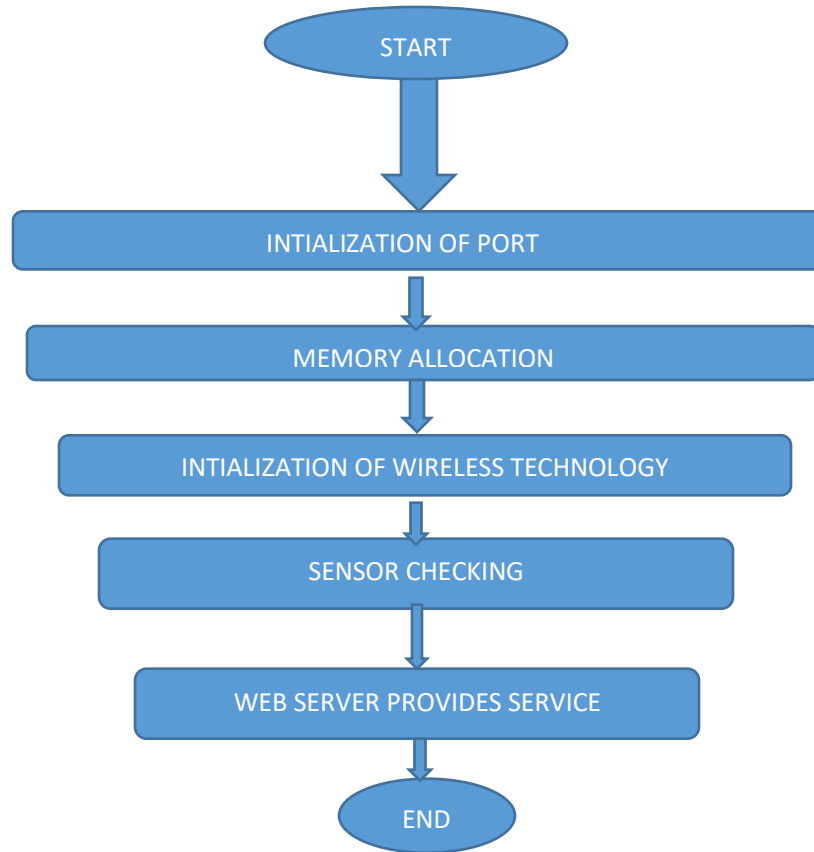


Fig 2.1(a)

6. HARDWARE & SOFTWARE EQUIPMENTS

(a) ESP8266 Wi-Fi Module:

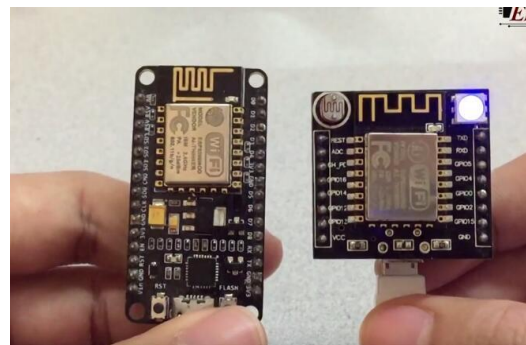


Fig 2.1 (b)

It is very cost efficient module. It contains full transmission control protocol.

Module specifications are :

1. PINS – 13
2. POWER – 3.3V
3. TCP/IP PROTOCOL
4. Wi-Fi DIRECT (P2P)

(b) ROUTER:

Data packets are being forwarded by the router in a specified network. Controlling the traffic on internet is also done by router. From one network to another data packets are forwarded and information is exchanged on the web, until it properly reaches the receiver.

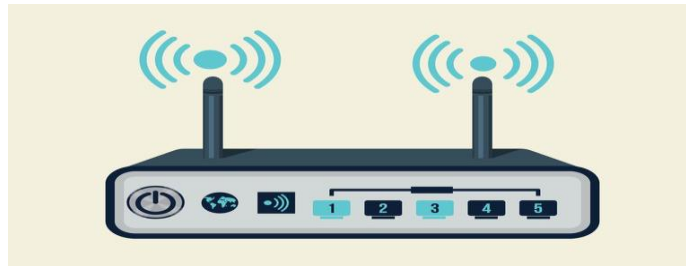


Fig 2.1 (c)

(c) SOLID STATE:

A switch that is operated electrically is being used called relay. In order to get operated mechanically, an electromagnet is used by the relay switches.

