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Electrical and Computer Engineering

DESIGN A SMART HOME AUTOMATION SYSTEM USING THE IOT DEVICE CLOUD

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Master of Science

Supervisor

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Istanbul, 2021

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The thesis titled DESIGN A SMART HOME AUTOMATION SYSTEM USING THE IOT DEVICE CLOUD prepared by Yehya EL MOHAMAD and submitted on 08.01.2021 has been **accepted unanimously** for the degree of Master of Science in Electrical and Computer Engineering.

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Yehya EL MOHAMAD

DEDICATION

First I would like to Allah Almighty for the power of mind , health, strength , guidance knowledge and skills to complete this study .This thesis is wholeheartedly dedicated to my beloved father, who have been my source of inspiration, he tells me that" every success in your life will be best gift for me". To my mother, who have been supporting me with the kind and pure love.

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ABSTRACT

DESIGN A SMART HOME AUTOMATION SYSTEM USING THE IOT DEVICE CLOUD

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With the advancement and development of communication technology, the Internet of Things (IoT) has become the focus of attention and attraction for many in terms of home automation. The Internet of Things is used to control and monitor devices and keep an eye on the home environment through the home automation system. Therefore, this paper provides a flexible, low-value and energy-efficient environmental monitoring tool with an intuitive interface based on the Internet of Things (IoT). The network server built into NodeMCU is used to access and control tools remotely either locally or globally. The tools are managed online or through a smartphone app that supports WIFI and mobile network (LTE / 4G) through access to a cloud hosting server. Provides a unique protocol for viewing and controlling the home environment over more than one switch. To demonstrate the safety and effectiveness of this device, the instruments are combined with medium switches, power components, temperature and humidity sensor, gas sensor and notification system with the proposed processing device. The proposed system can easily and efficiently control IoT based devices for home automation and support home safety through autonomous operation, energy saving and ensuring the required comfort and safety for residents.

Keywords: Home Automation System, IOT Device Cloud, NodeMCU (ESP8266), Web Page, Voice Control.

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LIST OF ABBREVIATIONS

IoT	:	Internet of Things
UMTS	:	Universal Mobile Telecommunications System
PV	:	Photovoltaic Energy
FC	:	Fuel Cell
WT	:	Wind Turbine
IDE	:	Integrated Development Environment

1. INTRODUCTION

1.1 INTRODUCTION TO THE PROJECT

The human continued to seek comfort requirements for mankind. Smart home has become the focus of attention of scientists and engineers to work on building an integrated house to provide comfort and safety necessary for humanity.

Modern technology in the 21st century has provided a huge leap in the world of telecommunications and the Internet. This facilitated communication and the transfer of information freely and contributed to the expansion of communication between individuals and groups. All thanks to the smartphone and the Internet, which provided all the requirements to achieve the field of smart control. With the help of these two mechanisms and automatic control of the house, it was possible. We can keep in mind that these machines start home automation. Now we can control all electrical, electronic and other devices using smart phones. This project revolves around home automation system and security system easy and cheap.

In the present day, safety systems play a critical role within the safety of lives and investment. that is performed by the incorporation of numerous subsystems into the security machine with a single control unit together with surveillance, intruder manage, access manipulate, hearth detection, etc. a clever home is one this is ready with lights, heating, and digital gadgets that can be controlled remotely via phone or thru the internet. a web primarily based domestic automation machine focuses on controlling home electronic devices whether you're interior or outdoor your home.

Internet of Thing (iots) is a major topic of our time and in our daily life. This led to a historic shift in technology, industry, and engineering in all respects. This technology is embodied in a huge assortment of sensors, tools and systems that intelligently connect across the network. This overall advancement in iots has set new standards for technology and data systems. Iots have changed our daily lives and the way we live in many ways. New iots products, such as internet devices, power management devices, and automation components, take us to the vision of a "smart home" that aims to provide intelligence, comfort, and safety inside the home. Iots further development and progress in the health field, which it has promised to provide within the smart home for the elderly and the disabled to provide the necessary health services at a low cost. Access to the Internet of

Things has become widely available to newspapers, articles, and the Internet, as it raises many issues and challenges that must be addressed in order to achieve the desired goal.

Some technologies have supported the smart home in many respects, which helped its progress and development. As an internal localization technology that enables us to find and track people through the Universal Mobile Telecommunications System (UMTS)[1].

Green energy sources are a great alternative to energy in our daily life, such as rechargeable batteries, photovoltaic energy (PV), fuel cell (FC) and wind turbine (WT)[2]. The advantages of these technologies are numerous, such as saving energy, lowering electricity bills, and reducing pollution.

Now, anyone, anytime, anywhere, can communicate and monitor anything via the Internet of Things. It is expected soon that these connections will form a very superior and vast dynamic network of iots. Every day a new idea or new feature in the Internet of Things is developed and presented to people to provide the necessary security and comfort. Today, the smartphone plays an essential and effective role in the field of Internet of things, through which you can control anything you want.

The NodeMCU (ESP8266) is like any other development board like Raspberry Pi or Arduino. It is handled and programmed on the Arduino program, which supports an Integrated Development Environment (IDE) for coding and uploading to the NodeMCU. With the help of this unit and the connection to the cloud computing servers, we can control and monitor the home from anywhere in the world, here it does not matter the distance, location or country you are in, we can simply access the home control interface from anywhere and see the developments, the system contains smart features that alert us By sending notifications if there is anything suspicious in the home such as fire, gas leak or theft, we can know the status of all devices connected to the system.

1.2 MOTIVATION

home automation makes our lives easier, more convenient and may allow decrease energy intake.

i. Turn on devices remotely (fan, water boiler, etc.)
ii. Schedule devices to work in specific times (TV, lights, air conditioner, etc.)
iii. Monitor your energy consumption.

1.3 THE PROPOSED PROJECT

In this proposed project, all devices and systems inside the house, such as doors, lighting, temperature, humidity, air conditioner, motion sensors, dust, smoke, home safety system and other devices are controlled through the NodeMCU (ESP8266) unit and the Web-based.

Figure 1.1: An example of a smart home network system.

1.4 ADVANTAGES

The ability to connect all devices and technologies in your home through only one interface, to deal with all devices and manage them from one location. The level of comfort and safety here is immense. This is a major step for home improvement and management.

Maximize internal security. Home protection is greatly increased by incorporating monitoring and security devices into your smart home network. This feature gives you many options. For example, smart surveillance cameras, motion detectors, and computerized door locks are attached to the home automation system so you can activate it with only one front before heading to bed. With a choice of several safety and security indicators.

Home monitoring and control. The ability to operate and manage home appliances from a distance. For example, when the weather is hot, you can order the house to get cooler while you are outside before returning home. You can also control the oven to heat it while you are on your way home to prepare dinner. You can also control the lights from your place with one click, check the door of the house, or check that all media is turned off while you exit.

Increased energy efficiency. It can make your home more energy efficient. For example, carefully managing heating and cooling inside the home through the use of a smart thermostat, the lighting can be activated automatically with the aim of saving energy through automatic lighting during entry or exit from rooms and the presence of evening mode at sunset to improve the lighting.

