THANTHAI PERIYAR GOVERNMENT INSTITUTE OF TECHNOLOGY

VELLORE-02.

HOME AUTOMATION USING IOT

A MINI PROJECT REPORT

Submitted by

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In partial fulfillment for the award of degree

of

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IN

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ANNA UNIVERSITY,

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THANTHAI PERIYAR GOVERNMENT INSTITUTE OF TECHNOLOGY

VELLORE-02.

BONAFIDE CERTIFICATE

This is to certify that the mini project report entitled **HOME AUTOMATION SYSTEM** Projectis a bonafide record of the project work done by **ANUSHIYA K [513120104002], GAYATHRI M [513120104008], SANDHIYA S [513120104029**], **THENMOZHI A [513120104040**], during the academic year 2021-2022 towards the partial fulfillment of the requirement of the award of BE Degree in **COMPUTER SCIENCE AND ENGINEERING** of Anna University, Chennai - 600025.

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ABSTRACT

The Internet of Things (IoT) is a network of interconnected processing devices where everything, even physical items, may be connected, making them smart, programmable, and suitable for interacting with people. The Internet of Things (IoT) and its practical applications for enabling smart communication between humans and machines as well as between machines can bring about significant change in the world in the current technological era, where enormous amounts of data are produced daily. The proposed framework is focused on the development of a home automation system based on the internet of things, allowing the client to computerize all of their home's appliances and combine them to provide constant control over every area of their residence. The proposed framework is focused on the development of a home automation system based on the internet of things, allowing the client to computerize all of their home's appliances and combine them to provide constant control over every area of their residence.

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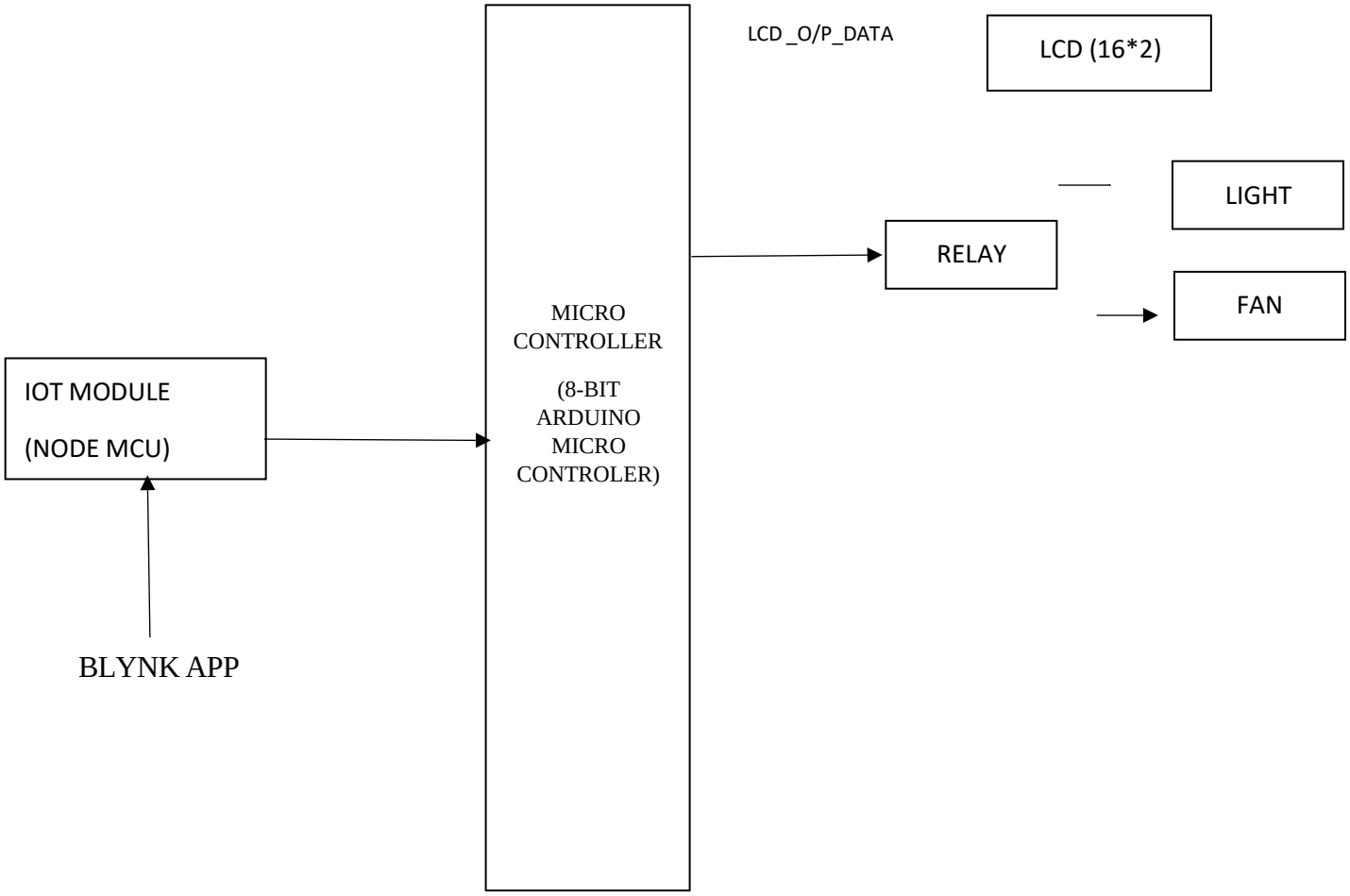
LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATION
IOT	Internet of Things
NodeMCU	Node Micro Controller Unit
Wi-Fi	Wireless Fidelity
HAS	Home Automation System
PCB	Printed Circuit Board
USB	Universal Serial Bus

LOCK DIAGRAM



CHAPTER 1

INTRODUCTION

The automated and electronic administration of house features, activities, and appliances is referred to as "home automation." Simply said, it implies that you may control your home's utilities and features online, making your life more comfortable and secure while also lowering your utility costs. The Internet of Things (IOT) is a concept in which each gadget is assigned a unique IP address that allows anyone to categorise that specific object on the internet. The automated and digitalized devices have unique IDs and the ability to communicate knowledge over the internet without involving any human or machine-to-machine or computer-to-computer interaction. In essence, it is taking place as a result of the computer network's connectivity. The range of objects known as "things" that will be connected to the internet and be referred to as the "Internet of Things" is expected to develop rapidly, according to analysis studies. The advancements in technology nowadays permit the use of wireless dominant environments, such as Bluetooth- or Wi-Fi-based technologies, which acceptably allow completely different devices to possess the capability of communicating with one another. Using a Wi-Fi shield to act as a small internet server for an Arduino-based system eliminates the need for a wired connection between the computer and the Arduino-based system, which reduces value and enables it to be defined as a standalone device. The Wi-Fi defence requires connection to the internet from a router or hotspot, which might serve as the gateway for the Arduino-based system to access the internet. Many other forms of connections, including the World System for Mobile Communications, Wi-Fi, and Bluetooth Technology, have been launched in the contemporary environment of advancement of wireless technology. Every organisation has its own unique specs and applications. Due to its suitable capabilities, Wi-Fi is utilised to select among the three widely used wireless-based connections that are always mandated in home automation systems.

1.1 OBJECTIVE

ESP 8266 Wi-Fi module will be used in the design and implementation of the home automation system, connecting sensors and electronic equipment. It connects to the cloud via a Wi-Fi network and communicates wirelessly with peripheral devices to accept commands from gadgets like laptops and smartphones. It will take commands from the user via IOT over Cloud to control the home appliance. With the aid of the system, the user can take action as needed. The sensor data is sent to the cloud using the Wi-Fi module. Electronic gadgets are regulated using machine learning rules that take user behavior into account. Rules are being developed based on the data gathered toenable appliances to respond in accordance with observed user behavior.

1.2 PROBLEM STATEMENT

Existing technologies often consist of traditional wall switches that are dispersed around the home. As a result, users must manually operate by pressing buttons to turn on or off appliances. The elderly and certain physically disabled persons will find it very difficult to use because it requires more manual labour and takes more time. There will always be someone who forgets to turn off any unneeded electrical appliances when they leave their home because being careless is a human fault. This will result in significant energy waste from electricity use and raise the danger of global warming. The majority of individuals in the world now have jobs, and some of them enjoy travelling abroad. The busy user lacks the time to gather their home's information. Rules are being developed based on the data gathered to enable appliances to respond in accordance with observed user behavior..

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

Systems for automating the home that use Bluetooth, an Arduino board, and a smartphone are safe and affordable. a solution for home automation that uses Bluetooth. A computer or smartphone serves as the receiver device in the Bluetooth system. It can be used as a real-time system because of its high communication rate, excellent security, and inexpensive cost. One of the primary drawbacks of Bluetooth-based home automation systems is their 10-meter range, which makes it impossible for smartphones to control appliances when they are outside of range. A home automation system based on speech recognition is suggested. Bluetooth technology is used for the wireless communication between the smartphone and the Arduino UNO. This will be more useful for elderly and disabled persons who want to use voice commands to operate appliances. This system's fundamental flaw is that it depends on the signal to noise ratio (SNR) for communication between the user and the voice recognition tool; if the voice signal is noisy, this can have a significant impact on communication and cause the system to perform inaccurately.

2.2 PROPOSED SYSTEM

Using an IOT module that connects sensors and electronic equipment, the suggested system is intended to build and implement a home automation system. It connects to the cloud via a Wi-Fi network and communicates wirelessly with peripheral devices to accept commands from gadgets like laptops and smartphones. By accepting user commands via IOT via Cloud, it will be able to manage home appliances. With the aid of the system, the user can take action as needed. Since this situation is ideal for lowering electricity costs, the lamp automatically controlled by IOT. Houseware Is Controlled by A BLUETOOTH-BASED Voice Automation Using An Android Application. The proposed system aims to develop a model using a IOT (cloud environment). There will be a several pre-processing steps that need to be activate the devices using wi-fi device with the help of Blynk android application.

CHAPTER 3

3.1SYSTEM SPECIFICATION

3.1.1 HARDWARE COMPONENTS:

- Wifi module(Node MCU)
- RELAY
- LIGHT
- FAN
- IOT
- LCD

3.1.2 SOFTWARE REQUIREMENTS:

- ARDUINO IDE
- Language : EMBEDDED C
- System type : 32-bit or 64-bit Operating System
- Code editer : VS code
- Operating System : Windows OS

3.2 WORKING PRINCIPLE:

NodeMCU is a development board based on the ESP8266 Wi-Fi chip that allows for easy internet connectivity and control of various electronic devices. Blynk is a smartphone app that enables the control of IoT devices from anywhere in the world.

The working principle of home automation using NodeMCU and the Blynk app is as follows:

1. Hardware setup: Connect the electronic devices such as lights, fans, etc. to the NodeMCU board using relays or other suitable circuits. Connect the NodeMCU board to your Wi-Fi network to enable internet connectivity.
2. Install Blynk app: Install the Blynk app on your smartphone and create an account. Create a new project in the Blynk app and obtain an authentication token.
3. Blynk library: Install the Blynk library for NodeMCU in the Arduino IDE. This library allows communication between the NodeMCU board and the Blynk app.
4. Program NodeMCU: Write a program for the NodeMCU board that uses the Blynk library to communicate with the Blynk app. The program should listen for incoming commands from the app and control the electronic devices accordingly.
5. Control devices: Once the NodeMCU board is programmed and connected to the Blynk app, you can use the app to control the electronic devices. You can turn on/off the lights, fans, etc. remotely from anywhere in the world using the app.

In summary, home automation using NodeMCU and the Blynk app involves connecting electronic devices to the NodeMCU board, installing the Blynk app on your smartphone, programming the NodeMCU board using the Blynk library, and controlling the devices remotely using the app.

CHAPTER 4

SYSTEM DESIGN

4.1 USECASE DIAGRAM

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.