Also, many other principles are followed up like Solid State Relays.

The specifications are , input supply of 230 V, under 50Hz frequency along with the current capacity of 15 A.



Fig 2.1 (d)

(d) ARDUINO (IDE):

Basically the language to be opted to write a code for Arduino can be any language, because the compiler that is used must be a compiler that can generate a machine code in binary for the destination processor.

The implementation environment is provided by Atmel.

Also, there's a new term called Sketch. This is the word used for a code that is being written with IDE. These are available on the computer that is used for development.

Its really easy , first to generate a code and then to implement easily on a board.

CHAPTER-3

SYSTEM DEVELOPMENT OF HOME AUTOMATION USING IoT IN Node MCU

3.1 INTRODUCTION OF Node MCU:

Node MCU is a new LUA technology and is a 2.4GHz Wi-Fi development board and is also known as ESP8266 which connects to internet to upload a data.

LUA is a very easy scripting language in which it works. Node MCU is a microcontroller chip consisting of different pins. The diagram is shown below. Fig 3.1(a)

Different pins have different functions which will tell that which pin will perform which function while we will use the Node MCU

Pinout of Node MCU is as follows:

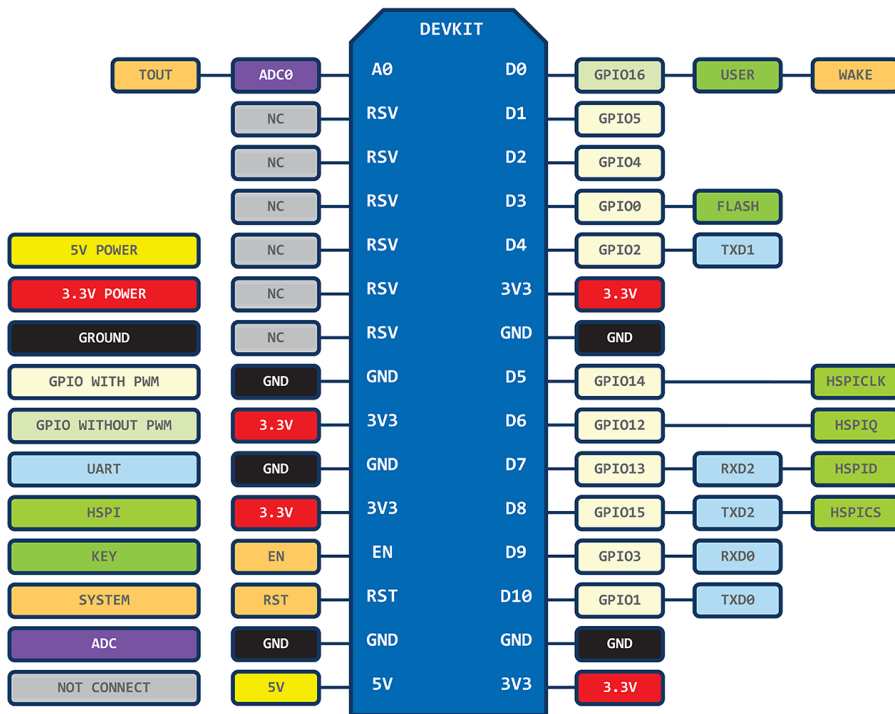


Fig3.1(a)

As you can see in diagram above there are different GPIO'S(General Purpose Input Output) so different index numbers are allotted to them which are as follows:

GPIO Pin	I/O Index Number
GPIO0	3
GPIO1	10
GPIO2	4
GPIO3	9
GPIO4	2
GPIO5	1
GPIO6	N/A
GPIO7	N/A
GPIO8	N/A
GPIO9	11
GPIO10	12
GPIO11	N/A
GPIO12	6
GPIO13	7
GPIO14	5
GPIO15	8
GPIO16	0

Table 3.1(a)

Index number is used so that we can easily differentiate between different pins of GPIO's

The functions of different pins is as follows:

