**Chapter 1: INTRODUCTION**

**1.1Overview:**

The project aims at designing an advanced home automation system using normal web server and Wi-Fi technology. The devices can be switched ON/OFF and sensors can be read using a Personal Computer (PC) through Wi-Fi. Automation is the most frequently spelled term in the field of electronics. The hunger for automation brought many revolutions in the existing technologies. These had greater importance than any other technologies due to its user-friendly nature. These can be used as a replacement of the existing switches in home which produces sparks and also results in fire accidents in few situations. Considering the advantages of Wi-Fi an advanced automation system was developed to control the appliances in the house. Wi-Fi (Short for Wireless Fidelity) is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi has initial speeds of 1mbps to 2mbps. Wi-Fi transmits data in the frequency band of 2.4 GHz. It implements the concept of frequency division multiplexing technology. Range of Wi-Fi technology is 40-300 feet. The controlling device for the automation in the project is a Arduino UNO. The data sent from PC over Wi-Fi will be received by Wi-Fi module connected to Arduino UNO. Arduino UNO reads the data and decides the switching action of electrical devices connected to it through Relays.

* The goal of this project is to develop a home automation system that gives the user complete control over all remotely controllable aspects of his or her home.
* The automation system will have the ability to be controlled from a central host PC, the Internet, and also remotely accessed via a Pocket PC with a Windows Mobile based application.
* The System will also sense the Accidental Gas leakage, water level and will notify the user by SMS.

Internet has become an important part of human’s social life and educational life without which they are just helpless. The Internet of things (Iot) devices not only controls but also monitors the electronic, electrical and various mechanical systems which are used in various types of infrastructures. These devices which are connected to the cloud server are controlled by a single user (also known as admin) which are again transmitted or notified to all the authorized user connected to that network [2-5]. Various electronics and electrical devices are connected and controlled remotely through different network infrastructures. Web browser present in laptop or smart phone or any other smart technique through which we can operate switches, simply removes the hassle of manually operating a switch. Now a day’s although smart switches are available they proves to be very costly, also for their working we required additional devices such as hub or switch [3, 6].As there is rapid change

in wireless technology several connectivity devices are available in the market which solves the purpose of communicating medium with the device and the micro-controller. Starting from Bluetooth to Wi-Fi, from ZigBee to Z-wave and NFC all solve the purpose of communicating medium. RF and ZigBee are used to use in most wireless networks [4, 7]. In this project we have taken ESP8266-01 Wi-Fi module which is programmed through Arduino UNO to control various devices. The rest of sections in this paper are organized as follows: Section II provides a system overview of the system. The hardware design is explained in Section III, Section IV discusses about the software design and experimental results are discussed in Section V. At the end the paper concludes by looking at the future research and recommendations which are required to make the system more effective.

**1.2Purpose:**

The purpose of this project is to develop a concept and a prototype of a smart power control system that allows for scalable home automation and can be used to operate existing home appliances and electrical equipment. The concept aims to increase the convenience of controlling home appliances for a broad audience, by being simple to install, maintain, and use.

**1.3SCOPE:**

Day by day, the field of automation is blooming and these systems are having great impact on human beings. The project which is to be implemented is a home automation using Easy IOT Web server and WIFI and has very good future development.

In the current system web server is installed on a windows PC so the home appliances can be controlled using only by using the device on which web server is installed. This can be further developed installing web server on cloud .

Advantage of installing web server on the cloud is that home can be controlled by using any device which has WIFI 802.1 and a web browser. By visiting the IP address of the cloud the control actions can be taken.

This project aims to create a concept for a home-automation system with the use of existing technologies. Control of a vast area of existing devices should be taken into consideration; however, as a limitation of the prototype, only functionality to control power supply to existing devices will be implemented. In order for users to control the system, this project will develop an Android application; however, aesthetics of this application will not be prioritized, as functionality is considered of higher importance. Furthermore, a home-automation system could involve features such as artificial intelligence (AI) or power measuring capabilities, but this is beyond the scope of this project. However, this project will attempt to implement simple automation functionality that could be beneficial to the user. Security aspects are also taken into consideration, but will not be implemented due to time restrictions.

**1.4Method:**

In order to make the purpose applicable and practicable to implement, specifics regarding what should be done needed to be gathered. Therefore, a preliminary survey was conducted with the intent of gaining perspective of the current home automation needs. The participants were asked questions regarding previous knowledge of home automation-systems and to give feedback on desired system features.

Based on the result of the preliminary survey, research was conducted on available technologies and utilization of these. Development was logically divided into several subareas, which were relatively independent of each other. Each project group member was assigned to mainly work on and be responsible for one such sub-area. This allowed different group members to work in parallel in a structured way.