2. LITERATURE REVIEW

The smart home system has become popular in this age of technology especially with the rapid boom of the Internet. There are many smart home systems with distinctive technologies that have been implemented and which have different goals to achieve. Most rely entirely on the Android app and web based, which provides a personal interface for home tracking and remote control[3].

There are many different projects that are implemented on home automation in different countries. Where there is a difference in these projects in many ways, through features, designs, factors, tools, and programs. Designed according to the availability of ingredients, desire, and money, and after a long search, we found several articles.

There are many projects that have addressed the theme of smart home and how to control all devices remotely via smartphone and Android system and easy navigation between options within the home. How to connect devices to each other using Wi-Fi or Bluetooth, an Ethernet layer that supports IPv6, and a web interface that supports system access and control[4] [5] [6].

There are a lot of smart home systems that use Bluetooth or ZigBee technology to control devices within a certain range, and many built-in devices can be connected[7] [8].

There are systems that rely on camera inputs and sensors with different degrees of user access control, which rely heavily on password essentials and entry policies. It works by having a GSM network, which in turn sends text messages to the user to alert him of what is happening[9] [10] [11].

There are some projects that deal with the topic of indoor air quality, dust density, temperature and humidity using Arduino. The system consists of gas sensor, temperature and humidity sensor and particle dust sensor[12] [13].

There are many articles dealing with the topic of controlling all devices available inside the home through the WIFI unit, Ethernet shield and the web platform through the use of the Arduino interface and the GSM interface and the feature of sending an email to the user[14] [15] [16] [17].

In this reference[18], The Raspberry Pi unit was used to control the devices by sending and receiving email via Gmail to start and stop the devices, this process is done by processing and reading mail to carry out commands.

In this reference[19], A ZigBee Module was used to interact and communicate with network devices to control and monitor them. This technology works through several elements as the moderator is responsible for initiating and controlling the work on the network. It also stores information about the network, which includes information about protection and approved broadcast centers. As for the routers, they are responsible for dynamically expanding the network, providing a copy of the router settings, and providing Fault Tolerance technology, which means that other devices do not stop when one of the devices stops. As for the devices, they are only the devices that receive and transmit only.

In this reference[20], Here the NodeMcu module was used to control the devices through Wi-Fi connectivity via smartphone using the Adafruit platform and with the help of IFTTT which provides the web-based service. The audio recording feature was used to control and execute the information by voice control.

Some studies related to smart home systems have been reviewed and summarized, and the limitations and barriers affecting home automation systems in general have been reviewed. Our current system aims to bypass the current limitations and develop the system in terms of efficiency and flexibility.

3. BRIEF INTRODUCTION OF ALL THE COMPONENTES

3.1 INTRODUCTION

Here we will look at the used components, sensors, and software. It is crucial to know the data related to each unit and every piece of equipment. The elements used are:

i. NodeMCU (ESP8266)
ii. Sensors:
- Gas Sensor MQ-2 (SEN 00091)
- AM2302 (wired DHT22) temperature-humidity sensor

iii. 1 Channel Relay Module (Active Low Control)
iv. Breadboard
v. Power supply (5V DC)
vi. Active Buzzer (LTE12)
vii. Resistor (220Ω)
viii. Led (T-1 3/4)
ix. Toy DC Motor

3.2 NODEMCU (ESP8266)

NodeMcu (ESP8266) provides flexibility for building an IoT based application which is open source firmware[20]. The NodeMcu Module (ESP8266) is the first choice for IoT applications in recent times, for several distinct reasons, the lower cost, and its features that support Wi-Fi. And it saves Nodejs, which takes little time in the account to perform the tasks.

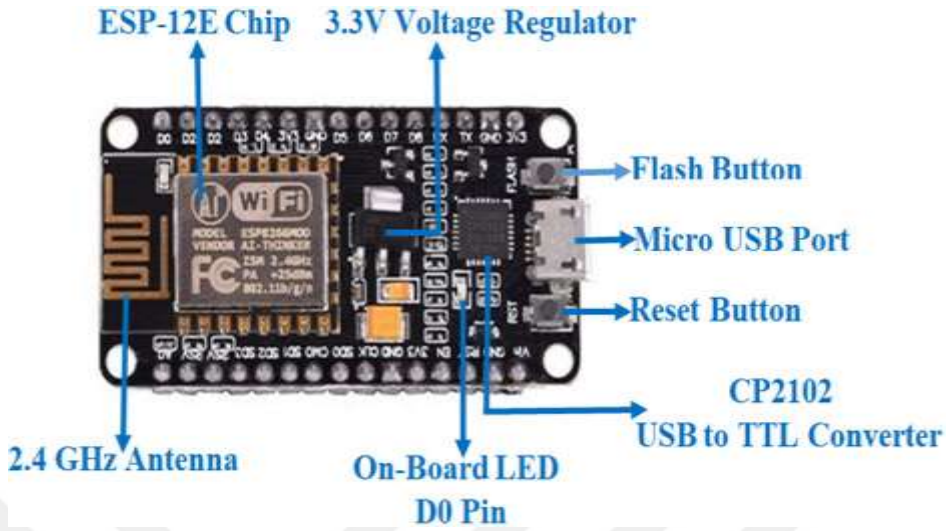


Figure 3.1: NodeMCU (ESP8266)

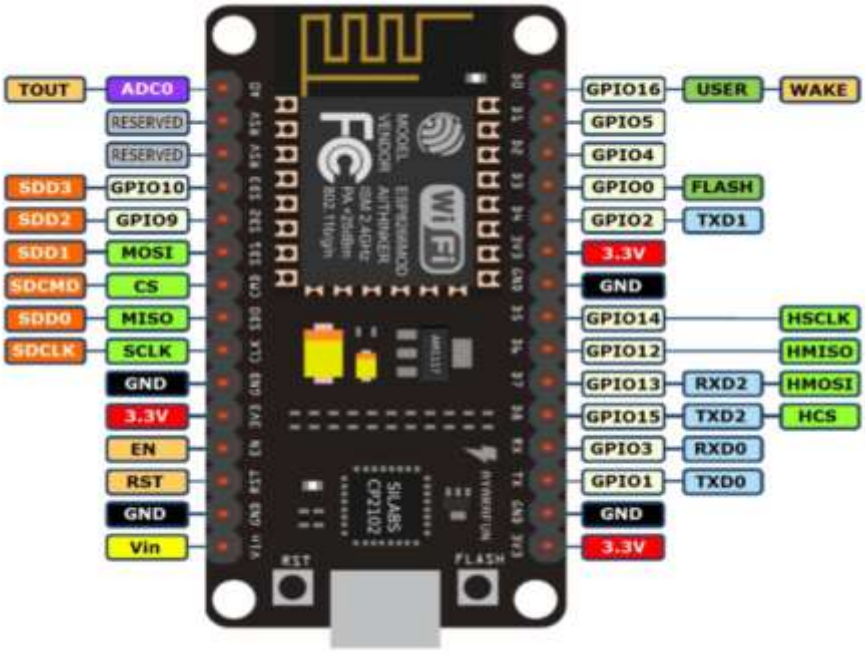


Figure 3.2: NodeMCU (ESP8266) Pinout Diagram.

Technical Specifications:

Table 3.1: Technical specifications of NodeMCU (ESP8266).