Pin	Description
VCC	3.3V (3.6V Max) Power Supply Pin
GND	Ground Pin
Tx	Data Transmit Pin (Works at 3.3V)
Rx	Data Receive Pin (Works at 3.3V)
CH_PD	Chip Power Down Pin. (LOW = Power Down, HIGH = Power UP). Connect this Pin to VCC Pin.
GPIO 0	General Purpose I/O Pin 0 (I/O Index 3)
GPIO 2	General Purpose I/O Pin 2 (I/O Index 4)
RESET	Reset Pin (LOW = Reset). Pull Down this Pin by connecting it to GND Pin to reset ESP8266

Table 3.1(b)

3.2 DESIGNING

The designing of Node MCU consists of software and hardware. Hardware contains different types of sensors, board, microcontrollers etc.

Software contains of different platforms in which we are coding and making the project to implement.

HARDWARE:

As discussed earlier the main hardware component of the project is Node MCU which is itself a microcontroller embedded with different functions and other hardware are different chips through which it will be connected and will perform its task accordingly.

This microcontroller consists of different sensors which are temperature or we can say humidity sensor so that we can broadcast or we can say update our data through Wi-Fi at any climate or temperature.

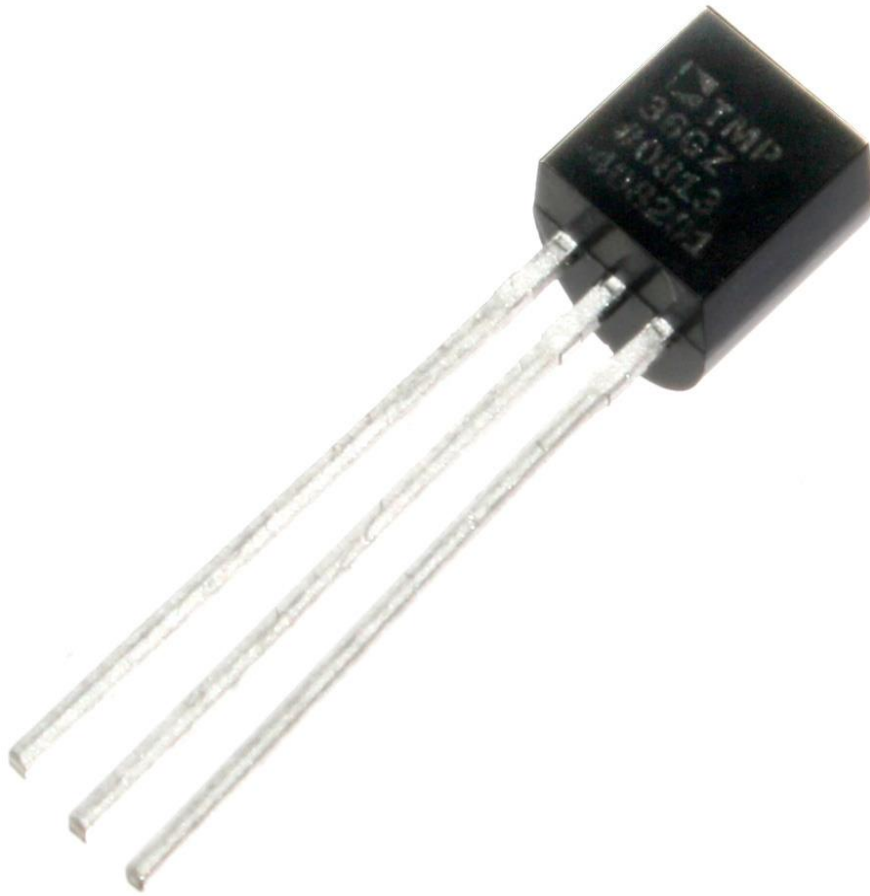


Fig 3.2 (a)

SOFTWARE:

With the help of C++ programming language we will connect with the wifi and by the sensors the microcontroller will start to work.