When the project group believed the product to be in a sufficient state, user tests were conducted to evaluate the result of the project. Each participant was handed a number of prototype units, as well as the Android application. When the test period was over, the participants evaluated the system by answering a set of questions in the form of a survey.

**Chapter 2: Literature survey**

**Review of Related Literature:**

When people think about home automation, most of them may imagine living in a smart home: One remote controller for every household appliance, cooking the rice automatically, starting air conditioner automatically, heating water for bath automatically and shading the window automatically when night coming. To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast.

**Review of Foreign Studies:**

In their paper, Tan, Lee and Soh (2002) proposed the development of an Internet-based system to allow monitoring of important process variables from a distributed control system (DCS). This paper proposes hardware and software design considerations which enable the user to access the process variables on the DCS, remotely and effectively Potamitis, Georgila, Fakotakis, and Kokkinakis, G. (2003) suggested the use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition In the year 2006, S. M. Anamul Haqus. M. Kamruzzaman and Md. Ashraful Islam proposed a system entitled “A System for Smart-Home Control of Appliances Based on Time and Speech Interaction” that controls the home appliances using the personal computer. This system is developed by using the Visual Basic 6.0 as programming language and Microsoft voice engine tools for speech recognition purpose. Appliances can be either controlled by timer or by voice command.

Ciubotaru-Petrescu, Chiciudean, Cioarga, and Stanescu (2006) present a design and implementation of SMS based control for monitoring systems. The paper has three modules involving sensing unit for monitoring the complex applications. A processing unit, that is microcontroller and a communication module that uses GPRS modem or cell phone via serial port RS-232. The SMS is used for status reporting such as power failure. Jawarkar, Ahmed, Ladhake, and Thakare (2008) propose remote monitoring through mobile phone involving the use of spoken commands. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS takes a decision of a particular task. Prof. Era Johri Dept. Of Information and Technology K.J.Somaiya College Of

Engineering VIDYAVIHAR, MUMBAI “Remote Controlled Home Automation Using Android Application via Wi-Fi Connectivity”.

Home automation is a challenging one not only to the developer but also to the consumer. Developer has to choose the component as per the customer requirement. Due to all the customer demands are not equal hence they have to compromise with the existing products.

Through detailed study of “Home Automation Using Internet of Thing” proposed by Shopan Dey, Ayon Roy and Sandip Das, it is found that they have used Raspberry pi module to connect ESP8266-01 module to the internet.

Through this module they are controlling various devices through web page and also through android application [2]. K. Venkatesan and Dr. U. Ramachandraiah in their paper have implemented Zigbee module in Arduino mega through which they are controlling devices. They have used various sensors for various purposes. Also they have provided real time notification, feedback on web-server in which customers can see what is happening in their home [1]. With the help of logic gates, a Raspberry pi, 555 timer and flip-flop also the devices are controlled from web app. Paper proposed by Shashank Shiva Kumar Jha, Vishwateja Mudiam Reddy, Tapan Pokharna, and Naresh Vinay shows how this is operated and controlled.

Rozita Teymourzadeh, Ceng, Salah Addin Ahmed, Kok Wai Chan, and Mok Vee Hoong have made use of the Global System for Mobile communication (GSM) technology to control various home appliances via Short Message Service (SMS). Home owners will be notified whenever any appliance is switched on/off using the mobile [12]. Ana Marie. D Celebre, Ian Benedict A. Medina, Alec Zandrae D. Dubouzet, Adrian Neil M. Surposa, and Engr. Reggie C. Gustilo have made use of Apple’s Siri’s capability of speech recognition as a controlling method of the home appliances. Raspberry Pi is used for interfacing with the appliances and SiriProxy is installed on the Raspberry Pi as the proxy server [1]. The drawback in this is that the system is only available to Apple users. There is no application which enables android user to use this system. Sharon Panth and Mahesh Jivani are using Bluetooth technology in their project for controlling appliances such as lights, fans, etc using a relay. It has the capability of controlling one to twenty four different appliances in the household [14]. However, this system only works with android phones and also, since it uses Bluetooth technology, the range for controlling the appliances is very limited. Sarthak Jain, Anant Vaibhav, and Lovely Goyal have designed a home automation system using Raspberry Pi through reading the subject of the e-mail. The algorithm used has been developed in python environment and LEDs are used to indicate switching actions [5]. To resolve a few problems in the above systems, wife technology should be used for a much wider range of communication. A pattern analysis can also be performed on the data collected by the sensors. This will make the system much more energy efficient as it will have the ability to automatically switch on/off appliances based on regular usage pattern

**Chapter 3: Requirement analysis**

This chapter categorizes requirements for creating applications in smart homes. The list of requirements provides guidance for tool developers from an industry perspective. A composition tool should either fulfill these requirements inherently or provide means to solution developers (e.g., installers, home owners) to cover relevant aspects with little effort. The requirements are clustered in seven categories, each of which consists of three to five requirements.