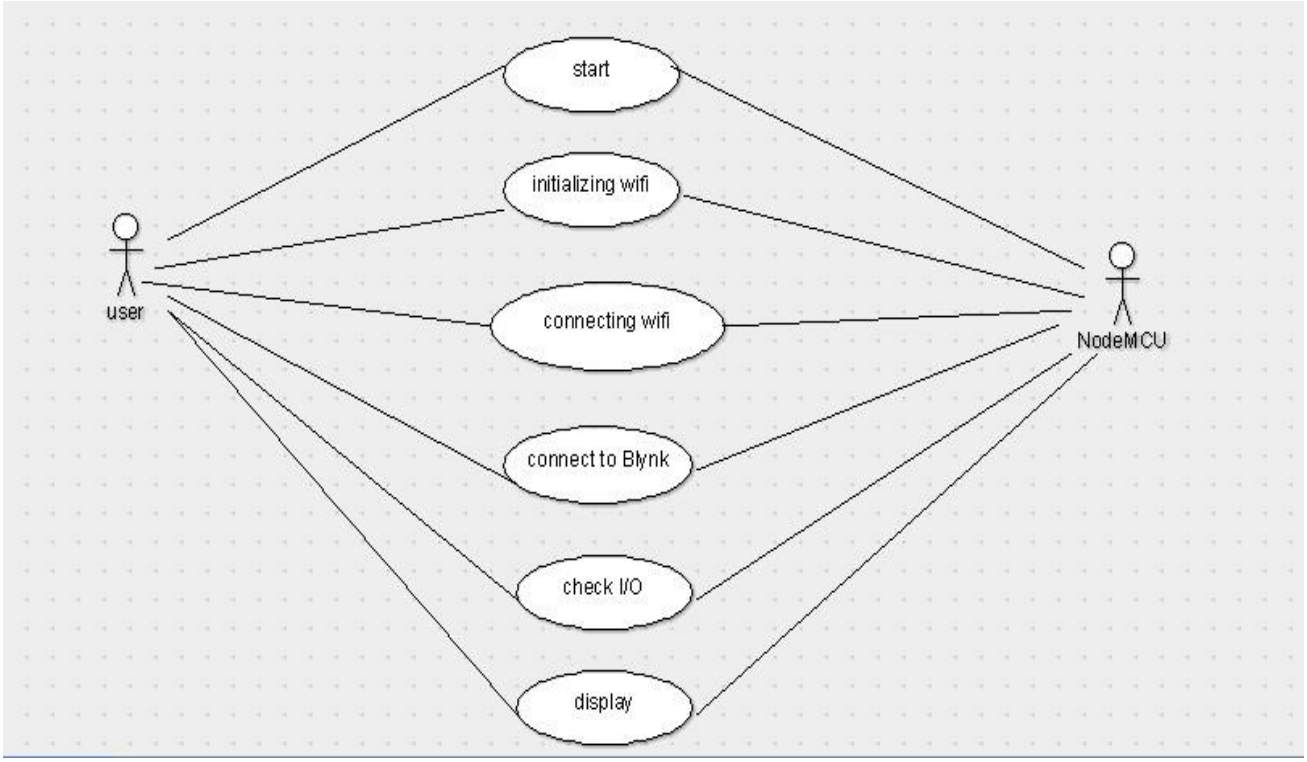


Fig 4.1 Usecase diagram

4.2 CLASS DIAGRAM

A class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

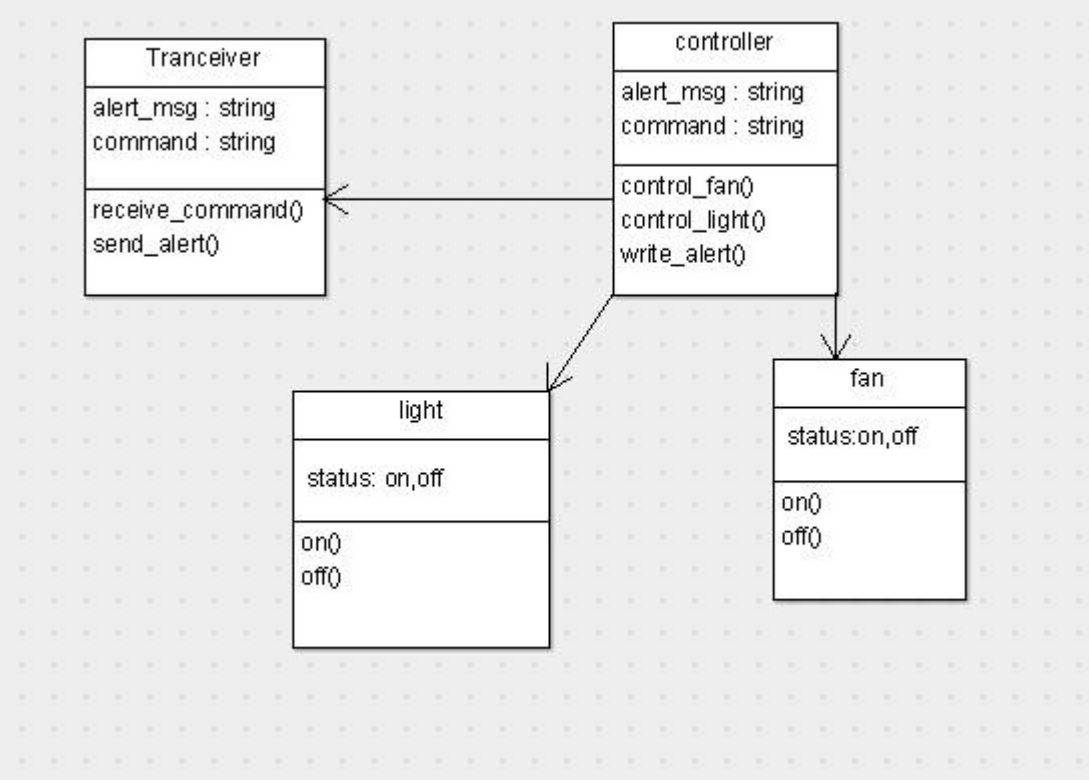


Fig 4.2 Class diagram

4.3 ACTIVITY DIAGRAM

An activity diagram is a behavioural diagram i.e., it depicts the behaviour of System activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity.

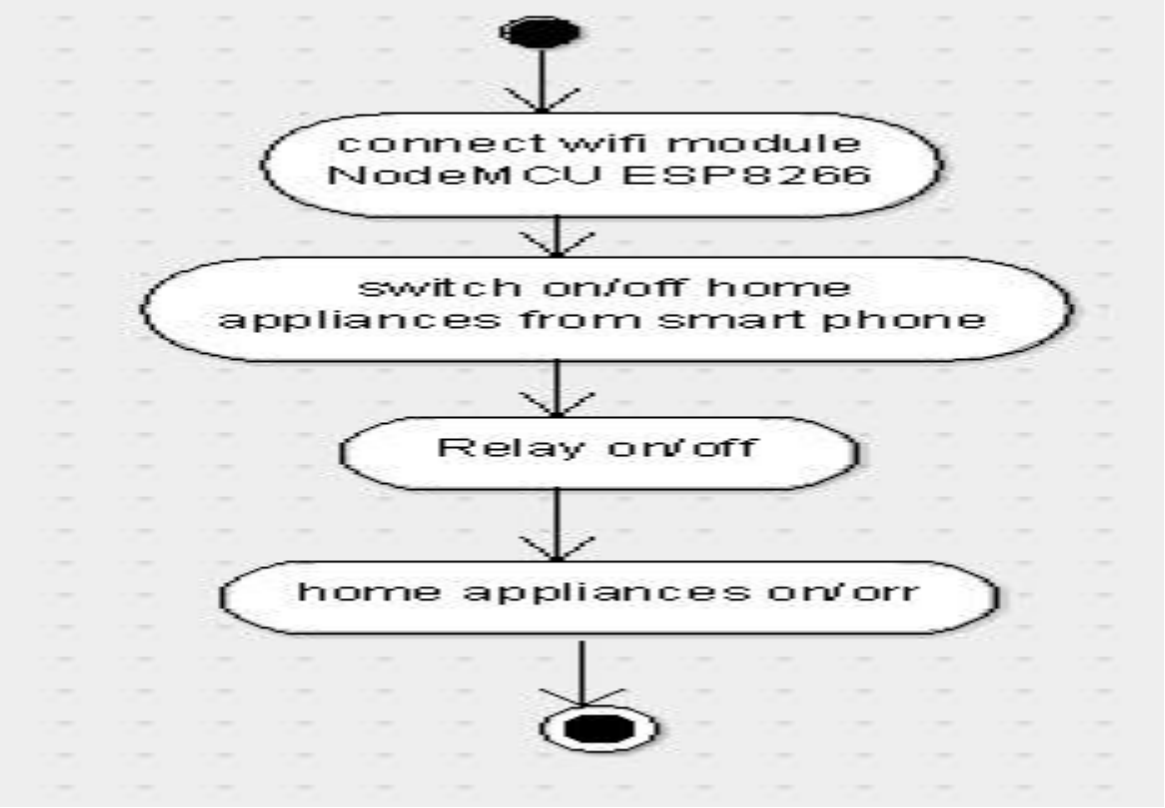


Fig 4.3 Activity diagram

4.4 DEPLOYMENT DIAGRAM

A deployment diagram is a UML diagram type that shows the execution architecture of a system, including nodes such as hardware or software execution environments, and the middleware connecting them. Deployment diagrams are typically used to visualize the physical hardware and software of a system.

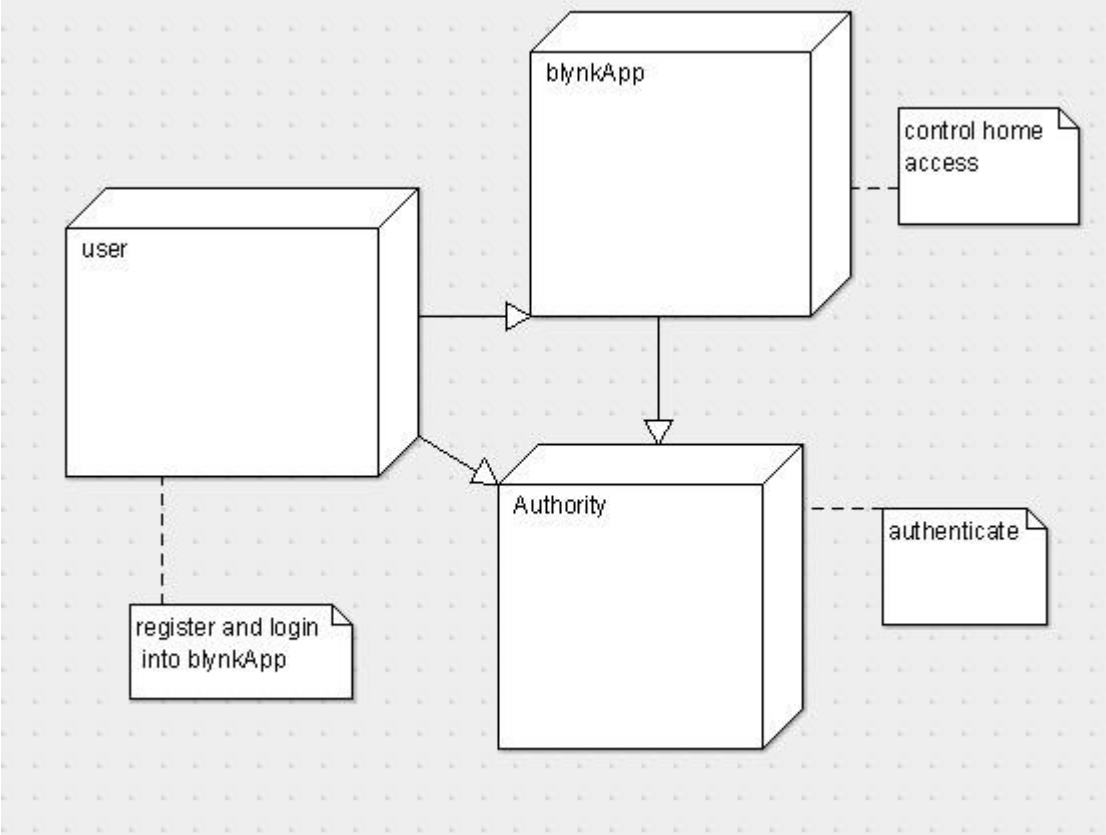


Fig 4.4 Deployment diagram

CHAPTER 5

4.1 LITERATURE SURVEY

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TITLE: Design and Implementation of a Smart Home System Using Multisensor Data Technology

AUTHOR: Yu-Liang Hsu, Po-Huan Chou

YEAR: 2021

ABSTRACT: This paper aims to develop a multisensor data fusion technology-based smart home system by integrating wearable intelligent technology, artificial intelligence, and sensor fusion technology. We have developed the following three systems to create an intelligent smart home environment a wearable motion sensing device to be placed on residents' wrists and its corresponding 3D gesture recognition algorithm to implement a convenient automated household appliance control system a wearable motion sensing device mounted on a resident's feet and its indoor positioning algorithm to realize an effective indoor pedestrian navigation system for smart energy management a multisensor circuit module and an intelligent fire detection and alarm algorithm to realize a home safety and fire detection system. In addition, an intelligent monitoring interface is developed to provide in real-time information about the smart home system, such as environmental temperatures, CO concentrations, communicative environmental alarms, household appliance status, human motion signals, and the results of gesture recognition and indoor positioning. Furthermore, an experimental testbed for validating the effectiveness and feasibility of the smart home system was built and verified experimentally. The results showed that the 3D gesture recognition algorithm could achieve recognition rates for automated household appliance control of 92.0%, 94.8%, 95.3%, and 87.7% by the 2-fold cross-validation, 5-fold cross-validation, 10-fold cross-validation, and leave-one-subject-out cross-validation strategies. For indoor positioning and smart energy management, the distance accuracy and positioning accuracy were around 0.22% and 3.36% of the total traveled distance in the indoor environment. For home safety and fire detection, the classification rate achieved 98.81% accuracy for determining the conditions of the indoor living environment.