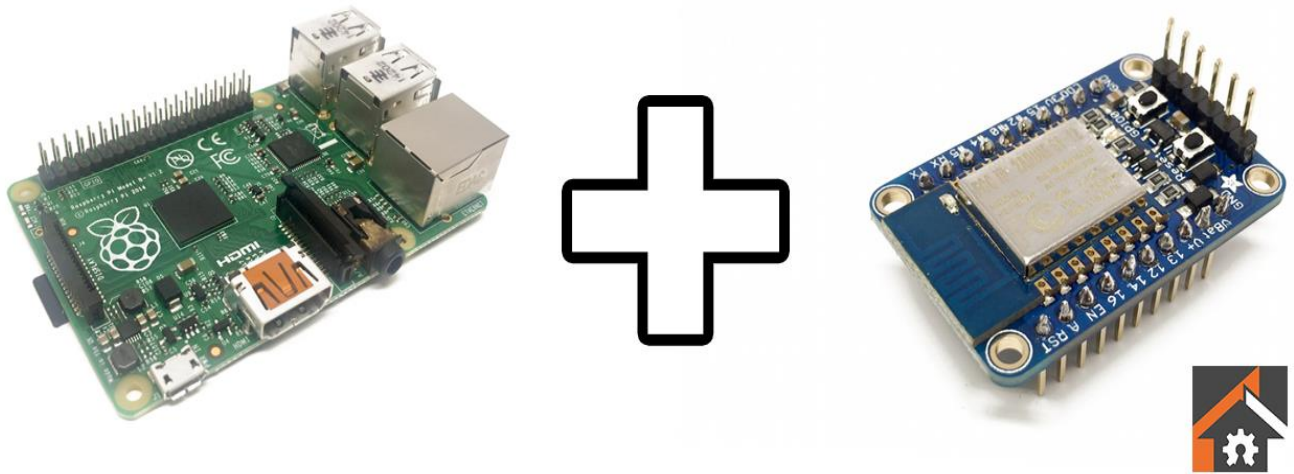


Fig 3.2 (b)

3.3 IMPORTANCE OF IOT IN Node MCU:

Internet of things is a on demand topic for projects because it makes every work easy and adoptable to use.

Node MCU is the best choice so that we can learn more about internet of things.