**3.1Simplicity:**

Simplicity describes the complexity of application development. It involves the interaction between the system and the application developer.

* Learning: Targeting usually untrained home end-users the composition tool must be easy to learn and simple to use.
* Building/Changing: Experienced or trained users should be able to quickly develop or modify even complex applications.
* Levels of abstraction: Providing multiple layers of abstraction allows to hide implementation details to end users and to expose them to more advanced developers.

**3.2Modeling:**

This category deals with requirements that affect the way the smart home applications can be modeled.

* Eventing: Applications in smart homes are highly event-driven. This is due to domain characteristics as well as resource and energy constraints of devices. Thus it should be possible to model fine-grained event management (e.g., subscribe, unsubscribe) and event delivery. It should further be possible to model event management, to deal with both synchronous and asynchronous events, and to handle events with defined and undefined order.
* Expressiveness: Smart home applications combine information from multiple domains (e.g., health care, security). To make creation of such applications efficient, application developers should be limited in their capabilities to some extent. However, the challenge is to still provide the expressiveness that is needed to develop powerful domain-specific and cross-domain applications.
* Statefulness: Modeling states of the complete environment and transitions between states is closely related to state-based devices in the home domain. This results in different behavior of a function with respect to a system’s state (e.g., when logged in or not logged in).

**3.3Time:**

The ability to impose timing constraints on the system is crucial for two reasons. First, smart home applications affect the real world. Second, applications interact with resource-constrained devices which exhibit limited availability and varying delays. This distinction between real world data timing and communication timing may significantly impact fulfilling the requirements in complex scenarios. For example, the age of a sensor reading may include the real world time of the measurement as well as the time of transporting the data from the source to the sink.

* Hard real-time: A system which supports hard real time guarantees that a certain action is performed within a given time frame. Smart home developers can specify this time frame in application development. In near term we expect no use case that requires actual hard real-time.
* Soft real-time: In contrast to hard real-time, missing a time frame in a soft real-time system is not considered as an error but a quality problem. Over time, if soft real-time deadlines are missed more often, system acceptance suffers.
* Age: In systems with energy-constrained devices caching mechanisms are used to reduce energy consumption. Providing means to the developer to specify a minimum or maximum age of sensor readings is required (e.g., a heating device which uses room temperature measurements).
* Synchrony: Performing actions synchronously (e.g., using a checkpoint-based approach) or intentionally asynchronously allows the developer to specify that events start or end at the same time (e.g., lights are switched on at the same time or avoiding all devices to be switched on at the same time to prevent from peaks in the power supply system). This requirement mostly addresses quality (acceptance) of the system.
* Periods: For periodical actions application developers must be able to specify both the period of events and a maximum jitter each event may have.

**3.4Mobility:**

Mobility includes both mobile devices and changes in the system (e.g., devices and services leave or join the system).

* Discovery: Discovery enables detection and integration of devices statically during design time or dynamically during runtime. In case of a repository, devices are located based on a match between their capabilities and the user’s preferences.
* Device Disappearance: The opposite of discovery denotes the capability of a system to detect when devices or services leave the network and to react accordingly.
* Location Awareness: Some applications require location-aware devices and services. Thus application developers should be able to a) find out the location of specific devices and b) find devices with respect to a given location in order to use services of these particular devices.

**3.5. Technical:**

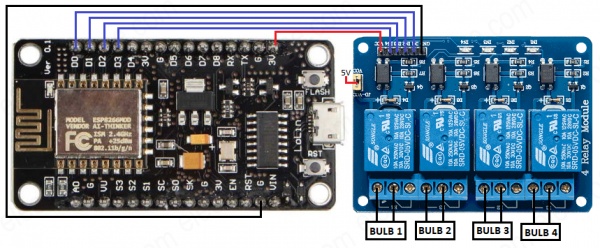
This section describes technical requirements to a composition solution.

* Interaction with Heterogeneous Services: Interconnecting heterogeneous services and devices (e.g., DPWS, REST, non-IP based) is necessary to develop smart home applications. Services might both reside on devices in the home or in the Internet (e.g., higher valued services like include weather forecast in heating control).
* Extensibility: Using new functionalities which are not foreseen at design time requires extensible tools and methods for application development. As an example, device discovery might be included later on but not in the first revision of the solution.
* Traceability: Tracing actions (e.g., start of a process, invoking an event) is often required either for statistics or liability issues.