Categories	Items	Parameters
Wi-Fi	Certification	Wi-Fi Alliance
	Protocols	802.11 b/g/n (HT20)
	Frequency Range	2.4 GHz – 2.5 GHz (2400 MHz – 2483.5 MHz)
	TX Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: –91 dbm (11 Mbps)
		802.11 g: –75 dbm (54 Mbps)
		802.11 n: –72 dbm (MCS7)
	Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware	CPU	Tensilica L106 32-bit processor
	Peripheral Interface	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/ADC/PWM/LED Light & Button
	Operating Voltage	2.5 V – 3.6 V
	Operating Current	Average value: 80 mA
	Operating Temperature Range	–40 °C – 125 °C
	Package Size	QFN32-pin (5 mm x 5 mm)
	External Interface	-
Software	Wi-Fi Mode	Station/SoftAP/SoftAP+Station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Software Development	Supports Cloud Server Development / Firmware and SDK for fast on-chip programming
	Network Protocols	IPv4, TCP/UDP/HTTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

3.3 BREIDF INTRODUCTION TO THE SENSORS

An overview about the used sensors is provided below.

3.3.1 Gas Smoke Sensor (MQ-2)

The sensor module (MQ2) is the gas sensor module used for gas leak detection (in industry and home). The sensor detects flammable gases, smoke, and other gases.

Figure 3.3: MQ-2 Gas Sensor

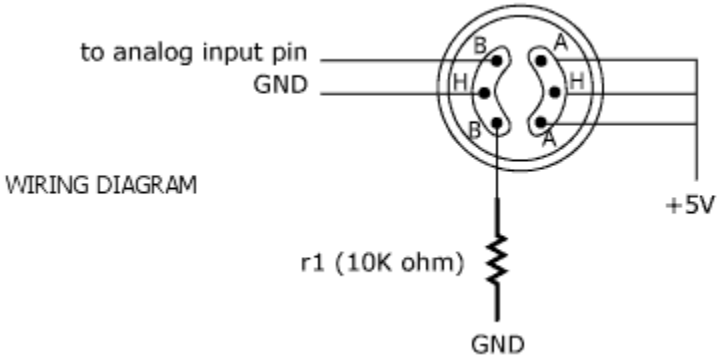


Figure 3.4: Pinout diagram of gas sensor.

Technical Specifications:

Table 3.2: Technical specifications of sensor MQ-2.

A. Standard work condition

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
V_H	Heating voltage	5V±0.1	ACOR DC
R_L	Load resistance	can adjust	
R_H	Heater resistance	33 Ω ± 5%	Room Tem
P_H	Heating consumption	less than 800mw	

B. Environment condition

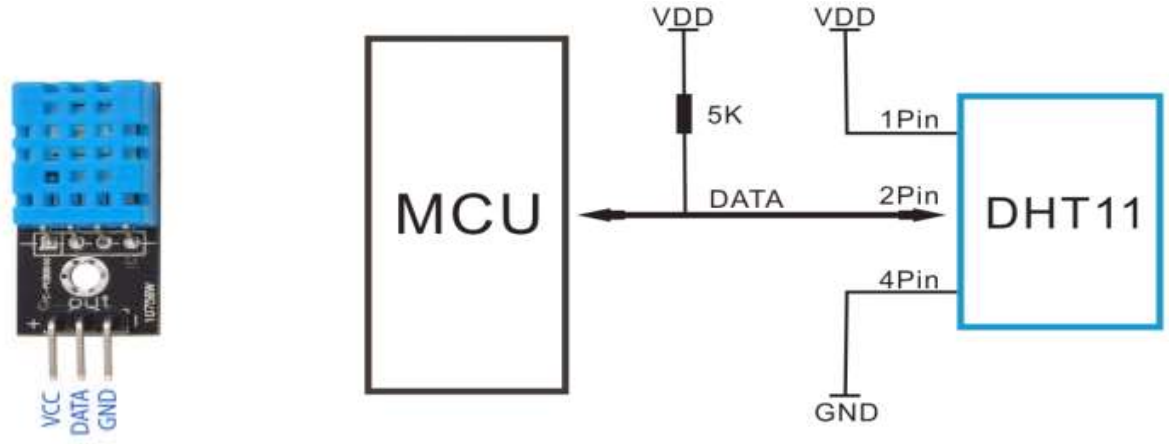
Symbol	Parameter name	Technical condition	Remarks
Tao	Using Tem	-20℃-50℃	
Tas	Storage Tem	-20℃-70℃	
R_H	Related humidity	less than 95%Rh	
O_2	Oxygen concentration	21%(standard condition)Oxygen concentration can affect sensitivity	minimum value is over 2%

C. Sensitivity characteristic

Symbol	Parameter name	Technical parameter	Remarks
Rs	Sensing Resistance	3KΩ-30KΩ (1000ppm iso-butane)	Detecting concentration scope: 200ppm-5000ppm LPG and propane 300ppm-5000ppm butane 5000ppm-20000ppm methane 300ppm-5000ppm H_2 100ppm-2000ppm Alcohol
α (3000/1000) isobutane	Concentration Slope rate	≤0.6	
Standard Detecting Condition	Temp: 20℃±2℃ Humidity: 65%±5%	Vc:5V±0.1 Vh: 5V±0.1	
Preheat time	Over 24 hour		

3.3.2 Temperature and Humidity Sensor (DHT11)

The DHT11 unit is a high precision temperature and humidity sensor. It has great performance that makes it ideal for long-term temperature and humidity monitoring. And with high performance 8-bit fine control connected.



(a) (b)

Figure 3.5: (a) Pin arrangement of temperature and humidity sensor (DHT11), (b) Typical application

Detailed Specifications:

Table 3.3: Detailed specifications of temperature and humidity sensor (DHT11).

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

Electrical Characteristics:

Power supply: DC 4.9～5.1V

Supply current: Measure 0.3mA Standby 60μA

3.4 INTRODUCTION OF THE DEVICES

Here is a brief introduction to the devices used:

3.4.1 Toy Dc Motor

DC Motor is a DC electric motor that is easy to use and control and is extremely durable and has a wide range of voltage levels. These motors can rotate in either the left or right direction and can also control speeds.

Figure 3.6: Toy DC Motor Wiring.

Motor Specifications:

Table 3.4: Specifications of dc motor

Operating Voltage	4.5V to 9V
Recommended/Rated Voltage	6V
Current at No load	70mA (max)
No-load Speed	9000 rpm
Loaded current	250mA (approx)
Rated Load	10g*cm
Motor Size	27.5mm x 20mm x 15mm
Weight	17 grams

3.4.2 1 Channel Relay Module (active low control)

A relay is a device that works with electricity. Through it, we can control the outputs and inputs through the control system that it contains. It runs automatically from the commands given to it. It simply functions as an automatic switch to control a high current circuit with a low current signal.