TITLE: Internet of Things-Based Intelligent Smart Home Control System

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AUTHOR: Absalom E. Ezugwu

YEAR: 2020

ABSTRACT: The smart home is now an established area of interest and research that contributes to comfort in modern homes. With the Internet being an essential part of broad communication in modern life, IoT has allowed homes to go beyond building to interactive abodes. In many spheres of human life, the IoT has grown exponentially, including monitoring ecological factors, controlling the home and its appliances, and storing data generated by devices in the house in the cloud. Smart home includes multiple components, technologies, and devices that generate valuable data for predicting home and environment activities. This work presents the design and development of a ubiquitous, cloud-based intelligent home automation system. The system controls, monitors, and oversees the security of a home and its environment via an Android mobile application. One module controls and monitors electrical appliances and environmental factors, while another module oversees the home's security by detecting motion and capturing images. Our work uses a camera to capture images of objects triggered by their motion being detected. To avoid false alarms, we used the concept of machine learning to differentiate between images of regular home occupants and those of an intruder. The support vector machine algorithm is proposed in this study to classify the features of the image captured and determine if it is that of a regular home occupant or an intruder before sending an alarm to the user. The design of the mobile application allows a graphical display of the activities in the house. Our work proves that machine learning algorithms can improve home automation system functionality and enhance home security. The work's prototype was implemented using an ESP8266 board, an ESP32-CAM board, a 5 V four channel relay module, and sensors.

TITLE: Smart Home Automation Using Machine Learning Algorithms

AUTHOR: John Jaihar; Neehal Lingayat

YEAR: 2020

ABSTRACT: A home automation system controls lighting, temperature, multimedia systems, and appliances. Since these devices and sensors are connected to common infrastructure, they form the Internet of Things. A home automation system links multiple controllable devices to a centralized server. These devices have a user interface for controlling and monitoring, which can be accessed by using a tablet or a mobile application, which can be accessed remotely as well. Ideally, anything that can be connected to a network can be automated and controlled remotely. Smart homes must be artificially intelligent systems that need to adapt themselves based on user actions and surroundings. These systems need to carefully analyze the user needs and the conditions of the surroundings in order to predict future actions and also minimizes user interaction. Traditional home automation systems that provide only remote access and control are not that effective in terms of being `smart', so in this paper we put forward the use of concepts of different machine learning algorithms along with computer vision to shape together a smart learning automated system that controls lighting, sound and other devices based on the user's emotion.

TITLE: Customary homes to smart homes using Internet of Things (IoT) and mobile application

AUTHOR: Vignesh Govindraj; Mithileysh Sathiyanarayanan

YEAR: 2020

ABSTRACT: With an exponential advancement of automation technology, the future of manual systems are changing into automatic systems for various benefits. Also, internet has become an integral part of one's life where Internet of Things (IoT) is the latest and emerging internet technology that has changed the way one looks at things. Internet of things is developing everyday from small scale machines to large scale machines that can share data and accomplish tasks while individuals are occupied with other activities. The main aim of the paper is to design a smart home automation system using IoT, that is to turn a customary home to a smart home for accessing and controlling devices and appliances remotely using Android based Smart phone app.

To be specific,we aim to design a low cost, extensible, flexible wireless smart home automation system using IoT which employs the integration of wireless communication, cloud networking to provide users to control a variety of devices from remote locations by providing an user friendly interface and ease of installation. This paper presents the design of smart home automation framework that utilizes the combination of cloud networking and wireless communication, to remote control various electrical appliances (like lights, fans), to users within their home using a smart phone. The system will automatically control appliances on the basis of sensors' data by constantly monitoring the home environment and storing sensor data onto the cloud. To exhibit the possibility and adequacy of our framework, electrical appliances (like lights, fans) and sensors have been incorporated within the proposed home control system.

TITLE: Recommender system for home automation using IoT and artificial intelligence

AUTHOR: R. Rathna , E. Brumancia

YEAR: 2020

ABSTRACT: Smart home automation system is the current and upcoming trending technology in the market which makes life simpler and easier to control. Internet of things (IoT) Based home automation system is designed for old and disabled people. This system design is not only using IoT technology but also using the feature of artificial intelligence (AI) as well as cloud. Due to this advancement people get an assistant to manage home and their needs, based on the commands they told them to do. The main control system using wireless communication technology is to provide remote access from tablet or Smartphone. Here, natural language processing (NLP) plays a vital role since it acts as an interface between human interaction and machines. Through NLP users can either command or control devices at home even though disabled persons command or request varies from presets. Home controls like door monitoring, home appliances monitoring, and bed movement monitoring will be assisted through IoT which in turn is controlled by AI and the information is stored in the cloud. All the controls of the home are thrown at AI. The user assists all the IoT functions using voice control and all related information is sent to the cloud. Predictions can be done through a predictive engine which in turn can be used in the near future.

TITLE: An Intelligent, Secure, and Smart Home Automation System

AUTHOR: Rizwan Majeed,Nurul Azma Abdullah

YEAR: 2020

ABSTRACT: The idea of a smart home is getting attention for the last few years. The key challenges in a smart home are intelligent decision making, secure identification, and authentication of the IoT devices, continuous connectivity, data security, and privacy issues. The existing systems are targeting one or two of these issues whereas a smart home automation system that is not only secure but also has intelligent decision making and analytical abilities is the need of time. In this paper, we present a novel idea of a smart home that uses a machine learning algorithm (Support Vector Machine) for intelligent decision making and also uses blockchain technology to ensure identification and authentication of the IoT devices. Emerging blockchain technology plays a vital role by providing a reliable, secure, and decentralized mechanism for identification and authentication of the IoT devices used in the proposed home automation system. Moreover, the SVM classifier is applied to classify the status of devices used in the proposed smart home automation system into one of the two categories, i.e., “ON” and “OFF.” This system is based on Raspberry Pi, 5 V relay circuit, and some sensors. A mobile application is developed using the Android platform. Raspberry Pi acting as the server maintains the database of each appliance. The HTTP web interface and apache server are used for communication among the Android app and Raspberry Pi. The proposed idea is tested in the lab and real life to validate its effectiveness and usefulness. It is also ensured that the hardware and technology used in the proposed idea are cheap, easily available, and replicable. The experimental results highlight its significance and validate the proof of the concept.

AUTHOR: Cristina Serbanescu, Aniello Castiglione

YEAR: 2019

ABSTRACT: The target of smart houses and enhanced living environments is to increase the quality of life further. In this context, more supporting platforms for smart houses were developed, some of them using cloud systems for remote supervision, control and data storage. An important aspect, which is an open issue for both industry and academia, is represented by how to reduce and estimate energy consumption for a smart house. In this paper, we propose a modular platform that uses the power of cloud services to collect, aggregate and store all the data gathered from the smart environment. Then, we use the data to generate advanced neural network models to create energy awareness by advising the smart environment occupants on how they can improve daily habits while reducing the energy consumption and thus also the costs.

TITLE: Smart Home Automation System Using ZigBee, Bluetooth and Arduino Technologies

AUTHOR: Nadim Rana ,Shafi'i M. Abdulhamid

YEAR: 2019

ABSTRACT: The use of modern technologies for control and monitoring and accessing devices in domestic or industrial buildings with convenience, comfortable and easy access from any location is the primary aim of the internet of things (IoT) technology for smart home automation. Complete Smart home automation, with overall control from any place at any time is still not fully available. Nevertheless, this work proposes a mobile application system for smart homes, with the purpose of overall monitoring and control of home appliances and devices. The proposed method is based on Zigbee, Arduino and Bluetooth for wireless communication among devices in the home. At the same time, a mobile application is used for the control and monitoring of the devices or appliances. In this study, Zigbee and Bluetooth are combined in order to establish efficient. communication either within or outside the home premises. A user scenario of the proposed work was simulated using Proteus Simulation software to validate the practicability of the new system.

TITLE: Early Detection System for Gas Leakage and Fire in Smart Home Using Machine Learning

AUTHOR: Lamine Salhi, Thomas Silverston

YEAR: 2019

ABSTRACT: Making houses more inclusive, safer, resilient and sustainable is an important requirement that must be achieved in every society. Gas leakage and fires in smart houses are serious issues that are causing people's death and properties losses. Currently, preventing and alerting systems are widely available. However, they are generally individual units having elementary functions without adequate capabilities of multi-sensing and interaction with the existing Machine-to-Machine (M2M) home network along with the outside networks such as Internet. Indeed, this communication paradigm will be clearly the most dominant in the near future for M2M home networks. In this paper, we are proposing an efficient system model to integrate the gas leakage and fire detection system into a centralized M2M home network using low cost devices. Then, through machine learning approach, we are involving a data mining method with the sensed information and detect the abnormal air state changes in hidden patterns for early prediction of the risk incidences. This work will help to enhance safety and protect property in smart houses.

TITLE: Enhanced Smart Home Automation System based on Internet of Things

AUTHOR: Tushar Chaurasia; Prashant Kumar Jain

YEAR: 2019

ABSTRACT: The Internet of Things (IoT) connects users with interconnection of things to facilitate the life. IoT is now shifted towards `Thing to Thing'. Smart home concept brings comfort and convenience in our lives with the aid of IoT. Major issues in current smart home scenario are automation and security.

Problem in security arises due to network of devices in the home with internet. Focus is sifted towards providing confidentiality, authenticity, and integrity of data sensed and exchanged by smart home objects. Computation overhead is also a concern for smart home solutions. Comfort and user requirements as per scenario or situation are basic need for automation.

TITLE: Smart Energy Efficient Home Automation System Using IoT

AUTHOR: Satyendra K. Vishwakarma

YEAR: 2019

ABSTRACT: Advancement in IoT based application has become the state-of-the art technology among the researcher due to the availability of Internet everywhere. To make the application more user friendly, web based and android based technologies have gained their importance in this cutting edge technology. In this paper, smart energy efficient home automation system is proposed that can access and control the home equipments from every corner of the world. For this system, Internet connectivity module is attached to the main supply unit of the home system which can be accessed through the Internet. For wireless connectivity, the static IP address is used. Home automation is based on multimodal application that can be operated using voice recognition command of the user using the Google Assistant or through a web based application. Thus, main objective of this work is to make our home automation system more secure and intelligent.

TITLE: Intelligent and secured software application for IoT based smart home

AUTHOR: Trio Adiono; Billy Austen Manangkalangi

YEAR: 2019

ABSTRACT: As saving the energy inside a house is an important issue to address, more home appliances are now implementing IoT technology. Here, we propose an IoT based smart home software application that are able to intelligently control the home appliances automatically based on our instruction set or behavior. The smart home uses the software to receive input from the user and forward the input to the server or host. In addition to receiving input from the user, the smart home software is also used to display all information about the house condition to the user. The smart home system uses AMQP as the communication protocol between software, server, and host.