**3.6. Security, Safety and Privacy:**

* Process Safety: Unsafe applications negatively impact devices or the environment in a way which is not foreseen by the developer and must be predicted to ensure process safety.
* Confidentiality: Information of the system should not be visible to anyone except for a defined group of people.
* Authentication and Authorization: Enabling confidentiality requires fine grained authentication and authorization mechanisms to access processes, devices and services.

**3.7.Hardware requirements**

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**Figure3.1:Circuit diagram**

**Circuit Diagram Explanation**

NodeMCU to 4- Channel Relay Board

* Connect D0 pin of NodeMCU to D1 pin of 4- Channel Relay board.
* Connect D1 pin of NodeMCU to D2 pin of 4- Channel Relay board.
* Connect D2 pin of NodeMCU to D3 pin of 4- Channel Relay board.
* Connect D3 pin of NodeMCU to D4 pin of 4- Channel Relay board.
* Connect 3.3V of NodeMCU to Vcc pin of 4- Channel Relay board.
* Connect GND pin of NodeMCU to GNDpin of 4- Channel Relay board.

**3.8 Software Requirements**

**Blynk Library Installation**

1. Download the zip file for Blynk Library : [Blynk\_Release\_v0.4.8](https://electrosome.com/wp-content/uploads/2018/09/Blynk_Release_v0.4.8.zip)
2. Extract the downloaded zip file in a folder.
3. Open up [Arduino](https://electrosome.com/arduino/) IDE*,*go to: File -> Preferences and under the *Settings* tab, copy the sketchbook location path.
4. Now open the file explorer and go to the copied path location. This is the path where all the libraries are installed. So, we have to copy all the newly downloaded Blynk libraries into this folder.

* Copy the files/folders from the Libraries folder of the downloaded Blynk directory, and paste it to the Libraries folder of your Arduino IDE’s directory (The path which we copied in step 3).
* Similarly, copy the files/folder from the Tools folder of the downloaded Blynk directory, and paste it to the Tools folder of your Arduino IDE’s directory.

**Installation and configuration of blynk app**

1. Firstly install “Blynk” application from play-store and open it.
2. Create an account by using Email account or Facebook account.
3. Click on New Project, enter the Project Name (enter the Project Name according to your wish) as “**Home Automation**“, Choose Device as “**NodeMCU**“, Connection Type as “**Wi-Fi**” and then click “**Create**” icon.
4. After the creation of Project, App will send the **Auth Token** code to registered Email ID.
5. Click on the “+” icon which located on top right side of the app to create buttons.
6. Enter the button name and select the GPIO pins (example: D0, D1, D2, D3)

**Chapter 4: System analysis**

**4.1 Existing system:**

**a) Bluetooth based home automation system**

Home automation systems using Smartphone, Arduinoboard and Bluetooth technology are secured and low cost. ABluetooth based home automation system proposed byR.Piyare and M.Tazil [2]. The Bluetooth system uses a PC orSmartphone as receiver device. It has a high communicationrate, great security and low cost, so it can be implemented as a real time system. Bluetooth network has limited range of 10 meters if the Smartphone is out of range, then it will not be able to control the home appliances, this is one of the main disadvantages of Bluetooth based home automation system

**b) Voice recognition based home automation**

Voice recognition based home automation system proposed and implemented by a researcher [3]. The wireless communication between the Smartphone and the Arduino UNO is done through Bluetooth technology. This will be more helpful for handicapped and aged people who wants to control appliances by speaking voice command The main drawback of this system is that communication between user and voice recognition tool depends on signal to noise ratio (SNR), if voice signal is noisy then communication can highly effect and the system will fail to show accuracy.

**4.2Proposed system:**

The proposed work aims at designing a smart laboratory that facilitates remote monitoring and control of the lab devices using mobile application and Node-RED dashboard. In this system, each lab device is interfaced with a data acquisition module that is an IoT object with a unique IP address resulting in a mesh wireless network of devices. The data acquisition System on Chip (SoC) module collects energy consumption data from each device of smart lab and transmits the data to a centralized server for further processing and analysis [7]. All appliances in the laboratory use MQTT (Message Queuing Telemetry Transport) protocol for communication.

****

**Figure4.2: Block diagram of the proposed system**

The proposed system is implemented using Node MCU by overcoming all the drawbacks of previous existing methods in this project all the sensors are connected to the Node MCU board and the results can be seen in Smart phone. For every second it shows new value. If any gas leakage happens the value of air purity sensor shows the high value at that time we can turn on the fan to send the gas out. The camera module is connected to the Arduino UNO board because in Node MCU board we have only one analog pin For camera module we will use more analog pins, so we are connecting camera module to Arduino UNO. When IR sensor detects the motion, the camera module will be turned on. The captured images will be stored in folder of our PC and, it sends Captured images to the user email.\

**4.3Feasibility study**

**4.3.1. Economical Feasibility**

To assess the cost benefits to Region 11 as a result of automation, we compared the effort that will be expended in the instrumental analyses, sample coordination, and management areas by manual methods to the expected effort by computer automated methods.