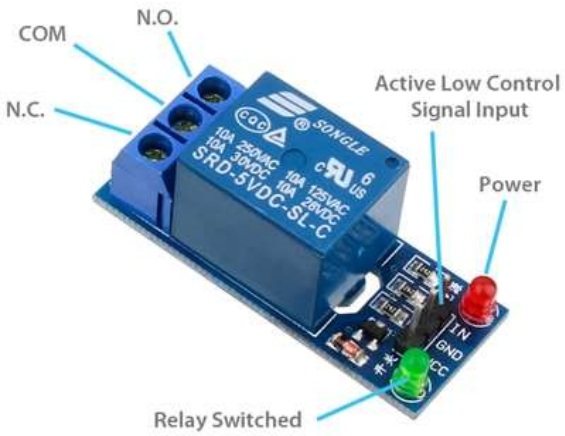


Figure 3.7: 1 Channel Relay Module (Active Low Control).

Specifications:

Table3.5: Specifications of 1 channel relay module.

Supply Voltage	3.75 to 6 V
Supply Current with Relay De-Energized	2 mA
Supply Current with Relay Energized	70 to 72 mA
Input Control Signal	Active Low
Input Control Signal Current	1.5 to 1.9 mA
Relay Max Contact Voltage	250 VAC or 30 VDC
Relay Max Contact Current	10 A
Dimensions	
Length	43 mm (1.69")
Width	17.5 mm (0.69")
Height	17 mm (0.67")
Weight	13 g (0.459 oz)

3.4.3 Active Buzzer (LTE12)

The Piezo Buzzer unit is an alarm bell. This unit is the alarm source for this system. Ringing starts when gas and smoke leaks are detected.

Figure 3.8: Active Buzzer (LTE12).

Specifications:

Table 3.6: Specifications of active buzzer (LTE12).

Type	Unit	LTE12-03	LTE12-05	LTE12-12
Rated Voltage	V	3	5	12
Operating Voltage	V	2-5	4-8	8-15
*Rated Current(MAX)	mA	30	30	30
*Min Sound Output at 10cm	dB	80	85	85
*Resonant Frequency	Hz	2300±300		
Operating Temperature	℃	-20 ~ +70		
Storage temperature	℃	-30 ~ +105		

3.4.4 Led (T-1 3/4)

An LED is a light-emitting diode. It has many different colors.

It is an electronic device that emits light when an electric current pass through it.

Figure 3.9: Led (T-1 3/4).

Technical Data Sheet:

Table 3.7: Technical data sheet of led (T-1 3/4).

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Rating	Unit
Continuous Forward Current	I_F	30	mA
Peak Forward Current(Duty /10 @ 1KHZ)	I_{FP}	100	mA
Reverse Voltage	V_R	5	V
Operating Temperature	T_{opr}	-40 ~ +85	℃
Storage Temperature	T_{stg}	-40 ~ +100	℃
Soldering Temperature (T=5 sec)	T_{sol}	260 ± 5	℃
Power Dissipation	P_d	100	mW
Zener Reverse Current	Iz	100	mA
Electrostatic Discharge	ESD	4K	V

4. METHODOLGY

4.1 INTRODUCTION

In this project, we present a low-cost wireless controller to control and track the home environment. The wireless NodeMCU and the built-in internet server are used to access and control all devices through only one interface, which is used from any device, be it a smartphone or laptop. The NodeMcu mini module was programmed by the Arduino IDE app. Through this interface, all devices and sensors are controlled and monitored. The interface requires you to create your own account for security and to gain acceptance into the device when opening the platform. Voice activation of switch software has also been integrated to help mainly to the elderly and the handicapped.

4.2 SYSTEM DESIGN AND IMPLEMENTATION

The proposed system uses WIFI and telephone services to connect to the Internet and access the control platform. The system includes a smart home web page, network server and NodeMcu as the main console that connects and controls devices by receiving and sending information and data from the user platform. The proposed smart home system includes various capabilities such as user authentication, fire and safety system with siren indicators, alarm notifications, and automatic home appliance management. The main objective of the system is to control and monitor the proposed devices from anywhere in the world and from any country. In our proposed system, voice control is used to access and control devices through specific voice commands. Voice control is one of the most important achievements of our time to facilitate access and assist users with special needs, the elderly and those with severe illnesses. The system is supported by voice control along with the proposed web platform to provide more powerful features for the proposed home automation system, and the NodeMcu small unit automatically communicates with the assigned server by programming this unit, to receive commands and send them for execution, as shown in the Figure 4.1.

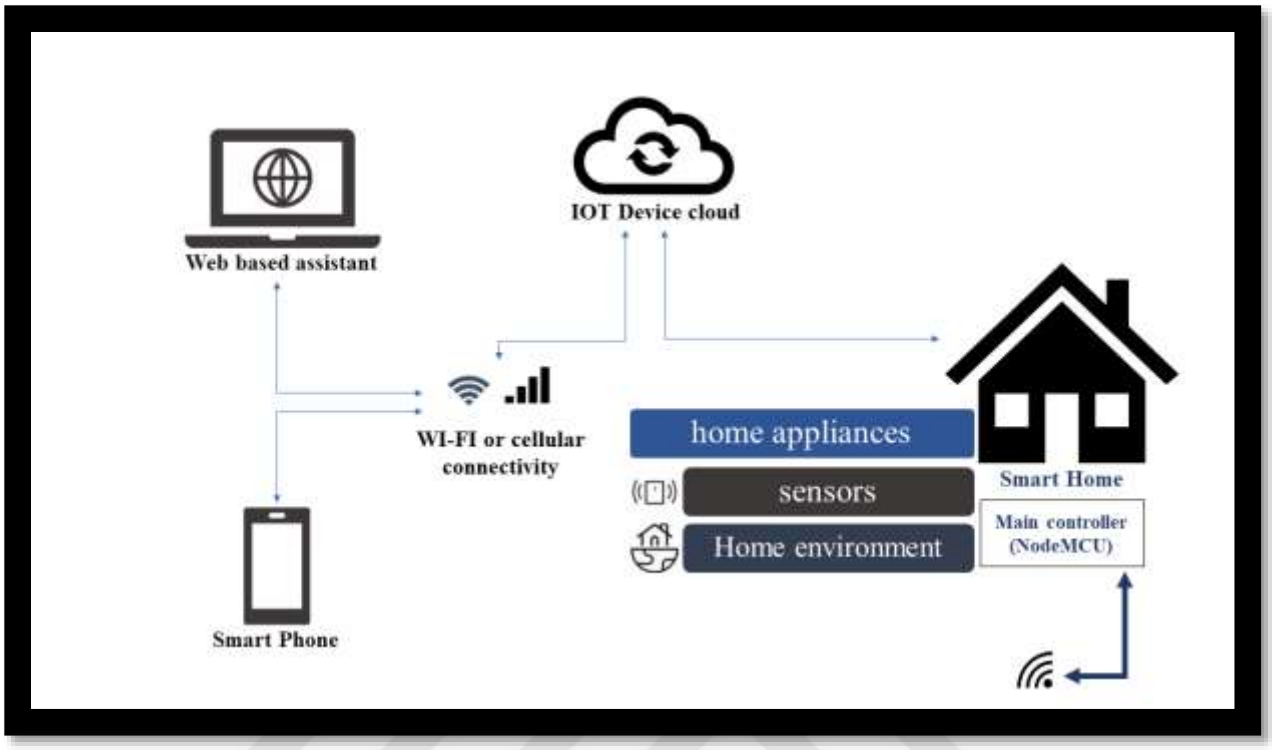


Figure 4.1: Smart home automation system architecture.