TITLE: Intelligent interface based speech recognition for home automation using application

AUTHOR: M. Tharaniya soundhari; S. Brilly Sangeetha

YEAR: 2016

ABSTRACT: The home automation system plays an important role in maintaining living standards and provide secure and flexible environment. The aim of this project is to design a home automation system which makes operating of electrical appliances in home through android application. The home automation system allows controlling of home appliances by using voice commands by recognizing the input speech. The speech recognition is done by Support Vector Machine. The home automation system is implemented wirelessly using General packet radio service (GPRS) technology. The electrical appliances such as fan, light switches, light sensors, current sensors are integrated in a system which then connected to microcontroller which act as a within the home to control and perform the user commands.

TITLE: Arduino and Raspberry Pi based smart communication and control of home appliance system

AUTHOR: Praveen Kumar; Umesh Chandra Pati

YEAR: 2018

ABSTRACT: The home automation technology makes human life comfortable and luxurious. That is why today every person wants a smart home. This technology provides the control of the home devices as well as a secure and intelligent interaction between personnel inside and outside of the room. The control system gives the status concerning ON or OFF of the selected instrument to the house owner. This system is also designed to assist, provide support and to fulfill the needs of an elderly person in the home. The system is intended to control electrical appliances in the house and effective interaction to the visitor with relatively lowcost design, user-friendly interface as well as easy of installation. Using this technology, consumers can save the electrical energy by regular monitoring of home devices or the proper ON/OFF scheduling of the devices.

CHAPTER 6

6.1 EMBEDDED SYSTEM

As its name suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor based system which is designed to perform a specific task. For example, a fire alarm is an embedded smoke.

An embedded system has three components:

- It has hardware.
- It has application software.
- It has Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies. RTOS defines the way the system works. It sets the rules during the execution of application program.

  A small scale embedded system may not have RTOS.

So we can define an embedded system as a Microcontroller based, software driven and reliable, real-time control system.

6.2 CHARACTERISTICS OF AN EMBEDDED SYSTEM

Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.

Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.

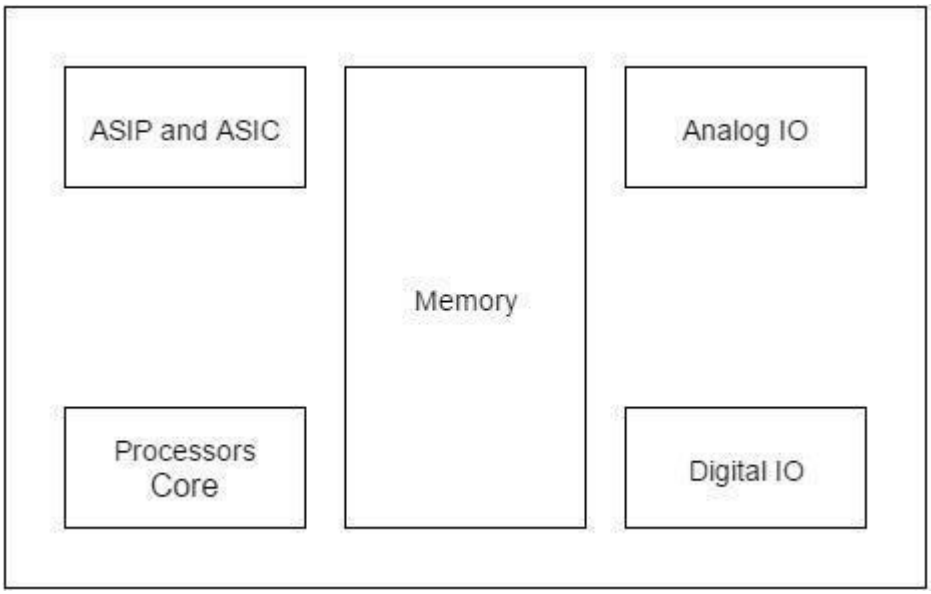
Reactive and Real time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed**.**

Microprocessors based – It must be microprocessor or microcontroller based.

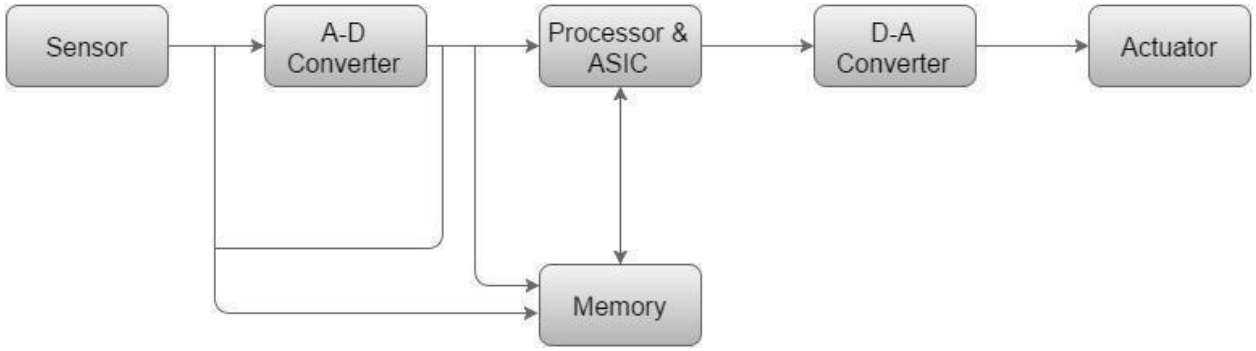
Memory – It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.

Connected – It must have connected peripherals to connect input and output devices.

HW-SW systems – Software is used for more features and flexibility. Hardware is used for performance and security.



6.3 BASIC STRUCTURE OF AN EMBEDDED SYSTEM



- **Sensor** − It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.

- **A-D Converter** − An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.

- **Processor & ASICs** − Processors process the data to measure the output and store it to the memory.

- **D-A Converter** − A digital-to-analog converter converts the digital data fed by the processor to analog data

- **Actuator** − An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

6.4 EMBEDDED SYSTEM SOFTWARE

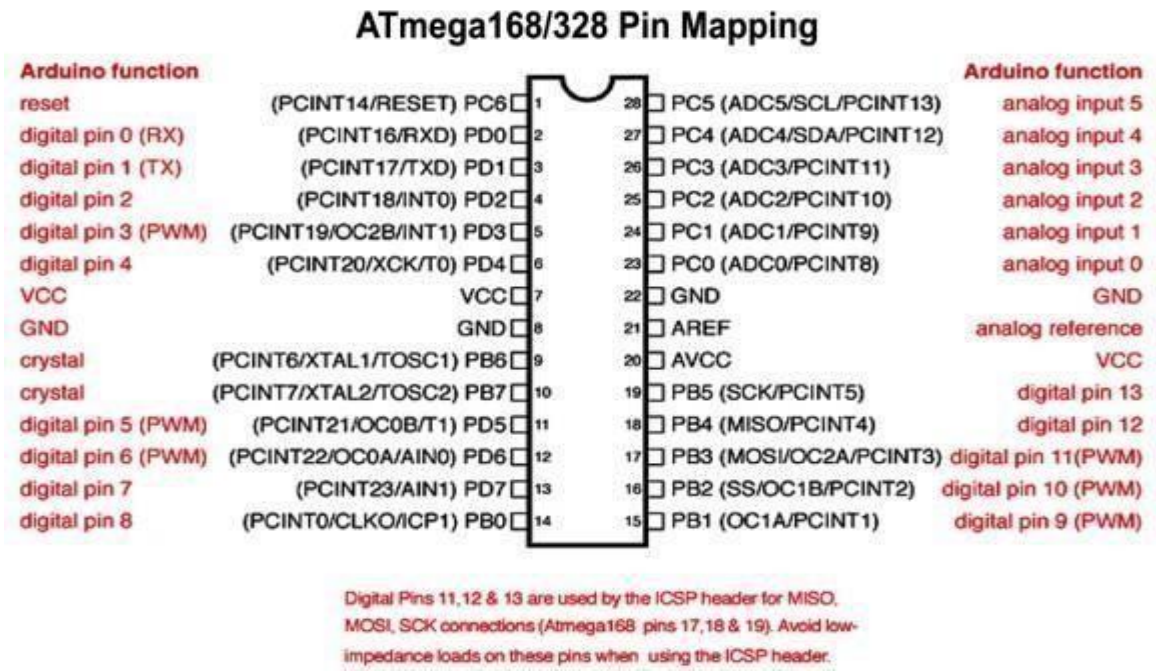
A typical industrial microcontroller is quite unsophisticated compared to a typical enterprise desktop computer and generally depends on a simpler, less-memory-intensive program environment. The simplest devices run on bare metal and are programmed directly using the chipCPU's machine code language.

Often, however, embedded systems use operating systems or language platforms tailored to embedded use, particularly where real-time operating environments must be served. At higher levels of chip capability, such as those found in SoCs, designers have increasingly decided that the systems are generally fast enough and tasks tolerant of slight variations in reaction time that "nearreal-time" approaches are suitable. In these instances, stripped-down versions of the Linux operating system are commonly deployed, though there are also other operating systems that have been pared down to run on embedded systems, including Embedded Java and Windows IoT (formerly Windows Embedded). Generally, storage of programs and operating systems on embedded devices make use either of flash or rewritable flash memory.

ARDUINO

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The source code for the IDE is released under the GNU General Public License, version 2. Nevertheless, an official Bill of Materials of Arduino boards has never been released by Arduino staff.

Although the hardware and software designs are freely available under copy left licenses, the developers have requested that the name Arduino be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product. Several Arduino-compatible products commercially released have avoided the project name by using various names ending in Arduino.



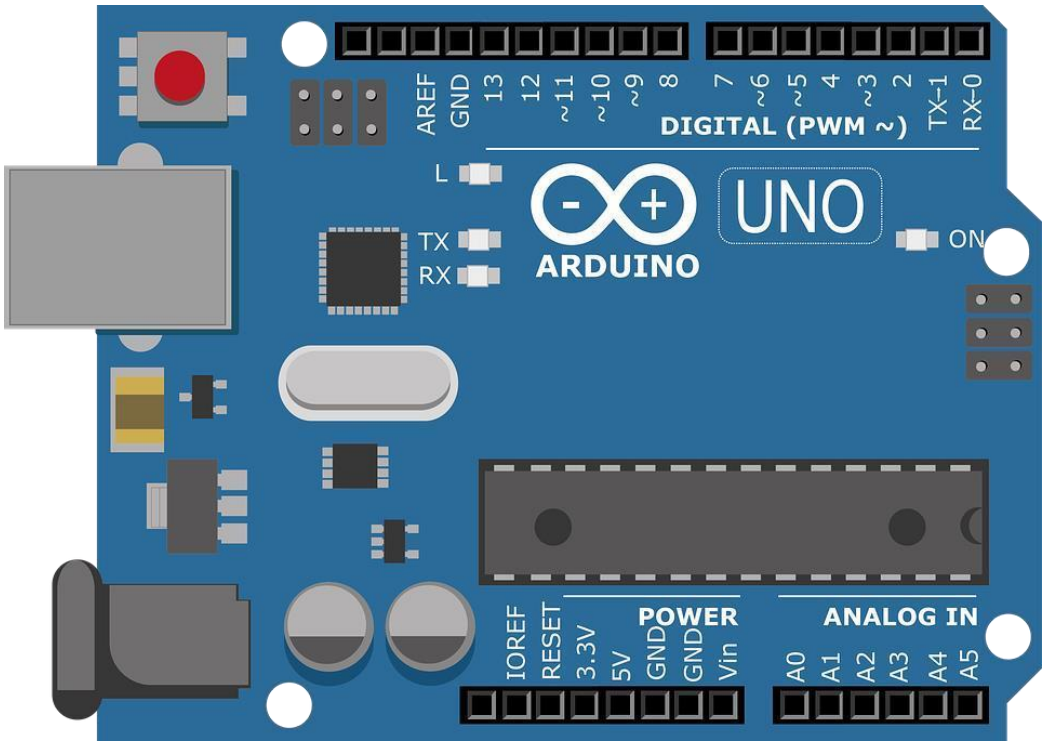
An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560), but other makers' microcontrollers have been used since 2015. The boards use single-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple, and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the Lily Pad, run at 8 MHz and dispense with the onboard voltageregulator due to specific form-factor restrictions.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default boot loader of the Arduino UNO is the optiboot boot loader. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via

its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable

.

USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.



The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The Diecimila, Duemilanove, and current Uno provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available.

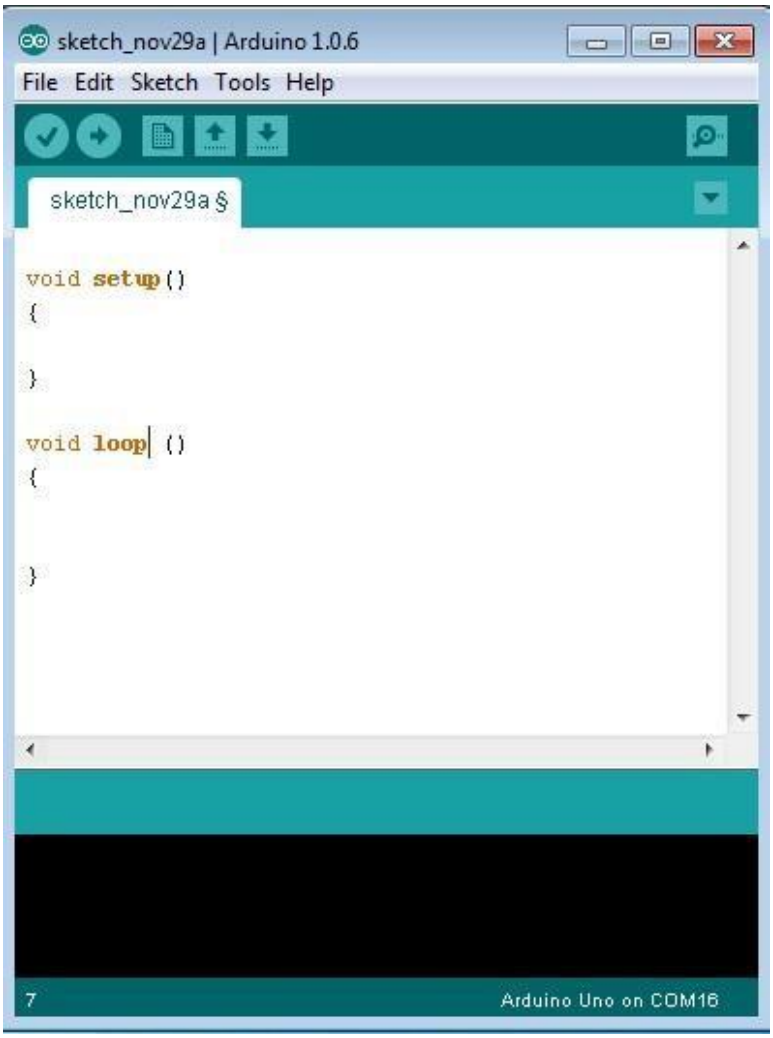
The Arduino Nano, and Arduinocompatible Bare Bones Board and arduino boards may provide male header pins on the underside of the board that can plug into solder less breadboards.Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by

adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining compatibility with shields, sometimes not.

Let us start with the Structure. Software structure consists of two main functions: Setup()

function

- Loop( )
  function



Arduino – Program Structure:

Void setup ( )

{

}

PURPOSE

The setup() function is called when a sketch starts. Use it to initialize the variables, pinmodes, start using libraries, etc. The setup function will only run once, after each power up or reset of the Arduino board.

INPUT

OUTPUT

RETURN

```
Void Loop ( )
{
}
```

PURPOSE

After creating a **setup()** function, which initializes and sets the initial values, the **loop()** function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.

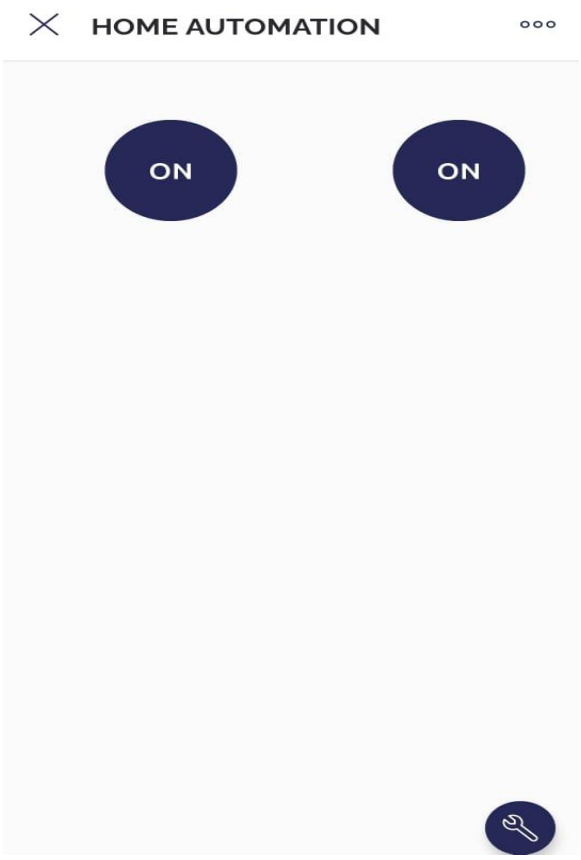
INPUT

OUTPUT

RETURN

SETTING UP THE SYSTEM

- Downloading and installing and Blynk application on smartphone
- Blynk application is downloaded and installed from the Play Store.
- Once the application is installed, a new account is created and logged in to it.
- After logging in, a new project is created. The project is named, hardware is selected as NodeMCU and the connection type is selected as Wi-Fi, and created.
- At this point Blynk will sends an authentication token to email id. This authentication token will be used to identify the hardware in the Blynk server.
- As the prototype uses 4 channel relay module, 4 buttons are added to the screen from the side bar.
- All the 4 buttons are then customised by adding a name and selecting the digital pin it will correspond to. This section will actually affect the hardware connection as the relays will be physically connected to the digital pins corresponded here.
- The setup of Blynk application is now complete.



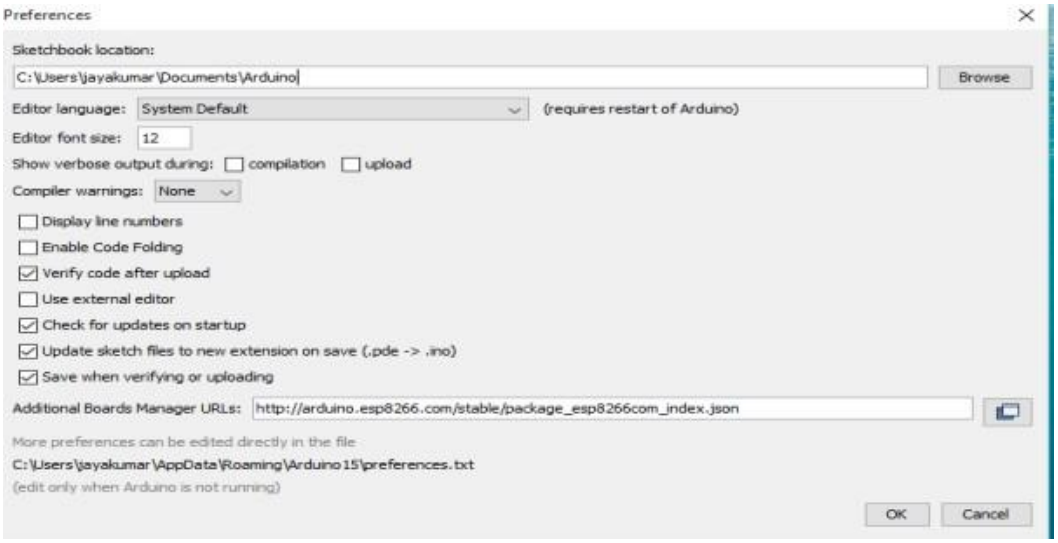
Installation for hardware interfacing

Mostly these days devices download and install drivers on their own, automatically. Windows doesn't know how to talk to the USB driver on the Node MCU so it can't figure out that the board is a Node MCU and proceed normally.

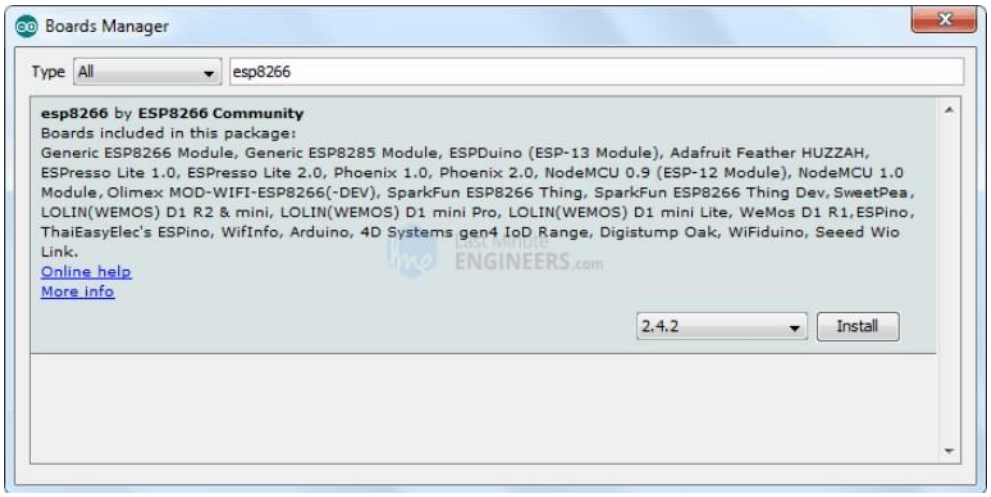
- Node MCU Amica is an ESP8266 Wi-Fi module based development board. It has got Micro USB slot that can directly be connected to the computer or other USB host devices. Ti has got 15X2 header pins and a Micro USB slot, the headers can be mounted on a breadboard and Micro USB slot is to establish connection to USB host device. It has CP2120 USB to serial converter.
- In order to install CP2120 (USB to serial converter), user is needed to download the driver forthe same.
- Once user downloads drivers as per its respective operating system, the system establishes connection to Node MCU.
- The user needs to node down the COM post allotted to newly connected USB device (Node MCU) from device manager of the system. This com port number will be required while using Node MCU Amica.

- Interfacing Node MCU with Arduino IDE

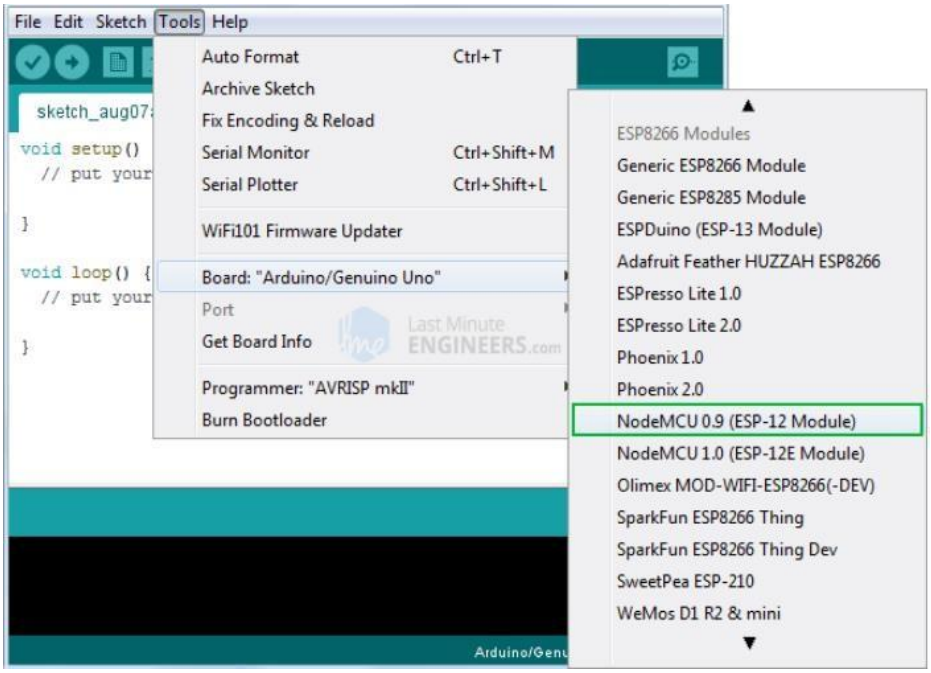
To begin with the latest Arduino IDE version, we'll need to update the board manager with a custom URL. Open up Arduino IDE and go to File > Preferences. Then, copy below URL into the Additional Board Manager URLs text box situated on the bottom of the window: *http://arduino.esp8266.com/stable/package_esp8266com_index.json*