The increased efficiency after automation can be expressed as full time employee (FTE) effort made available for other tasks such as making more analyses or surveys. Benefits, expressed as increased efficiency, are summarized in Table 4. Details of this assessment are given in Appendix C. On-line instrument automation and quality control (QC) will make available 3.36 FTE, while san pie management automation will free another 2 FTE. Because the laboratory's expected average annual cash output per employee is a; proximately S45.600,\* the savings attributable to laboratory automation and QC is equivalent to $153,200/y. The savings in management effort is equivalent to $91,200/y. Thus, the total savings accrued to Region II is $244,400 annually.

**4.3.2. Technical Feasibility**

The Technical Support Branch participates in all six phases of a typical survey. The primary functions of the branch are to provide reliable data as quickly as possible in the field and laboratory. The activities within the Technical Support Branch differ from those of the other branches. This is because much of the time must be spent on complex chemical analyses (e.g., tests using Auto- Analyzer, atomic absorption, chromatographic, and gas chromatographic-mass spectrometer methods) of water and gasoline surveillance surveys,

and quality-control records.

Many different variables are determined in the Region II Edison laboratory for the most part by instrumental techniques. Some of the more frequently to be certain that the methods and instruments are functioning properly. Region II maintains one Mobile Laboratory at Edison and one at Rochester ',hat are used on-site to monitor bacteriological changes, biological oxygen demand, pH, total suspended solids, and other time-sensitive tests. There is also an Air Mobile Laboratory at Edison containing instruments for the analysis of S02, NO>, oxidants, methane and non methane hydrocarbons, CO, and a tape sampler for particulates in air. The data is collected on a Wang 600 and reduced from the tape on a second Wang 600 for printout of hourly averages and other data on a typewriter.

**Chapter 5: System Design & Architecture**

**5.1. High Level Design**

High-level design (HLD) explains the architecture that would be used for developing a software product. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the product and their interfaces. The HLD uses possibly nontechnical to mildly technical terms that should be understandable to the administrators of the system. In contrast, low-level design further exposes the logical detailed design of each of these elements for programmers.

**5.1.1. System Architecture**

**Description:** The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that’s just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to

Occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution!

**Features:**

802.11 b/g/n

 Wi-Fi Direct (P2P), soft-AP

 Integrated TCP/IP protocol stack

 Integrated TR switch, balun, LNA, power amplifier and matching network

 Integrated PLLs, regulators, DCXO and power management units

 +19.5dBm output power in 802.11b mode

 Power down leakage current of <10uA

 1MB Flash Memory

 Integrated low power 32-bit CPU could be used as application processor

 SDIO 1.1 / 2.0, SPI, UART

 STBC, 1×1 MIMO, 2×1 MIMO

 A-MPDU & A-MSDU aggregation & 0.4ms guard interval

 Wake up and transmit packets in < 2ms

 Standby power consumption of < 1.0mW (DTIM3)

Specification of ESP 8266:

Wi-Fi Direct (P2P), soft-AP

 Integrated TCP/IP protocol stack

 Integrated TR switch, balun, LNA, power amplifier and matching network

 Integrated PLLs, regulators, DCXO and power management units

 19.5dBm output power in 802.11b mode

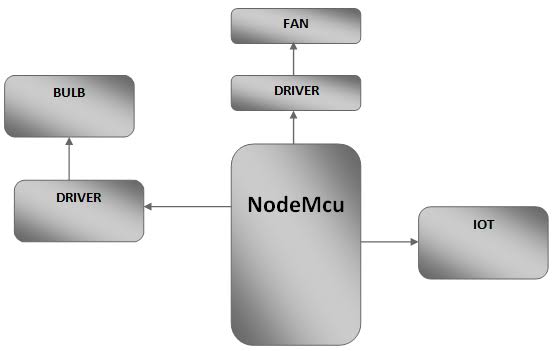
 Power down leakage current of <10uA

 1MB Flash Memory

 Integrated low power 32-bit CPU could be used as application processor

 Standby power consumption of < 1.0mW (DTIM3)

Figure. And .Gives an idea about the operation of home automation system. The four different appliances such as fan, light, room heater and TV are operated remotely using Wi-Fi and through an application installed on android or iPhone. These appliances are connected through Arduino Uno with its digital input/output pins. These devices are connected with local Wi-Fi using a communicating module called esp8266-01.