4.2.1 System Requirement

i. NodeMcu (ESP8266).
ii. Web Page (PHP, MYSQL, HTML, jQuery).
iii. Arduino Software (IDE).
iv. Android application (Android Studio).

NodeMcu (ESP8266) provides flexibility for building an IoT based application which is open source firmware[20]. The NodeMcu Module (ESP8266) is the first choice for IoT applications in recent times, for several distinct reasons, the lower cost, and its features that support Wi-Fi. And it saves Nodejs, which takes little time in the account to perform the tasks.

The web page is programmed and shaped using the following applications and software (PHP, MYSQL, HTML, jQuery). An Android application was created via (Android Studio) linked to the web page for ease of access and control. The page was protected by logging in to the user to avoid piracy problems in order to provide the necessary privacy for the user, and the page was provided with voice controller to make the system more flexible and efficient with manual control as shown

in the figure 13 and 15. The information is executed and processed by this page via a global server. The Arduino IDE program was used to compile the code.

The system is equipped with a feature to alert you in the event of something suspicious in the house, such as a fire, gas leak, or theft. The user is notified by sending an electronic notification of the existing problem, as shown in the figure 14.

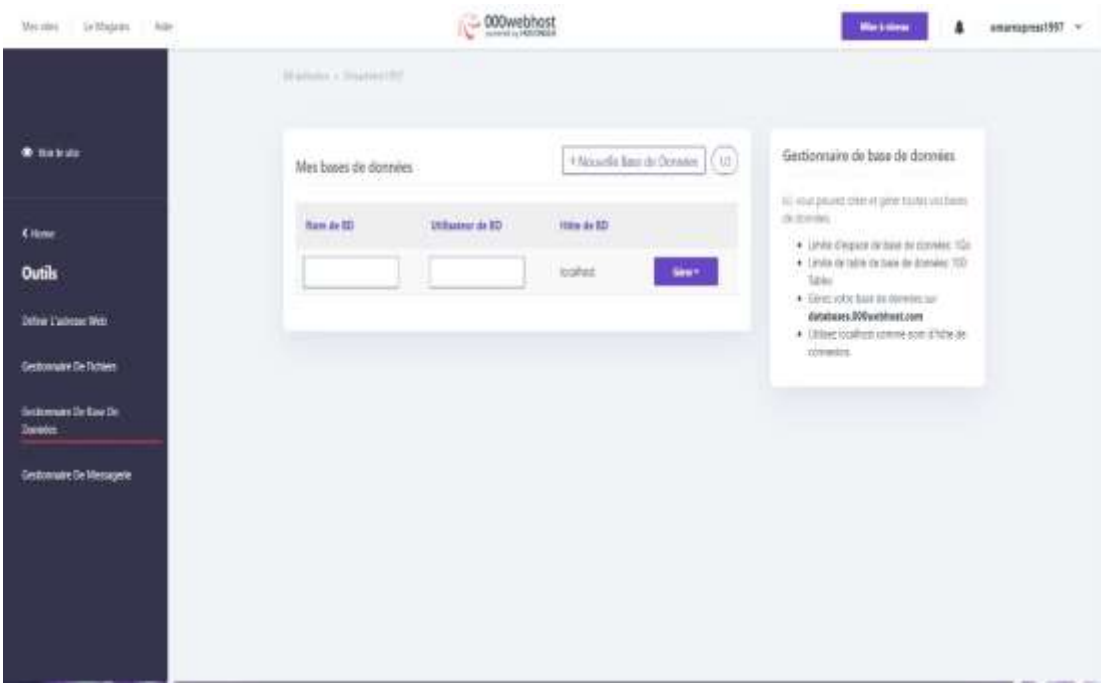


Figure 4.2: Web page programming interface.

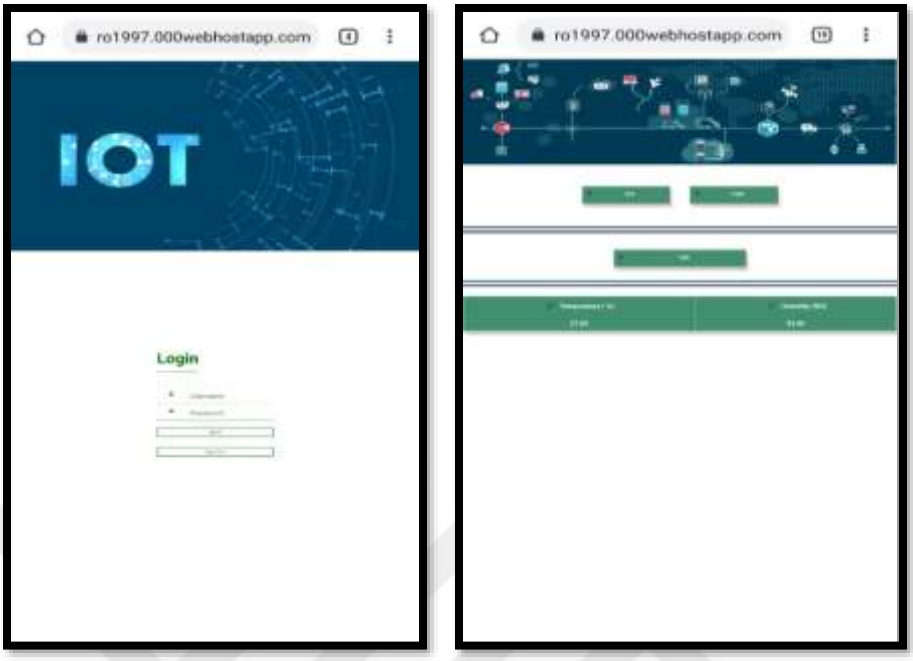


Figure 4.3: Web page interface.

Figure 4.4: Email interface when there is an urgent alert at home.