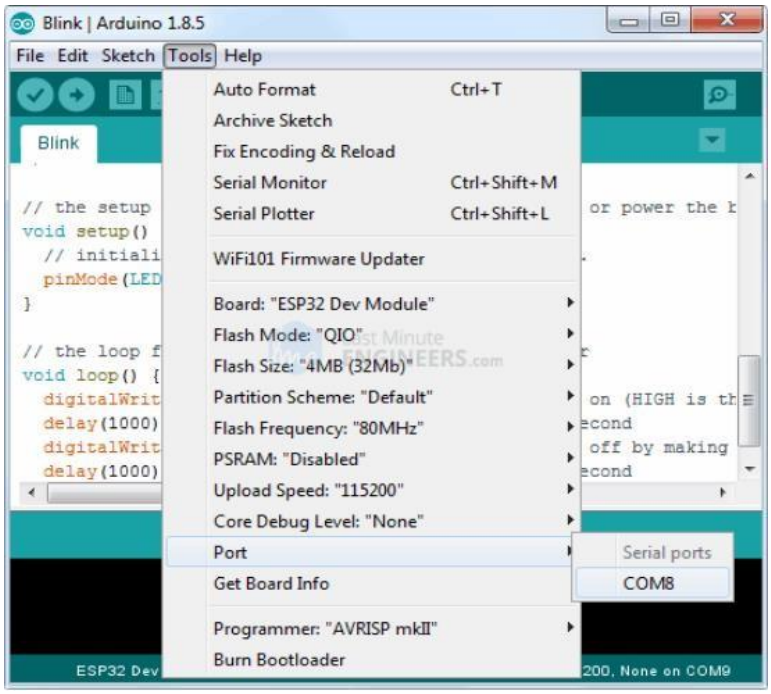
OK. Then navigate to the Board Manager by going to Tools > Boards > Boards Manager. There should be a couple new entries in addition to the standard Arduino boards. Filter your search by typing esp8266. Click on that entry and select Install.



Before we get to uploading sketch & playing with LED, we need to make sure that the board is selected properly in Arduino IDE. Open Arduino IDE and select Node MCU 0.9 (ESP-12 Module) optionunder your Arduino IDE > Tools > Board menu.



Now, plug your ESP8266 NodeMCU into your computer via micro-B USB cable. Once the board is plugged in, it should be assigned a unique COM port. On Windows machines, this will be something like COM#, and on Mac/Linux computers it will come in the form of /dev/tty.usbserial-XXXXXX. Select this serial port under the Arduino IDE > Tools > Port menu. Also select the Upload Speed: 115200



Uploading code to Node MCU

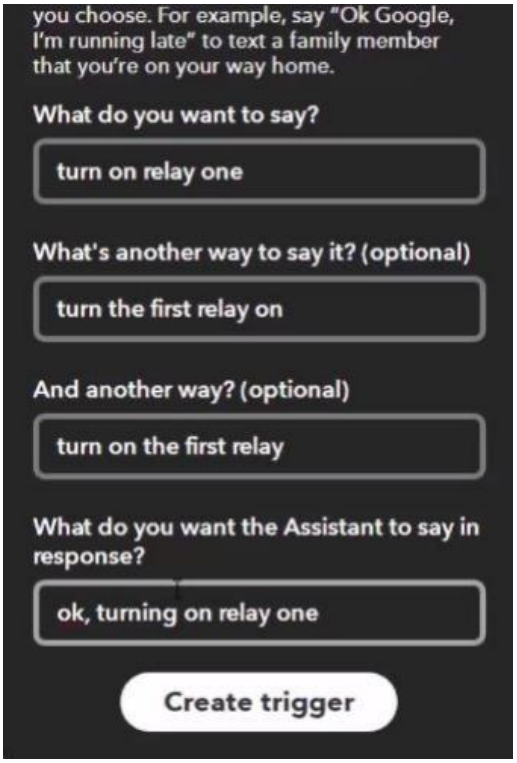
- NodeMCU is connected to PC using a USB cable.
- Now, we'll set up the Arduino IDE by changing some settings. So, open up the Arduino IDE. Select Tools > Board and select 'NodeMCU 1.0 (ESP-12E Module)' as the board. And that's allthe settings we need to change. So now we begin writing the code.
- Select Files > Examples > Blynk > Boards_WIFI > ESP8266_Standalone. A new file with someprewritten code opens. The following changes to the code are made.

1. The line which says 'char auth[] = "YourAuthToken", replace YourAuthToken part withyour Blynk's authentication token that was generated by the Blynk server.
2. The line which says char ssid[] = "YourNetworkName", replace YourNetworkName partwith the name of Wi-Fi network that the Node MCU must connect to.
3. The line where it says char pass[] = "YourPassword" and replace the YourPassword partwith the password of the Wi-Fi network.

Figure 21. Code in Arduino IDE to be installed to Node MCU.

- The code is ready to be uploaded to the hardware. On clicking upload button, the code is uploaded to Node MCU and the next time it's powered on, it automatically connects to the assigned Wi-Fi network.

- Installation and setup of IFTTT
  - To configure IFTTT we visit their website https://ifttt.com and sign up using google account.
  - After signing in, we select My Applets from header, and select New. Search for Google assistant and connect. Allow IFTTT for permission to use Google account to add voice commands to it.
  - Configure the application to work as desired, and Create Trigger.



- Select webhooks that will allow to send commands to Blynk server. Add http://188.166.206.43/ YourAuthTokenHere / update / DigitalPinToBeUpdateHere to the URL field.

  YourAuthTokenHere is replaced by the authentication token generated by Blynk server. DigitalPinToBoUpdatedHere is replaced by the digital pin of Arduino that corresponds to the Node MCU rather than the one of Node MCU itself.

  Following details are added to program the applet. Here '0' means to turn on, so we are basically saying Blynk to turn on relay that is connected to pin D3, which in our case is relay one.

  Click on Create Action and finish.

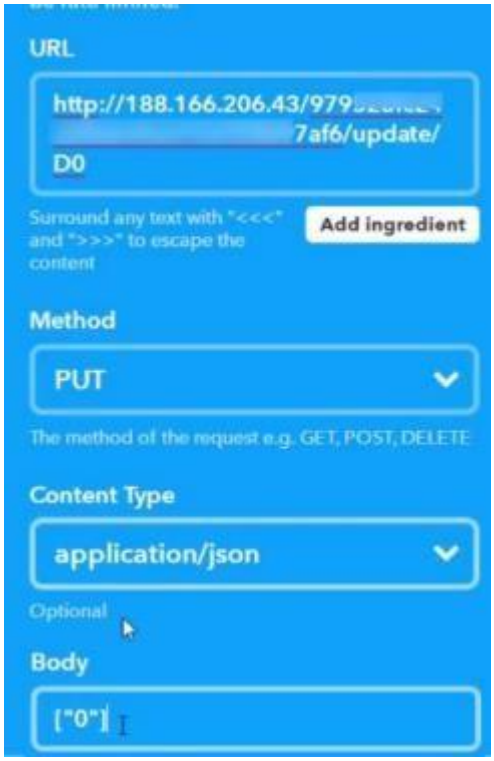


Figure 23. Configuration of applet to switch relay with voice commands.

- Similarly, another applet is created to turn off the relay, repeating all the steps above except the following changes: instead of writing “Turn on relay one”, written “Turn off relay one”and instead of [“0”], written [“1”]. Two triggers are created to turn on and off one Relay.

- Similarly, we create triggers for remaining 3 relays by change the phrase and Digital pin for each Relay. All the other steps will remain the same.

In the end for 4 relays, we have 8 triggers to turn each of them on or off. After all this is done, voice commands to Google Assistant can switch relay.

CHAPTER 7

7.1 MODULES AND DESCRIPTION:

LIGHT-EMITTING DIODE (LED)

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an **infrared emitting** diode (IRED).

An LED or IRED consists of two elements of processed material called P-type semiconductors and N-type semiconductors. These two elements are placed in direct contact, forming a region called the P-N junction. In this respect, the LED or IRED resembles most other diode types, but there are important differences. The LED or IRED has a transparent package, allowing visible or IR energy to pass through. Also, the LED or IRED has a large PN-junction area whose shape is tailored to the application.

Benefits of LEDs and IREDs, compared with incandescent and fluorescent illuminating devices, include:

- **Low power requirement**: Most types can be operated with battery power supplies.
- **High efficiency:** Most of the power supplied to an LED or IRED is converted into radiation.
- **Long life:** When properly installed, an LED or IRED can function for decades.

Typical applications include:

- **Indicator lights:** These can be two-state (i.e., on/off), bar-graph, or alphabetic-numeric readouts.
- **LCD panel backlighting:** Specialized white LEDs are used in flat-panel computer displays.
- **Fiber optic data transmission:** Ease of modulation allows wide communications bandwidth with minimal noise, resulting in high speed and accuracy.
- **Remote control:** Most home-entertainment "remotes" use IREDs to transmit data to the main unit.
- Opt isolator**:** Stages in an electronic system can be connected together without unwanted interaction.

2. POWER SUPPLY:

Power supply block consists of following units:

- Step down transformer.
- Bridge rectifier circuit.
- Input filter.
- Voltage regulators.
- Output filter.
- Indicator unit.

Step down transformer:

The step-down transformer is used to step down the supply voltage of 230v ac from mains to lower values, as the various IC's used in this project require reduced voltages. The transformer consists of primary and secondary coils.

To reduce or step down the voltage, the transformer is designed to contain less number

of turns in its secondary core. The outputs fromthe secondary coil which is center tapped are the ac values of 0v, 15v and 15v.

Rectifier Unit

A diode bridge is an arrangement of four diodes connected in a bridge circuit. That provides the polarity of output voltage of any polarity of the input voltage. When used in its most common application, for conversion of alternating current (A.C) input into direct current (D.C) output, it is known as a bridge rectifier. The diagram describes a diode-bridge design known as a full wave rectifier. This design can be used to rectify single phase A.C. when no transformer center tap is available. A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

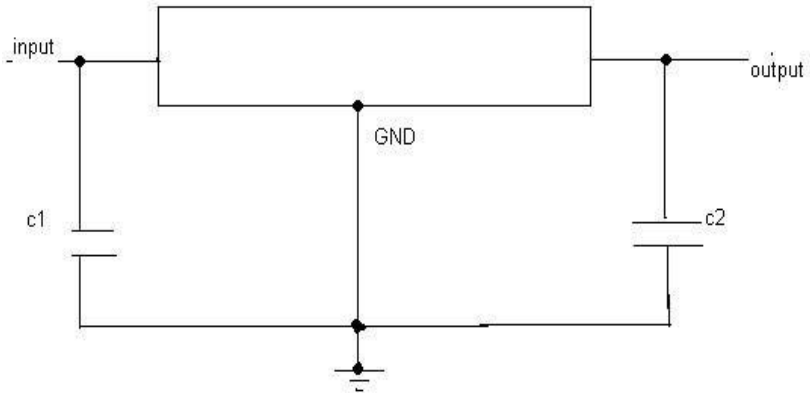
For both positive and negative swings of the transformer, there is a forward path through the diode bridge. Both conduction paths cause current to flow in the same direction through the load resister, accomplishing full-wave rectification. While one set of diodes is forward biased,the other set is reverse biased and effectively eliminated from the circuit.

Input Filter

Capacitors are used as filters. The ripples from the dc voltages are removed and pure dc. voltage is obtained. The primary action performed by capacitor is charging and discharging. It charges in positive half cycle of the ac voltage and it will discharge in negative half cycle. So it allows only ac voltage and does not allow the dc voltage. This filter is fixed before the regulator. Capacitors used here are of the value 1000Uf.