**Figure5.1. Network Architecture of Figure 5.2. Home automation system**

**IoT devices**

**5.1.2Arduino code**

#define BLYNK\_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

char auth[] = "YourAuthToken";

char ssid[] = "YourNetworkName";

char pass[] = "YourPassword";

Void setup ()

{

Serial. begin (9600);

Blynk.begin(auth, ssid, pass);

}

void loop()

{

Blynk.run();

}

Code explanation

We are including ESP8266 Wi-Fi library which provides ESP8266 specific Wi-Fi routines and we are calling it to connect to the network. BlynkSimpleEsp8266 library establishes the communication between Blynk App and ESP8266.

#define BLYNK\_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

Get and enter Auth Token which is received from the Blynk App while creating a Project.

char auth[] = "YourAuthToken";

Get and enter the “ssid” and “password” i.e., your Wi-Fi name and password.

char ssid[] = "SERVER NAME";

char pass[] = "SERVER PASSWORD";

Put your setup or configuration code in the setup function, it will only run once during the startup.  
Here in the setup function, it will initialize serial communication for debugging and logging with a baud rate of 9600. This begins the connection for respective Blynk Auth Token, Server Name and Server Password.

void setup()

{

Serial.begin(9600);

Blynk.begin(auth, ssid, pass);

}

Put your main code in void loop() function to run repeatedly. This continuously runs with Blynk App commands.

void loop()

{

Blynk.run();

}

**Working**

The home automation circuit is built around ESP8266, Blynk Android App, and a 4-channel relay board. The hardware set up should be according to the circuit diagram. AC mains appliances (Bulbs) will be connected to relays which are controlled by the ESP8266.

User has to install and configure the Blynk App as per the above instructions.

Whenever the user presses a icon in the app, then that information will be send to ESP8266 via Wi-Fi. The ESP8266 analyses the received commands and turns ON/OFF of the respective device via 4 – channel Relay board.

Relay board:-



A relay is an electrical device which is generally used to control high voltages using very low voltage as an Input. This consists of a coil wrapped around a pole and a two small metal flaps (nodes) that are used to close the circuit. One of the nodes is fixed and other is movable. Whenever electricity is passed through the coil, it creates a magnetic field and attracts the moving node towards the static node and the circuit gets completed. So, just by applying small voltage to power up the coil we can actually complete the circuit for the high voltage to travel. Also, as the static node is not physically connected to the coil there is very less chance that the Microcontroller powering the coil gets damaged if something goes wrong.

This is Four Channel relay board controlled by computer USB port. The usb relay board is with 4 SPDT relays rated up to 10A each. You may control devices 220V / 120V (up to 4) directly with one such relay unit. It is fully powered by the computer USB port. Suitable for home automation applications, hobby projects, industrial automation. The free software allows to control relays manually, create timers (weekly and calendar) and multivibrators, use date and time for alarms or control from command line. We provide software examples in Labview, .NET, Java, Borland C++, Python

Features:-

Power led: Yes

 Relay leds: Yes High quality

 4 SPDT Relay channels - selectable by user:

* JQC-3FC/T73 DC5V (7A / 250VAC, 10A / 125VAC, 12A / 120VAC, 10A /

28VDC)

RAS-05-15 (10A / 250VAC, 15A / 120VAC, 15A / 24VDC)

 PCB parameters: FR4 / 1.5mm / two layers / metalized holes / HAL / white

Stamp / solder mask / еxtra PCB openings for better voltage isolation /

Doubled high voltage tracks

 Power supply: from USB port

 Current consumption: 400 mA

 Chip: FT245RL

 Size: 77mm x 56mm x 17mm

 Supported by DRM software (Windows and Linux): Yes

 Supported by Denkovi Command line tool (Windows, Linux): Yes

 Android software available (low cost but very useful): Yes - New

 Software examples - here

 Documentation: here

Advantages:-

* High quality
* Low cost
* No extra power supply
* Software with many functions
* Control electrical devices according weekday/date/time
* Create timers or pulses with our software

Applications:-

 Home automation

 Robotics

 Alarms

 Timers

 Open doors and windows via PC

 Aquariums applications

Additional information:-

This is relay board with 4 SPDT Relays controlled from USB port of your computer. The main purpose of this USB relay module is to help you building projects regarding robotics and home automation (domotic). You may control different electrical devices like home lights, DC motors, pneumatic cylinders, lasers and so on. Each such board requires one USB port. The more

USB ports you have the more such relay units you may connect and control. . The relay module outputs are controlled by FT245RL. It has 8 bit data output controlled directly via COM port

you need to download our DRM Software to control the device. The usb relay unit cannot work without PC. Only one such device can be supplied from single USB port. If you want to supply many such devices you need USB HUB with extra power supply.