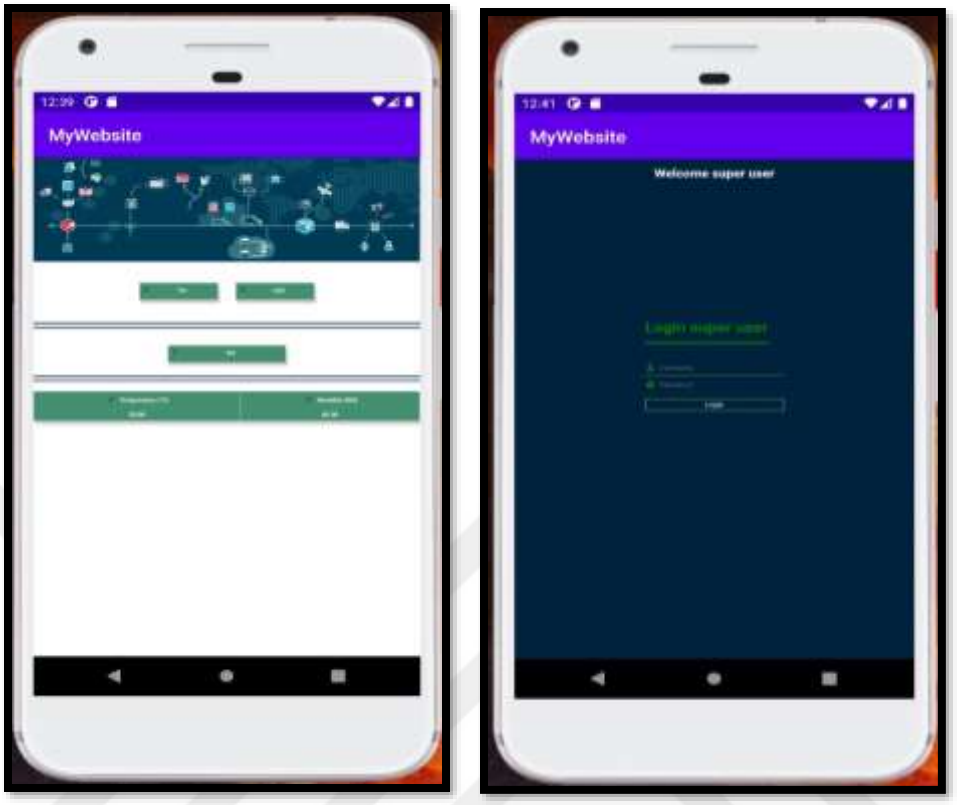


Figure 4.5: Application Interface.

4.2.2 Working Models

Figure 4.6 shows how smart home automation works. As explained below, internet connection is required as a prerequisite for accessing and controlling a smart home. The user accesses his smart home through the created web page.

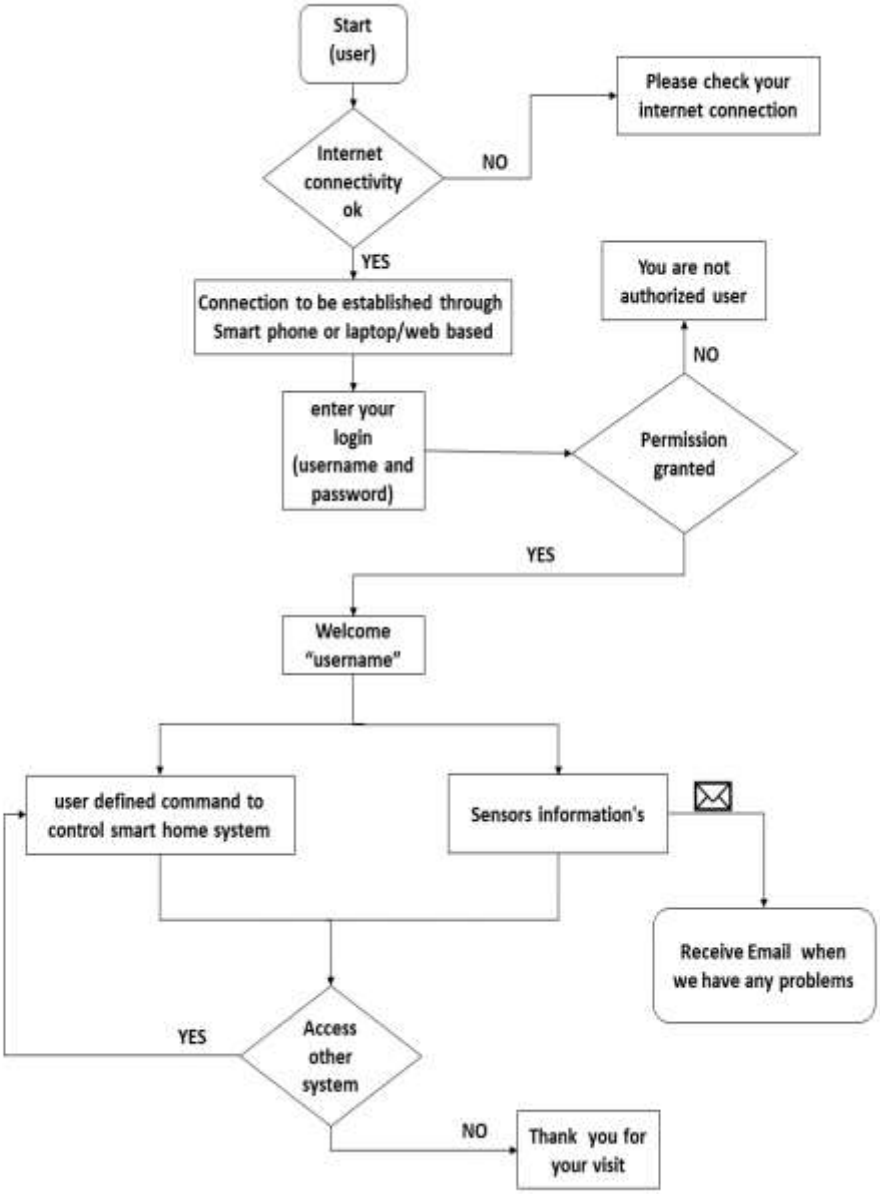


Figure 4.6: System flow on the smart home automation system

First, the smart home is controlled via the web page or application that has been linked to the page to facilitate user access to control and monitor the smart home. Controlled here by voice control and manual control of the user page. The user has been assigned an access code for security purposes, which is required by the web page for security and privacy, and to prevent unauthorized access to the smart home.

After verifying the success of the connection, the user will be able to access and control his devices through the web page or the application. Here a connection is established between the web page and the NodeMCU smart home automation main console. The page control functions include ON/OFF switches for home appliances and the voice control to control by giving voice commands and monitoring the environment through sensors that display what you read such as temperature, humidity, movement, fire detection, gas leaks, and others. Which is displayed directly on the web page. The user is notified through the arrival of an email when a problem occurs within the home to solve it and provide safety and protection for the smart home.

A new feature called Unique Username has been added. This feature allows us to add a new user who can access and control smart home systems by logging in with a username and access code to access the web page or app for control and monitoring. Here the super user is added by the system owner or the project founder. The advantage of this addition is that it allows many people to become users of the system within the same house, such as wife and children, through their own phones. If anyone is busy, others stay aware of what is happening in the home and control and monitor devices. Users also receive an email alerting them if there is a danger inside the home.

In this paper, a small example of a main controller designed for a smart home is covered. Existing devices (led and dc motor) and sensors (temperature, humidity, and gas sensor) were connected to the NodeMcu main control unit, and then were linked to an IoT server to access and execute commands. The figure 18 shows the connection of devices and sensors to NodeMcu.

The user controls the proposed home automation systems through the web page or the application. The user can control the devices manually through the ON/OFF buttons and through the Google Assistant by executing voice commands. Sensors alert us to the occurrence of a danger by sending an e-mail to the user. We can augment and connect any devices and sensors in this proposed design and control them.

Through Relay, we can connect any electrical device in the house in order to control it through the control interface and continuously monitor devices such as the refrigerator, heater, air conditioner and fans, etc.

The system has been studied and followed in terms of speed of response to specific commands and rate of energy consumption. The system responded successfully and completely in terms of quick execution of orders, and the power consumption was very low. Most of the information and studies that have been submitted to the system through the data sheet for each device and through immediate monitoring by calculating the time that the system takes to execute the orders. Hardware response times to commands are very approximate. The figure 17 shows power consumption and system response.