Regulators can be classified as: -

1. Positive regulator, which regulates the positive voltage(7805,7812)



2. >input pin

3. > ground pin

4. > output pin

2. Negative regulator, which regulates the negative voltage (7912).

4. > ground pin

5. > input pin

6. > output pin

Regulators used in this application are-

7805 which provides 5v dc

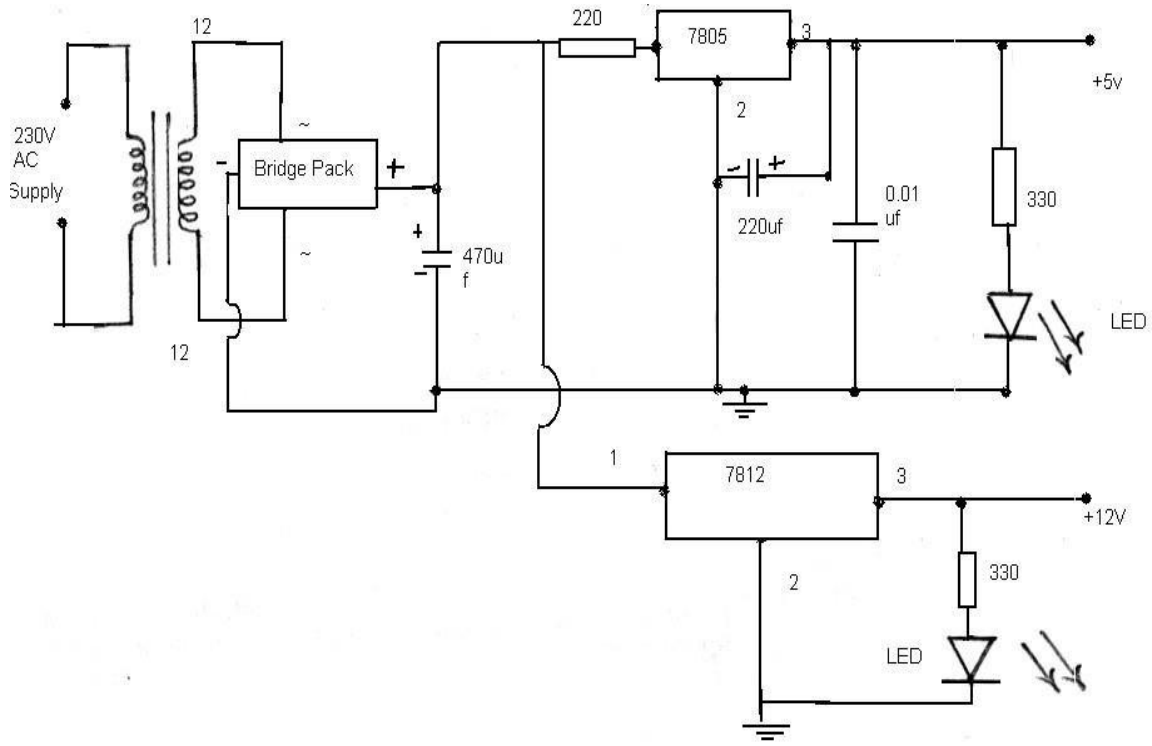
7812 which provides 12v dc

7912 which provides -121v dc

Output Filter

This filter is fixed after the Regulator circuit to filter any of the possibly found ripples in the output received finally. Capacitors used here are of value 10F.

Power Supply Circuit Diagram:



7.2 MODULE DESCREPTION:

ARDUINO UNO Overview

Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

You can find in the Getting Started section all the information you need to configure your board,use the Arduino Software (IDE), and start tinker with coding and electronics.

Need Help?

- On the Software on the Arduino Forum
- On Projects on the Arduino Forum
- On the Product itself through our Customer Support

Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V

Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Programming

The Arduino/Genuino Uno can be programmed with the Arduino Software (IDE). Select "Arduino/Genuino Uno" from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino/Genuino Uno comes preprogramed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicatesusing the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then rese ing the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer(overwriting the DFU bootloader). See this user-contributed tutorial for more information.

Warnings

The Arduino/Genuino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and over current. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Differences with other boards

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USBto-serial converter.

Power

The Arduino/Genuino Uno board can be powered via the USB connection or with an externalpower supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. Theadapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V,however, the 5V pin may supply less than five volts and the board may become unstable. If usingmore than 12V, the voltage regulator may overheat and damage the board. The recommended rangeis 7 to 12 volts.

The power pins are as follows:

- Vin. The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.
- IOREF. This pin on the Arduino/Genuino board provides the voltage reference with which The microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to workwith the 5V or 3.3V.

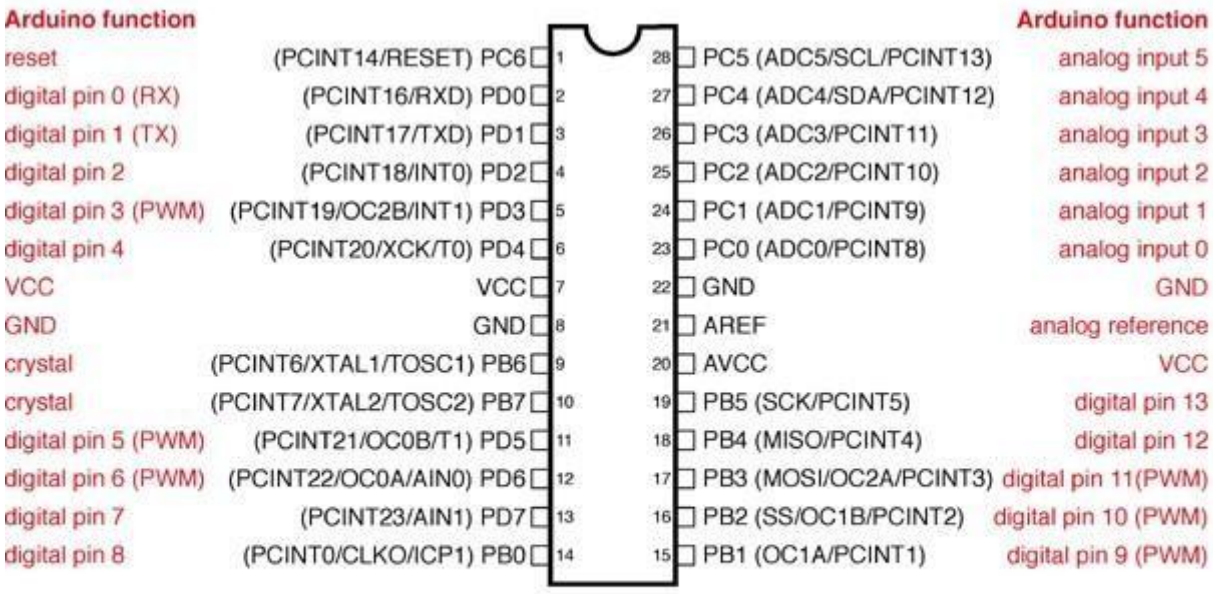
Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAMand 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8,168, and 328 is identical.

PINDIAGRAM:



PIN MAPPING

ATmega328P

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not beexceeded on any I/O pin to avoid permanent damage to the microcontroller.
In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication.

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well- coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data. The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forumthread for details.

Revisions

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The

second one is a not connected pin, that is reserved for future purposes.

- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

IOT

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

Increasingly, organizations in a variety of industries are using IoT to operate more efficiently,. better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.

HOW DOES IOT WORK?

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

The connectivity, networking and communication protocols used with these web-enabled deviceslargely depend on the specific IoT applications deployed.

IoT can also make use of artificial intelligence (AI) and machine learning to aid in making data collecting processes easier and more dynamic

WHY IS IOT IMPORTANT?

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, IoT is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

IoT enables companies to automate processes and reduce labor costs. It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as wellas offering transparency into customer transactions.

As such, IoT is one of the most important technologies of everyday life, and it will continue to. pick up steam as more businesses realize the potential of connected devices to keep them competitive.

What are the benefits of IoT to organizations?

The internet of things offers several benefits to organizations. Some benefits are industry-specific, and some are applicable across multiple industries. Some of the common benefits of IoT enable businesses to:

- monitor their overall business processes;
- improve the customer experience (CX);
- save time and money;
- enhance employee productivity;
- integrate and adapt business models;
- make better business decisions;
- generate more revenue.

IoT encourages companies to rethink the ways they approach their businesses and gives them thetools to improve their business strategies.

What are the pros and cons of IoT?

Some of the advantages of IoT include the following:

- ability to access information from anywhere at any time on any device;
- improved communication between connected electronic devices;
- transferring data packets over a connected network saving time and money; and
- automating tasks helping to improve the quality of a business's services and reducing the needfor human intervention.

Some disadvantages of IoT include the following:

- As the number of connected devices increases and more information is shared between devices,the potential that a hacker could steal confidential information also increases.
- Enterprises may eventually have to deal with massive numbers -- maybe even millions -- ofIoT devices, and collecting and managing the data from all those devices will be challenging.
- If there's a bug in the system, it's likely that every connected device will become corrupted.
- Since there's no international standard of compatibility for IoT, it's difficult for devices fromdifferent manufacturers to communicate with each other.

What is NodeMCU?

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The NodeMCU (**N**ode **M**icro**C**ontroller **U**nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also

defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory.

chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some evenhave a serial data port instead of a USB port.

NodeMCU Specifications

The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout.

Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint – an important consideration to be aware of.The most common models of the NodeMCU are the Amica (based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board. The open-source design of the base ESP8266 enables the market to design new variants of the NodeMCU continually.

NodeMCU Pinout and Functions Explained

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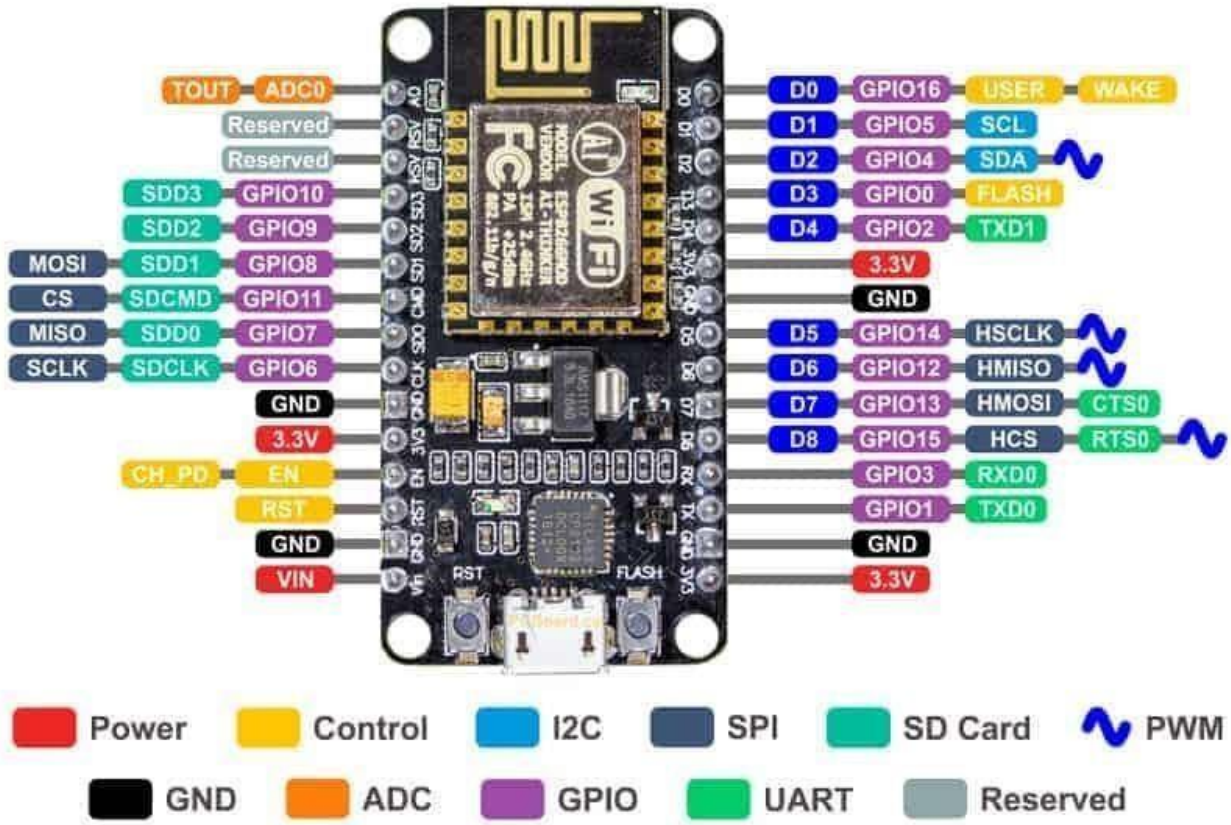

Power Pins There are four power pins. **VIN** pin and three **3.3V** pins.