**5.2. Low Level Design**

(LLD) is a component-level design process that follows a step-by-step refinement process. This process can be used for designing data structures, required software architecture, source code and ultimately, performance algorithms. Overall, the data organization may be defined during requirement analysis and then refined during data design work. Post-build, each component is specified in detail.

The LLD phase is the stage where the actual software components are designed.

During the detailed phase the logical and functional design is done and the design of application structure is developed during the high-level design phase.

The goal of LLD or a low-level design document (LLDD) is to give the internal logical design of the actual program code. Low-level design is created based on the high-level design. LLD describes the class diagrams with the methods and relations between classes and program specs. It describes the modules so that the programmer can directly code the program from the document.

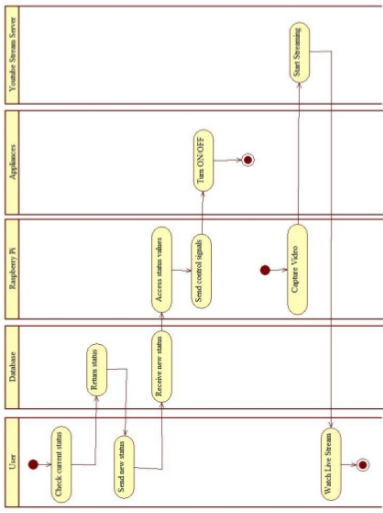
A good low-level design document makes the program easy to develop when proper analysis is utilized to create a low-level design document. The code can then be developed directly from the low-level design document with minimal debugging and testing. Other advantages include lower cost and easier maintenance.

**5.2.1. Data Flow diagram**

****

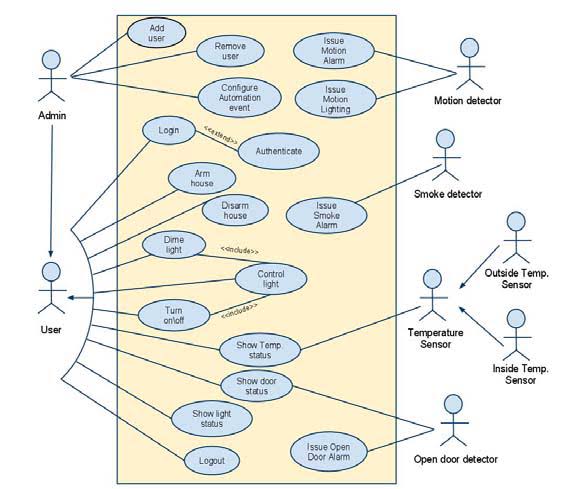
**Figure5.3.Data flow diagram**

**5.2.2. Sequence diagram**

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**Figure5.4: sequence diagram**

**5.2.3. Use Case diagram**

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**Chapter 6: Implementation**

**6.1. Modules**

There are 3 types of modules in this project:

1) Working Module 1.

2) Working Module2.

3) Working Module 3.

**1) Working Module 1:**

In this module, the hardware module contains microcontroller, device driver, serial communication, relay board, devices and sensors.max 232 cable is used for serial communication between the pc and the circuit board two types of sensors are used.ie.IR (Infrared sensors) and PIR sensors.IR sensors are used for keeping count of number of people entering and leaving the lab.PIR sensors are used for detecting motion within the lab in case there is entry other than the main entrance of the lab. There is also an ADC converter which converts the analog signals sent from the signal conditioner to digital signals. There is a 32bit microcontroller which has a high performance but low power during operation. The device operates between 1.8-5.5 volts The ULN2003 is known for its high-present, high-voltage limit. The drivers can be paralleled for even higher current output. Significantly further, stacking one chip on top of another, both on top of another, both electrically and physically has been done.

Generally it can be used for interfacing with a stepper motor, where the motor requires high ratings which cannot be provided by other interfacing devices. There is a relay board on which devices like fans, lights etc connected for operation. A device driver is attached to the relay board. Now, this whole circuit board is connected to the PC database via a MAX 232 cable specifically used for serial communication.

**2) Working Module 2:**

In this module, the database used is Glassfish. It’s a desktop application. This is connected to the circuit board by serial communication by MAX 232 cable. The database checks the count of people entering and leaving the lab. It also checks the time .i.e. the time within which people enter and leave the lab. If any motion is detected after the lab hours then an alert is generated and consequently an alert message is sent to the lab admin.

**3) Working Module 3:**

****

**Figure6.1. Working Module 3**

In this module, there are 2 concepts described.

1. Remote Monitoring and

2. Remote Controlling.

These 2 concepts are widely used in securing the labs.