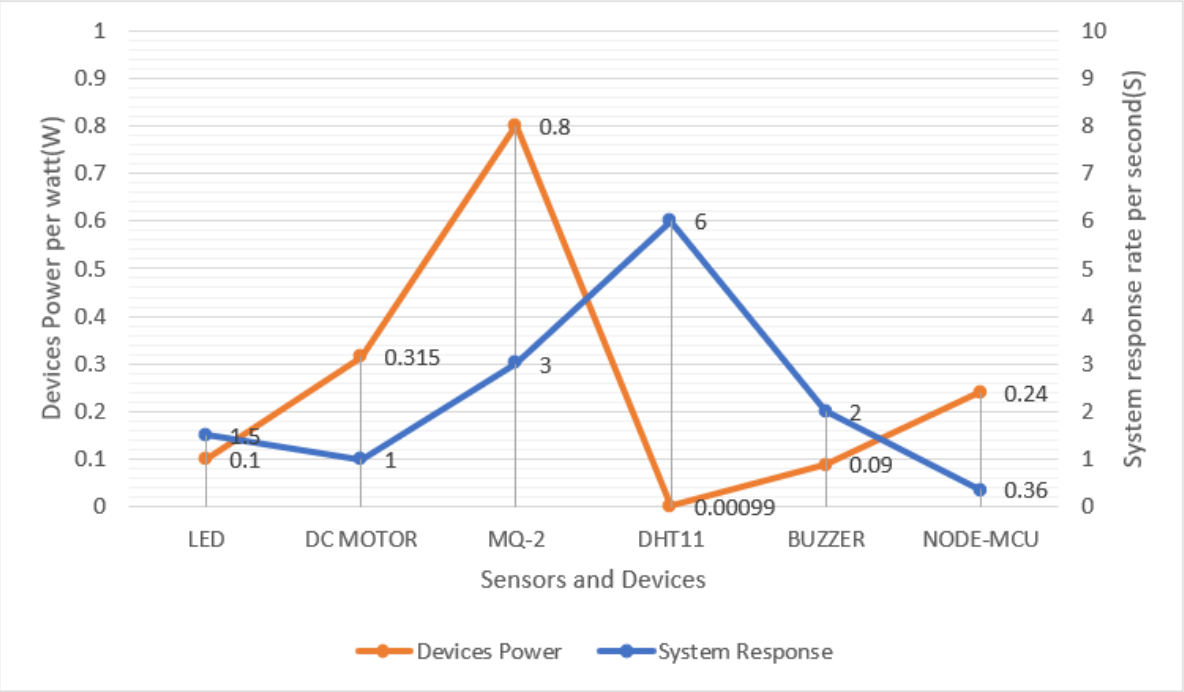


Figure 4.7: The rate of energy consumption and response to commands in the system.

The information provided to the devices and sensors and their energy consumption in the system as shown in the data sheet is as follows:

1. Temperature and humidity sensor response rate (MQ-2).

Relative Humidity: Response time → 1/e (63%)25℃ 6s

1m/s Air 6s

Temperature: Response time → 1/e (63%) 10S

Electrical Characteristics:

Power supply: DC 3.3～5.5V

Supply current: Measure 0.3mA Standby 60μA

Sampling period: Secondary Greater than 2 seconds

2. Gaz sensor (DHT11).

Response time → 3 second

Electrical Characteristics:

Power supply: DC 4.9～5.1V

3. NodeMCU (ESP8266).

Response time→ jumps from 0.03 to 1 second if incoming POST payload is >1024 bytes

Electrical Characteristics:

Operating Voltage: DC 2.5 V ~ 3.6 V

Operating Current Average value: 80 mA

4. Active Buzzer (LTE12)

Response time → from 2 to 3 second

Electrical Characteristics:

Rated Voltage: DC 3～5V

Rated Current (MAX): 30 mA

5. Led (T-1 3/4)

Response time → from 1 to 2 second

Electrical Characteristics:

Rated Voltage: DC 5V

Rated Current: 30 mA

6. Toy DC Motor

Response time → from 1 to 2 second

Electrical Characteristics:

Operating Voltage: 4.5V to 9V

Current at No load: 70mA (max)

Loaded current: 250mA (approx)

No-load Speed: 9000 rpm

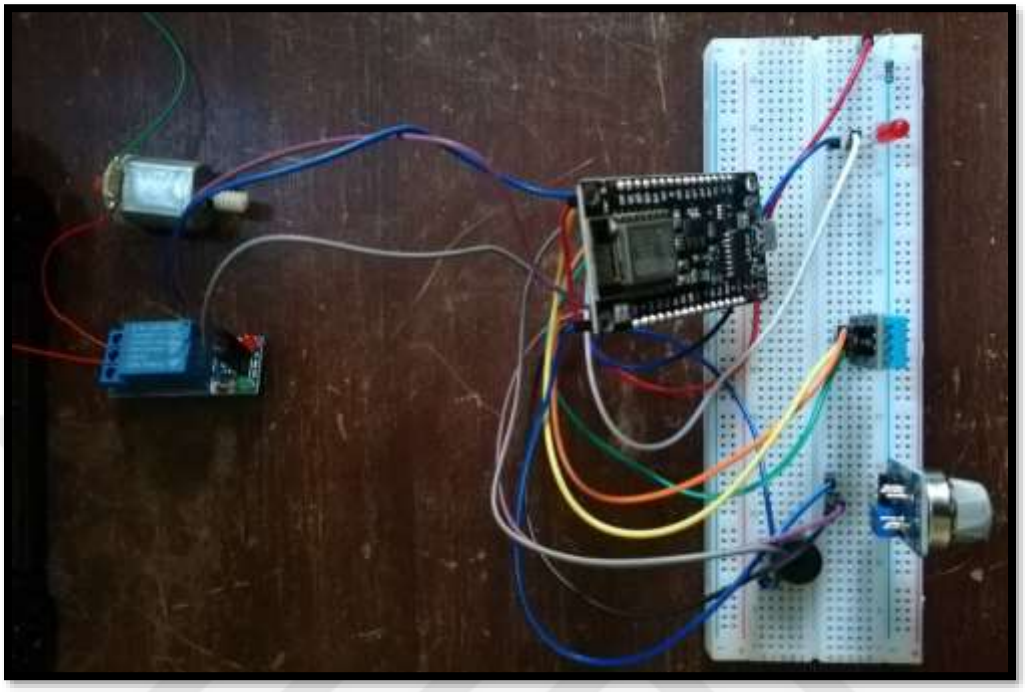


Figure 4.8: Internal architecture of the controller unit.

4.3 PROGRAMMING NODEMCU (ESP8266)

For interaction between NodeMcu and the application used in this project, some software (code) is loaded into NodeMcu.

Arduino provides an easy-to-use program known as IDE which allows you to write any code for any function that the Arduino requires and upload it to the whiteboard.

An integrated development environment (IDE) is a software suite that integrates the basic equipment required to codify and verify programs.

Figure 4.9: Integrated development environment program interface.

4.4 CONNECTING NODEMCU (ESP8266) TO WIFI

A link between NodeMcu and available WIFI is required for user access in order to control the system.

WIFI Shield on NodeMcu allows connection to available internet. In order for the NodeMcu unit to function fully, it must be connected to the computer using a USB cable in order to download the codes to it, and through programming, the available wireless connection is determined by entering the password and the access code to connect the NodeMcu to the Internet.