VIN can be used to directly supply the NodeMCU/ESP8266 and its peripherals. Power delivered on **VIN** is regulated through the onboard regulator on the NodeMCU module – you can also supply 5V regulated to the **VIN** pin.

3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components.

GND are the ground pins of NodeMCU/ESP8266

I2C Pins are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins NodeMCU/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

ADC Channel The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

UART Pins NodeMCU/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1(TXD1 pin) features only data transmit signal so, it is usually used for printing log.

SPI Pins NodeMCU/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. TheseSPIs also support the following general-purpose SPI features:

a) 4 timing modes of the SPI format transfer

b) Up to 80 MHz and the divided clocks of 80 MHz

c) Up to 64-Byte FIFO

SDIO Pins NodeMCU/ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequencyrange is adjustable from 1000 μs to 10000 μs (100 Hz and 1 kHz).

Control Pins are used to control the NodeMCU/ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

- **EN:** The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
- **RST:** RST pin is used to reset the ESP8266 chip.
- **WAKE:** Wake pin is used to wake the chip from deep-sleep.

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CHAPTER 8
IMPLEMENTATION

8.1 SOURCE CODE:

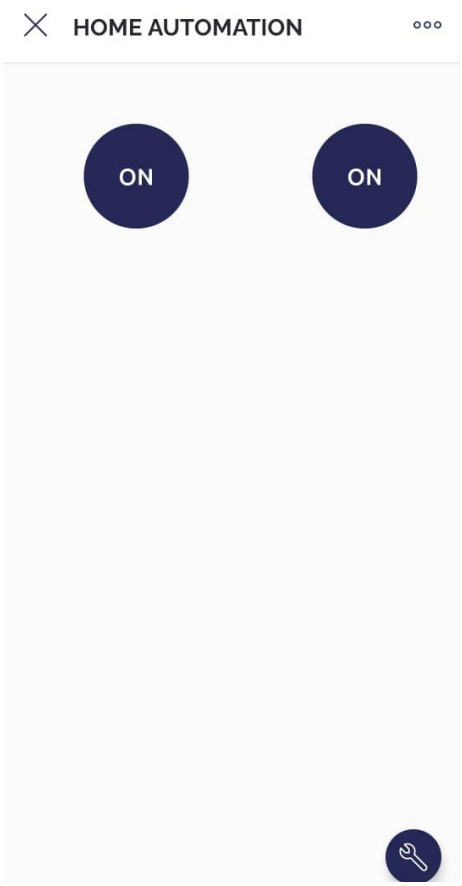
```
#define BLYNK_PRINT Serial

#define BLYNK_TEMPLATE_ID "TMPLY8uoE-0M"

#define BLYNK_TEMPLATE_NAME "HOME AUTOMATION"

#include <ESP8266WiFi.h>

 #include <BlynkSimpleEsp8266.h>

char auth[] = "RVVRd5kjOGwhQ1QiL_kvtIEnZnZ7RcSe"; // You should get Auth

                                                    // Go to the Project

Settings (nut icon) char ssid[] = "Lunnaaa";                  // Your WiFi credentials.

 char pass[] = "ziffyy@29";

// Set password to "" for open networks.


#define RelayPin1 D4

#define RelayPin2 D5

#define VPIN_BUTTON_1    V0 #define

VPIN_BUTTON_2    V1

bool toggleState_1 = LOW; //Define integer to remember the toggle state for relay 1

booltoggleState_2 = LOW; //Define integer to remember the toggle state for relay 2

BLYNK_CONNECTED() {
  // Request the latest state from the server

  Blynk.syncVirtual(VPIN_BUTTON_1);
  Blynk.syncVirtual(VPIN_BUTTON_2);

}
```

```
BLYNK_WRITE(VPIN_BUTTON_1) {
 toggleState_1 = param.asInt();
if(toggleState_1 == 1){
digitalWrite(RelayPin1, LOW);
 } else {
digitalWrite(RelayPin1, HIGH);
 }
}

BLYNK_WRITE(VPIN_BUTTON_2) {
 toggleState_2 = param.asInt();
if(toggleState_2 == 1){
digitalWrite(RelayPin2, HIGH);
 }
else {
   digitalWrite(RelayPin2,LOW);
 }
}
void setup()
{
  Serial.begin(9600);// Debug console
   Blynk.begin(auth, ssid, pass);
   pinMode(RelayPin1,OUTPUT);
   pinMode(RelayPin2, OUTPUT);
```

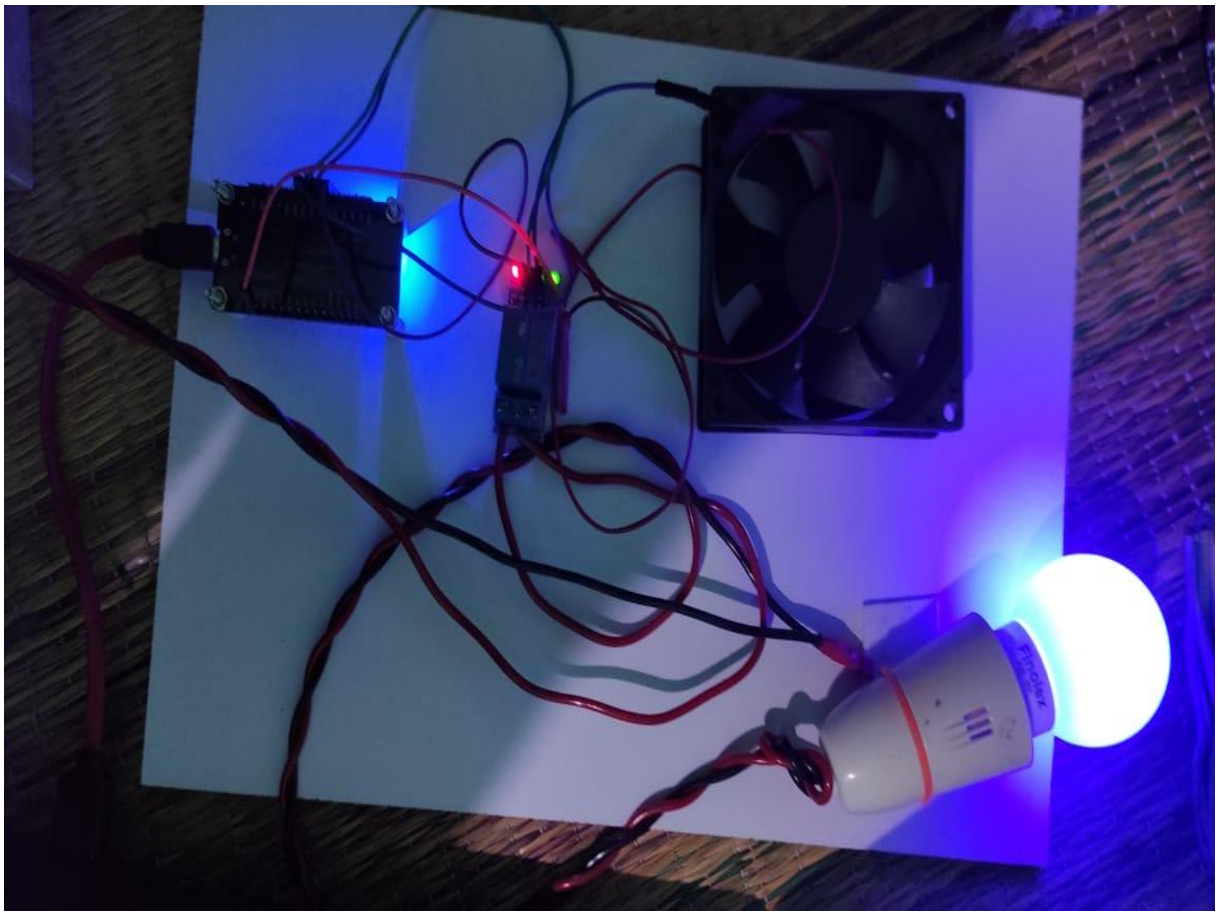
```
    digitalWrite(RelayPin1,HIGH);
    digitalWrite(RelayPin2, HIGH);
    Blynk.virtualWrite(VPIN_BUTTON_1,toggleState_1);
    Blynk.virtualWrite(VPIN_BUTTON_2, toggleState_2);

} void loop()
{
    Blynk.run();
}
```

8.2 OUTPUT

BLYNK APP INPUT:



OUTPUT



CHAPTER 9

SYSTEM TESTING:

1. Unit Testing

It is the testing of an individual unit or group of related units. It is done by the programmer to test that the implementation is producing expected output against given input and it falls under white box testing.

Unit testing is done in order to check registration whether the user properly registered into the cloud. It is done in order to check whether a file is properly uploaded into the cloud. And an encryption and decryption are checked with unit testing if it is converted properly. Then deduplication is checked with unit testing.

2.Integration Testing

All the modules should be integrated into a single module and it should be checked that it is still working still by integration testing.

3. System Testing

It is done to ensure that by putting the software in different environments and check that it still works. System Testing is done by uploading same file in this cloud checking whether any duplicate file exists.

4. Software Testing

It is the process of evaluating a software item to detect differences between given input and expected output. Testing assesses the quality of the product. In other words, software testing is a verification and validation process.

5. Verification

Verification is the process to make sure the product satisfies the conditions imposed at the start of the development phase. In other words, to make sure the product behaves the way we want it to.

6. Validation

Validation is the process to make sure the product satisfies the specified requirements at the end of the development phase. In other words, to make sure the product is built as per customer requirements.

7.Black Box Testing

Black box testing is a testing which ignores internal mechanism of system and focuses on output generated against any input and execution of system. It is done for validation. It is done to check encryption and decryption after uploading a file into the cloud.

8.White Box Testing

It is done for verification and it is a testing that takes into account the internal mechanism of the system. It is done by checking content verification. It will verify that whether same content exists in the cloud.

CHAPTER 10

10.1 CONCLUTIONS

The internet of things' (IoT) principles and advantages will probably completely change how people interact with their surroundings. The advancements have made it possible for people to control several aspects of a home from a single system. Although having a single system control all aspects of the house raises security concerns, these worries are unfounded. The technology allows for customization of the features, and in the event of an incursion in one section of the system, there is a good possibility that the homeowner will notice the change. In addition, the IoT idea is good for the environment because it encourages communal resource management. As an illustration, the light bulb turning off since there is no longer any darkness demonstrates that waste is kept to a minimum. More importantly, it indicates that there is hope for the proper use of our food resources when the refrigerator alerts the home owner that a product's expiration date is approaching. As a result, it is imperative that more people accept the ingenious concepts of the internet of things.

10.2 FUTURE ENHANCEMENT

Based on our experience we'd suggest that adding value to the worth of your home is a secondary benefit as opposed to a primary reason for adding smart devices. We certainly wouldn't advocate installing Smart Home Tech just to try and increase the value of your home!

That said, by creating energy efficient smart homes that have a positive impact on things like saving energy, comfort, security and convenience, it should be easy to demonstrate to any potential future purchaser that your house is a better prospect than an equivalent property that doesn't haveany Home Automation installed.

And remember, Vesternet are the only Home Automation supplier to offer free pre-sales advice – use and abuse this fact! We're here to help you in the initial planning phase and answer your questions to assist you with making good choices.Smart devices are already available to suit most requirements, so in terms of the type (sensors, actuators, etc) we don't believe that there will be much development in that respect. Instead, evolution will take over, with existing products being improved in terms of technological advancements in the protocols that they use (WiFi, Z-Wave, Zigbee, etc) and in terms of the features and functionality that they offer.

CHAPTER 11

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