1) In Remote Controlling, the devices (fans, lights, and computers) can be controlled .i.e. they can be switched off and switched on by an android application via speech Recognition. Once the lab admin enters the lab in the morning, via speech recognition, the lights and fans and other devices are automatically switched on.

2) In Remote Monitoring the IR sensors keep count of people entering and leaving the lab. If the count is 0 then there is no issue but if the count is 1 then there is an alert.

If there is unauthorized access in the lab or any motion is detected after the lab hours then an alert message is sent to the lab admin on his android phone using the android application using Wi-Fi.

**Chapter 7: Testing**

There are two fundamental approaches to testing called, black- and white box testing. White-box testing means that the tester has access to the source code, and the tester commonly writes unit tests using this knowledge. Unit testing is the testing of the smallest unit of isolated code. A unit test in an object oriented environment commonly tests a single method by making assertions on what output is expected from the method given certain input.

The purpose of unit tests is thus to make certain that a method behaves as expected even when given

Unexpected input, for instance a string instead of an integer or an integer above a certain threshold (for instance in the home automation system, a Dimmer’s level property should never exceed 100). Generally all the “corners” should be tested. Unit tests are written for whole classes, meaning for every method in a class, and a so-called “driver” is written to automate the execution of unit tests. These forms of testing have not been employed in any of the systems implemented during this project. This is unfortunate as unit testing, from personal experience, is a good way to perform code review to both secure and optimize methods, but time simply has not permitted it.

The “black” in black box testing implies that the tester has no access to the source code, but can interact with the system being tested to see if it fulfills system requirements. Section 2.3.1 defines requirements for-users (a.k.a. Mr. and Mrs. Smith) and the system is tested in a black box manner, to show that it fulfills the functional requirements listed there, namely:

**7.1. Test cases**

|  |  |
| --- | --- |
| 1 | On click-on button light is on |
| 2 | On click-off button light is off |
| 3 | Check it should worked in high and low voltage |
| 4 | Click on whether the bulb is glowing after power on |
| 5 | Click off whether the bulb is shutdown after power off |
| 6 | Check whether the bulb glows when there is a Wi-Fi is connected |
| 7 | Check whether the bulb glows when there is a power supply |
| 8 | Check it is handled very carefully |
| 9 | Check whether the bulbs glows for many months then it suddenly not glows |
| 10 | Check the written program for light on and off error free |
| 11 | Life of the bulb should meet the requirements |
| 12 | Should glow with reqd illumination (correct me if wrong) |
| 13 | Check whether the wife connect to the room or not |
| 14 | If On click-off should not glow on |
| 15 | If On click-off should not glow on |
| 16 | Check the bulb is fitted to the bulb attached |
| 17 | Verify the initial voltage it takes to blow |
| 18 | Verify if suddenly click on and off what will happen |
| 19 | verify the electricity passing thought that wire or not |
| 20 | Verify the power consumption |

**7.2. Screen shots**

**Conclusion**

Lab is secured. If the fans and lights are ON in the absence of the staff and students, then they are automatically turned OFF. Intruders if any can be detected after lab working hours using motion detection sensors. IR (Infrared) Sensors keep the count of number of people going in and out of the lab. If an intruder breaks in, then the buzzers automatically starts to work and via this the security guards are alerted and the intruder can be caught red-handed for trying to steal confidential data or hack into the system server.

Thus all devices can be controlled universally, and the status of the devices can be visualized. This feature will help the user to analyze the status of these devices anytime and anywhere. It reduces human intervention in monitoring the devices. This system can be further extended for automatic ON and OFF of appliances depending upon the number of users in the Lab using Omron thermal sensors. This system can be further implemented in hospitals for physically challenged people for controlling the appliances.

Internet of things based home automation system can only work in the presence of internet. The rapid growth of IoT devices brings concerns and benefits. Even though Wi-Fi is not available we can go to 3G or 4G services. This is one big advantage of IOT In this project, the use of a camera connected to the microcontroller might help the user in taking decision whether to welcome the guest after receiving the captured picture of the guest or intruder, If the user identifies he is an unknown person then the user can further forward the same photograph to the police station by explaining his situation. This project can also be implemented by using Raspberry.

a home automation system was designed and implemented using Arduino Uno as the microcontroller and Wi-Fi as the method of monitoring and controlling the home appliances which enables the user to remotely access the system from anywhere around the world. The system is capable of automating the operation of the appliances by analyzing the regular usage patter of the appliances by the user. This not just saves a lot of human effort, but also helps in conserving energy. Also, it can help the differently abled and the elderly in performing basic tasks at home such as switching on/off the light, fan, and so on without having to depend on others.

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