4.5 CONNECTING THE APPLIANCES TO NODEMCU (ESP8266)

Each device and every connected sensor must be verified in its appropriate position on the NodeMcu module and the location of all inputs and outputs must be verified, then the code is uploaded to the NodeMcu module to start the work of the board, then we verify the wireless connection by calling over the phone and checking the application that appears through it All devices.

After everything is ready, we can now connect the phone via WIFI or phone network and access our web page or app to control and monitor all home appliances.

5. EXPERIMENTAL RESULTS AND VALIDATION

In this section, system functionality results are displayed and verified from the applicable model for home automation systems. Thus, the NodeMcu module (ESP8266) successfully controls the devices and sensors (LED, DC Motor, temperature humidity sensor and gas sensor) through the created web page which enables us to access and control the devices either by manual control ON/OFF or via Voice control.

The proposed system allows us to access and monitor devices from anywhere in the world using an Internet of Things device cloud. The system was tested with manual and voice ON/OFF commands to operate the devices from another country via the user interface (web page) or the application. The system works successfully and efficiently, the system displays on the user interface the temperature and humidity inside the house through the sensor (DHT11), and the gas and smoke sensor (MQ2) senses the risks in the event of a gas leak or a fire inside the house and works efficiently through the experience by setting the alarm (BUZZER) when we are at home and if we are outside the house an email is sent to alert us of the dangers.

The superuser feature has been verified and has fully worked by adding new users to the system to access and control the devices through their own username and password. Only the owner of the system or program creator can add a distinguished user when he wants to.

The project presented a completely successful business in terms of efficiency and flexibility of use. The commands were executed through manual control and voice control to access the system and ease of control through the web page or the application. The system provides assistance and comfort in controlling and monitoring the home environment for the elderly and the disabled.

6. CONCLUTION AND FUTURE WORKS

This study presents a flexible and cost-effective IoT home automation system. The actuators and sensors were connected to the NodeMcu to continuously control and monitor it through the web interface, or the application created to access and control devices from anywhere in the world, which in turn updates the data to the IoT server. The home environment is monitored through the data that is updated on the web page via a smartphone or laptop. An email is also sent to inform us if there is a danger inside the home for safety and security purposes. Devices are controlled easily and efficiently through the web page, either by manual operation ON/OFF or via voice control. The results of this study are promising, and additional actuators and sensors can be added to the system, and the security, safety, intelligence and comfort of the user at home can be increased through the developed system, and we can benefit from developing this model to market it in the future due to its low cost and ease of use. And saving the energy source through green energy which is a great alternative. Such as rechargeable batteries, photovoltaic (PV) power, fuel cell (FC) and wind turbine (WT).

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CODES

```
/**Author: yehya el mohamad
   Internet of Things Project**/
#include <Arduino.h>
#include <ESP8266WiFi.h>
#include <ESP8266WiFiMulti.h>
#include <ESP8266HTTPClient.h>
#include <WiFiClient.h>
#include "DHT.h"
DHT dht;
int Buzzer=2;//D4
int SensorGaz=A0;
const uint8_t D1=5;//led
const uint8_t D2=4;//data DHT11
const uint8_t D5=14;//Fan
int id=1;
int t=0;
String previoustemp="None";
void SensTemHum();
void Connection(String Host,int idHost);
void GetInfoDevices();
void SensGaz();
ESP8266WiFiMulti WiFiMulti;
String Data;
void setup() {

  Serial.begin(115200);
  // Serial.setDebugOutput(true);
  pinMode(D1,OUTPUT);
```

```
  pinMode(D5,OUTPUT);
  digitalWrite(D5,0);
  digitalWrite(D1,0);
  Serial.println();
  Serial.println();
  Serial.println();
//  Serial.println("Status\tHumidity (%)\tTemperature (C)\t(F)");
  pinMode(SensorGaz,INPUT);
  dht.setup(D2);   /* set pin for data communication */
  for (uint8_t t = 4; t > 0; t--) {
    Serial.printf("[SETUP] WAIT %d...\n", t);
    Serial.flush();
    delay(1000);
  }
  WiFi.mode(WIFI_STA);
//  WiFiMulti.addAP("Yehyaa", "yehya#$@1122");
WiFiMulti.addAP("IOT", "yehya123");
}
void loop()
{
  GetInfoDevices();
  SensTemHum();
  //SensGaz();
}
void GetInfoDevices()
{
  String site="http://omarterro1997.000webhostapp.com/data_arduino.txt";
  Connection(site,1);
  delay(1000);
}
```

```
void SensTemHum()
{
    delay(dht.getMinimumSamplingPeriod());  /* Delay of amount equal to sampling period */
    float hum = dht.getHumidity();     /* Get humidity value */
    float temp = dht.getTemperature(); /* Get temperature value */
    String temperature=String(temp);
    String humidity=String(hum);
    if(previoustemp!=temperature)
      {
       previoustemp=temperature;
       String
site="http://omarterro1997.000webhostapp.com/connect.php?id=1&temperature="+temperature
+"&humidity="+humidity;
       Connection(site,0);
       delay(5000);
      }
}
//GetDataSensorTemp.php
void SensGaz()
{
 int analogSensorGaz=analogRead(SensorGaz);
 Serial.println("SensorGaz:"+String(analogSensorGaz));
 if(analogSensorGaz>=70)
  {
   String
site="http://omarterro1997.000webhostapp.com/GetDataSensorTemp.php?gazSensorID=1";
   Connection(site,0);
   digitalWrite(Buzzer,HIGH);
   Serial.println("Gaz detecting");
  }
else
```

```
 {
   String
site="http://omarterro1997.000webhostapp.com/GetDataSensorTemp.php?gazSensorID=0";
   Connection(site,0);
   digitalWrite(Buzzer,LOW);
   Serial.println("Gaz not detecting");
 }
 delay(5000);
}
void Connection(String Host,int idHost)
{
  if ((WiFiMulti.run() == WL_CONNECTED)) {
    WiFiClient client;
    HTTPClient http;
    if (http.begin(client,Host)) {  // HTTP
      //Serial.print("[HTTP] GET...\n");
      int httpCode = http.GET();
      if (httpCode > 0) {
        //Serial.printf("[HTTP] GET... code: %d\n", httpCode);
        if (httpCode == HTTP_CODE_OK || httpCode ==
HTTP_CODE_MOVED_PERMANENTLY) {
          Data= http.getString();
          Serial.println(Data);
          if(idHost==1)
          {
               if(Data=="Light ON")
                 {
                   digitalWrite(D1,1);
                   Serial.println("Light arduino ON");
                 }
```

```
            if(Data=="Light OFF")
              {
               digitalWrite(D1,0);
               Serial.println("Light arduino OFF");
              }
             if(Data=="Fan OFF")
              {
               digitalWrite(D5,1);
               Serial.println("Fan arduino OFF");
              }
            if(Data=="Fan ON")
              {
               digitalWrite(D5,0);
               Serial.println("Fan arduino ON");
              }
        }
     }
    } else {
      Serial.printf("[HTTP] GET... failed, error: %s\n", http.errorToString(httpCode).c_str());
    }
    http.end();
  } else {
    Serial.printf("[HTTP} Unable to connect\n");
  }
}
}
```