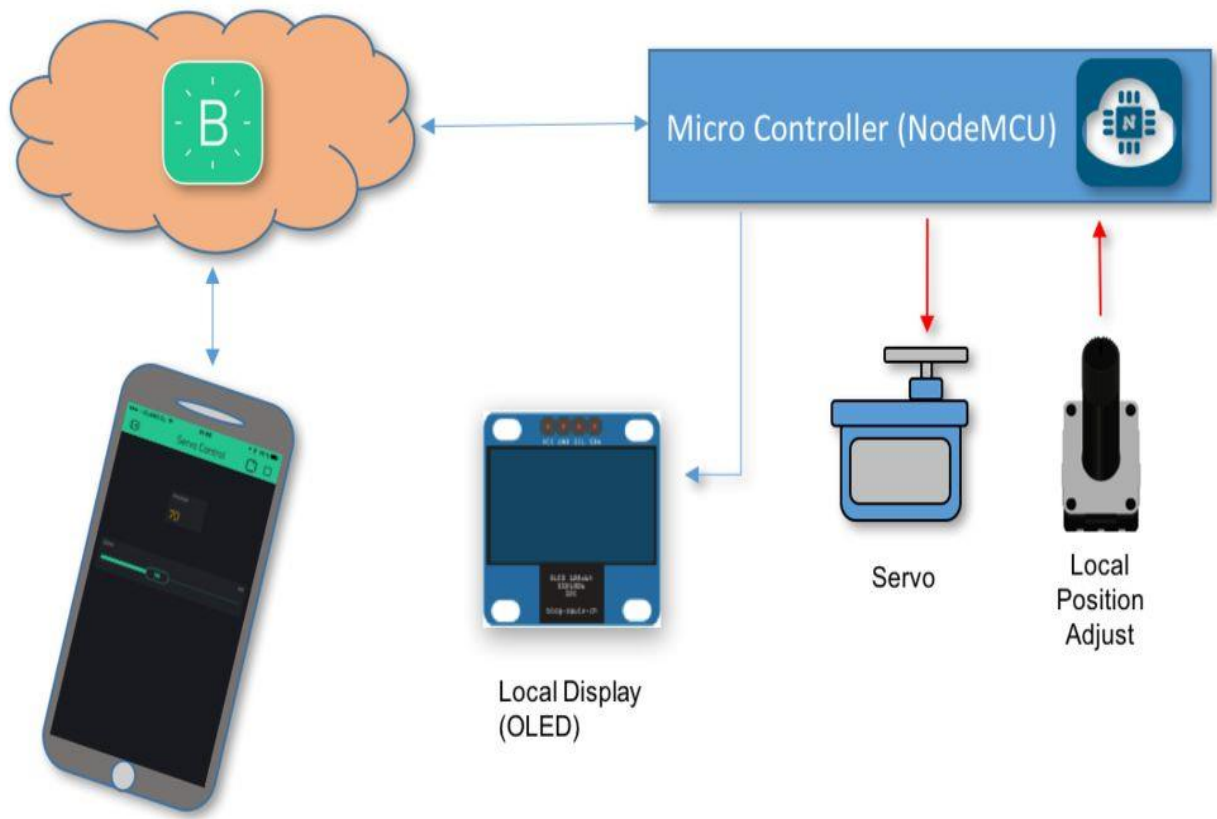


Fig 3.3 (a)

3.4 CODE USED:

Defining the main function -

```
static void ICACHE_FLASH_ATTR procTask(os_event_t *events)
{
    system_os_post(procTaskPrio, 0, 0 );
    printf( "Idle Task\n" );
}

void user_init(void)
{
    system_os_task(procTask, procTaskPrio, procTaskQueue, procTaskQueueLen);
    system_os_post(procTaskPrio, 0, 0 );
}
```

Fig 3.4(a)

Connecting ESP8266 in 8 lines of code to an AP -

```
const char ssid[32] = "my_home_ssid";
const char password[32] = "my_home_password";

struct station_config stationConf;

wifi_set_opmode( STATION_MODE );
os_memcpy(&stationConf.ssid, ssid, 32);
os_memcpy(&stationConf.password, password, 32);
wifi_station_set_config(&stationConf);
wifi_station_connect();
```

Fig 3.4(b)

Serving the TCP:

```
//Allocate an "espconn"
pHTTPServer = (struct espconn *)os_zalloc(sizeof(struct espconn));
ets_memset( pHTTPServer, 0, sizeof( struct espconn ) );

//Initialize the ESPConn
espconn_create( pHTTPServer );
pHTTPServer->type = ESPCONN_TCP;
pHTTPServer->state = ESPCONN_NONE;

//Make it a TCP connection.
pHTTPServer->proto.tcp = (esp_tcp *)os_zalloc(sizeof(esp_tcp));
pHTTPServer->proto.tcp->local_port = 0;

//"httpserver_connectcb" gets called whenever you get an incoming connection.
espconn_regist_connectcb(pHTTPServer, server_connectcb);

//Start listening!
espconn_accept(pHTTPServer);

//I don't know what default is, but I always set this.
```

Fig3.4 (c)

Receiving Connections:

```
//This function gets called whenever
void ICACHE_FLASH_ATTR server_connectcb(void *arg)
{
    int i;
    struct espconn *pespconn = (struct espconn *)arg;

    //espconn's have a extra flag you can associate extra information with a conn
    pespconn->reverse = my_http;

    //Let's register a few callbacks, for when data is received or a disconnect h
    espconn_regist_rcvcb( pespconn, http_rcvcb );
    espconn_regist_disconcb( pespconn, http_disconnectcb );
}
```

Fig3.4 (d)

CHAPTER-4
PERFORMANCE ANALYSIS

Different parameters are found in the performance analysis of the Node MCU which is interesting to see.

LOSS:

$$PL(db)=10\log_{10}(P_t/P_r)$$

This tells us that there a wide variation in signal to noise ratio in it.

We use Thingspeak in this module because it allows us to use this software and hardware from any part of the world.

It also allow us to measure different types of sensor data which is also important for us to know.

4.1 DIFFERENT WORKING UNITS OF IoT:

A module is said as an IoT system comprises of different working units such as sensors, identifying, automation etc.

This is the basic diagram showing different working units:

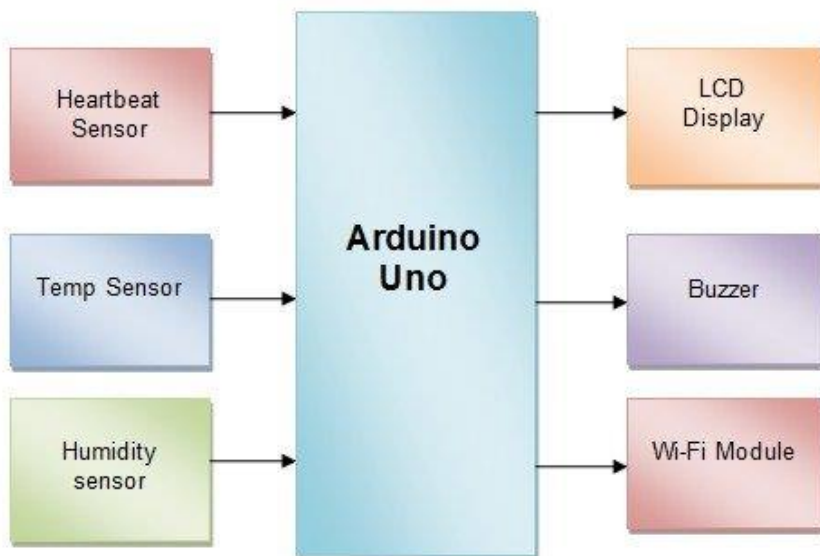


Fig 4.1 (a)

1. Approachable in coding: In Node MCU coding makes the working more convenient

for testing the module anywhere in the world which is the performance analysis of the module

2. Security: Security is the most important working function which should be taken care of while we analyzing the performance of the system .there should be privacy in the data that we are uploading or sharing to others through this module.

3. Function: This unit plays a vital role as it checks the overall system of the module which tells what is the scope of the module in future and what is the role in the present scenario.

IoT is the stage where we can work single or we can work in a group. It depends on our needs, what we want in result. this platform totally depend on sensors and actuators. It is a smart environment which makes our work easy and convenient to use.

4.2 IoT PLATFORMS:

So there are different platforms on which we can work using Internet of Things:

1. ARDUINO: It is the freely accessible device or microcontroller which can be used with any protocols that is fitting to the IoT device.

The process of using Arduino is very easy and convenient for us

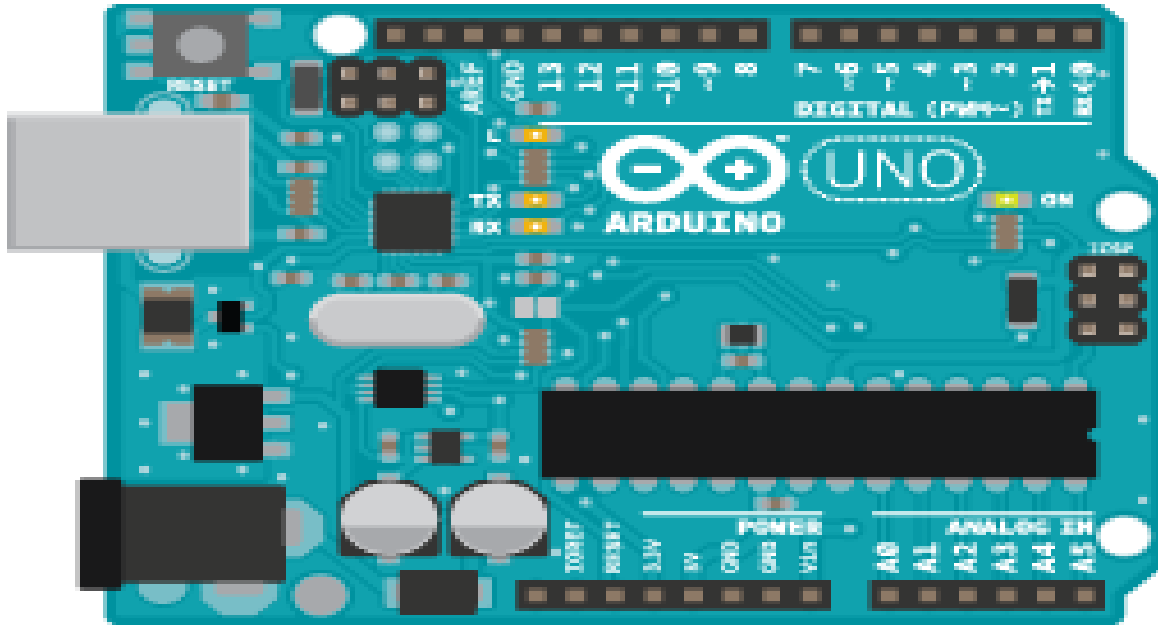


Fig 4.2 (a)

2. RASPBERRY Pi: Raspberry Pi is a small sized Broadcom power minicomputer. It easily gets plugged to monitor due to its inbuilt General purpose input output ability. Uses mouse and keyboard for its implementation .uses languages like c, python.

The RAM of Raspberry Pi is very huge as compared to the other boards used in internet of things

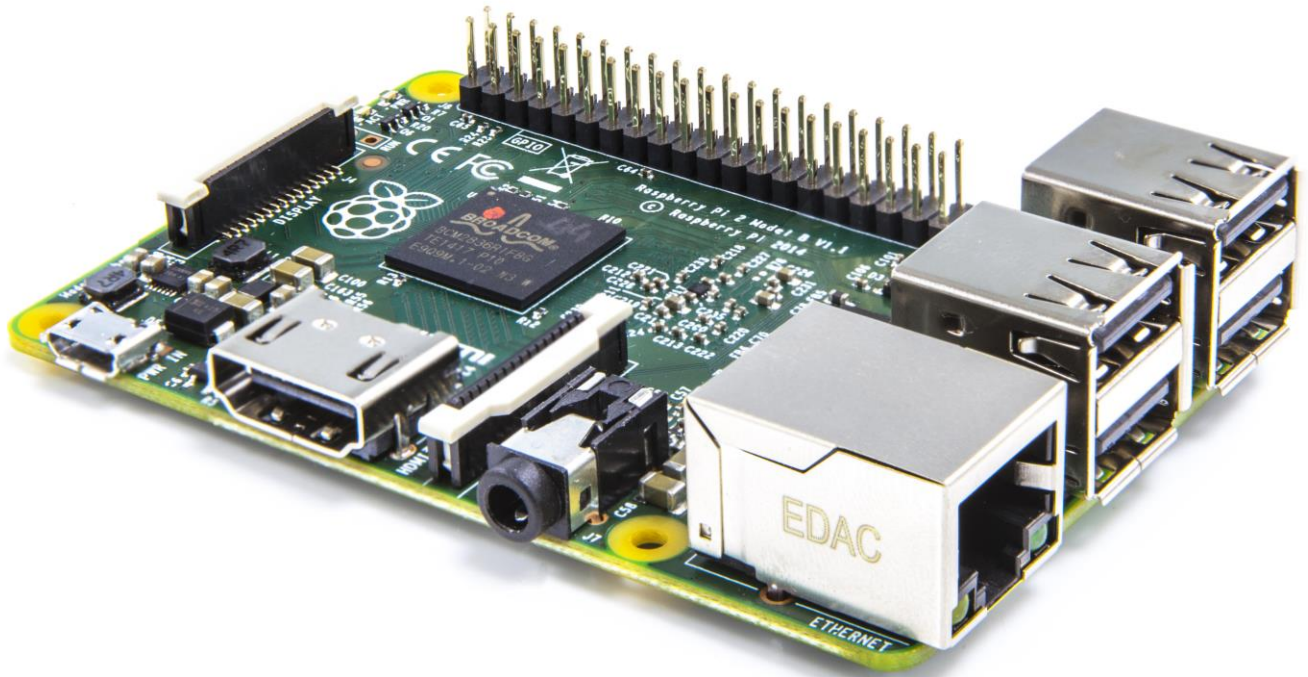


Fig 4.2 (b)

3.ESP-8266:It is very capable wireless programmable microcontroller board

that gives access to the wifi and is able to sense or upload or fetch data anywhere in the world with the help of the sensors e.g. temperature sensor, humidity sensor etc

So this the platform we are using because it is a wireless connection oriented module and can be used anywhere, anytime we want to use it.

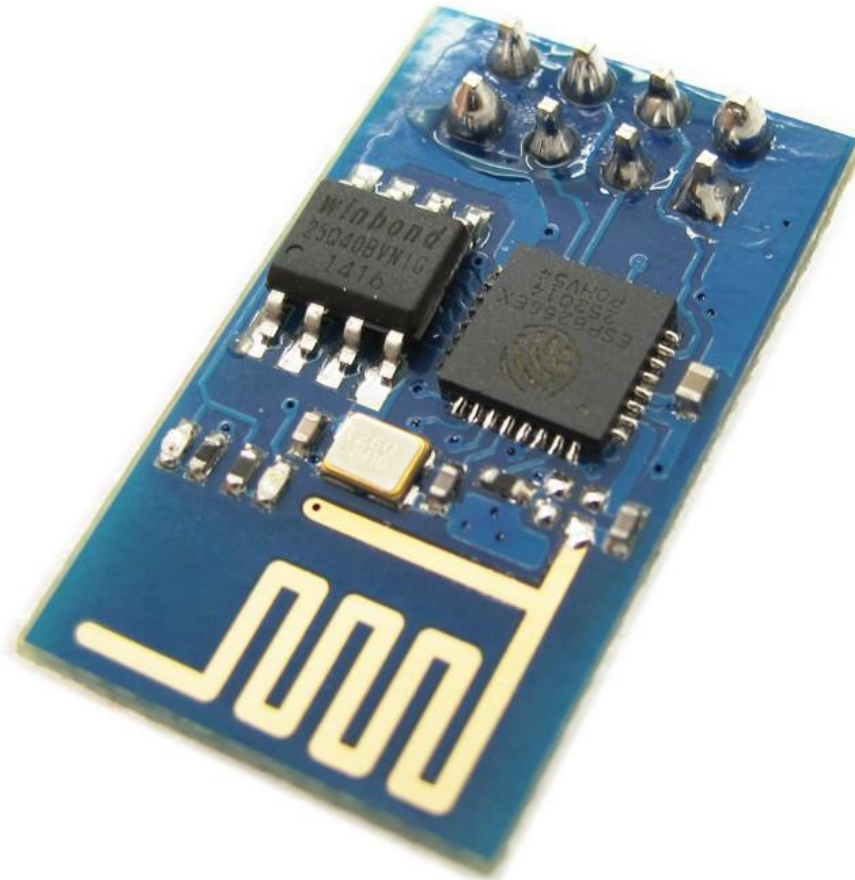


Fig 4.2 (c)

Above diagram gives the closer look to the ESP-8266 module which is commonly used these days using the IoT platform makes it much easier for the consumers to use it safely.

COMPARISON:

Comparison

	ESP8266	Arduino	Raspberry Pi
Cost	~\$3	\$3-\$30	~\$35
Wifi	Built-in	Shield (\$60) or ESP8266	USB Dongle
Programming	C++/Lua	C++	Python/Java/C++
Code distribution	Serial/ OTA	USB/ SPI/ Serial	In-Situ
Storage	Built-In	Built-In	SD-Card
I/O	10 GPIO/ 1 ADC	Arduino Uno: 13 GPIO/ 6 ADC	17 GPIO

Table 4.2 (a)

CHAPTER-5
CONCLUSION

5.1

CONCLUSION

From this project we got to know that Internet of Things is the turning point in the field of IT sector and we have lot of growth in this field .Now everything is possible with the help of different sensors.

In this project we learned that there is limitless possibilities in Internet of things .

New sectors has been made in the platform of internet of things. If we will think in deeper way we will discover a new thing that is the main advantage in this platform. We have learnt that everything is wireless in IoT which removes physical burden to Human beings.

5.2

FUTURE SCOPE

In coming years each object will be allied with internet. According to the famous Gartner estimation is made that in 2020 ,26 billion devices will be connected with internet and \$300billion of revenue will be generated .

Data creation will be more cheaper and easy by this platform. There will be more and more jobs in the future because of its day by day development going on. More deeper study will be there of each and every topic in future because of Internet of things.

There is lack of security still going on in this platform and study is going on how to control it so in future there is a scope of strict security in Internet of things.

New databases will be made, user-interfaces will be increased and there will new-services provided in this Platform.



Fig 5.2 (a)

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APPENDIX

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