IOT Home Automation

A Major Project report for the evaluation and partial fulfillment of the requirement for the award of the degree

B. TECH. (IT)

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Candidate's Declaration

We, hereby, certify that the work embodied in this project report entitled "IOT Home Automation" in partial fulfillment of the requirements for the award of the Degree of B. Tech. (IT) submitted to the School of Information and Communication Technology, Gautam Buddha University, Greater Noida is an authentic record of our own work carried out under the supervision of Mr. Aamir Ali, School of ICT. The matter presented in this report has not been submitted in any other University / Institute for the award of any other degree or diploma. Responsibility for any plagiarism related issue stands solely with us.

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Signature of Supervisor

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Place: Gautam Buddha University, Greater Noida

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Abstract

Home automation is a topic which is gaining popularity day by day, because of large advantages. One can achieve home automation by simply connecting home appliance electrical devices to the internet or cloud storage. The reason for this surge demand of network enabled home automation is reaching the zenith in recent days for its simplicity and comparable affordability. Platforms based on cloud computing help to connect to the things surroundings everyone so that one can find it easy to access anything and everything at any time and place in a user friendly manner using custom defined portals. Hence, cloud act as a front end to access IOT. Here we are assuming a system which can control devices through wireless based network or cloud based approach. In project we use IOT based home automation system which goal 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 ability to be controlled from a central host PC, the internet, and also remotely accessed via a packet PC with a windows mobile based application using the VNC Viewer Server application.

Abbreviations

IOT	Internet Of Things
GPIO	General Purpose Input/Output
RPI	Raspberry Pi
DHT11	Digital Humidity & Temperature
VNC	Virtual Network Computing
IDLE	Integrated Development and Learning Environment

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CHAPTER-1. Introduction

1.1 Introduction

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture to communicate and sense interactions amongst each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established.

Home Automation

In the IoT home automation ecosystem, you can control your devices like light, fan, TV, etc. A domestic automation system can monitor and/or manage home attributes adore lighting, climate, enjoyment systems, and appliances. It is very helpful to control your home devices. [4]

Raspberry Pi

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.[1] It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

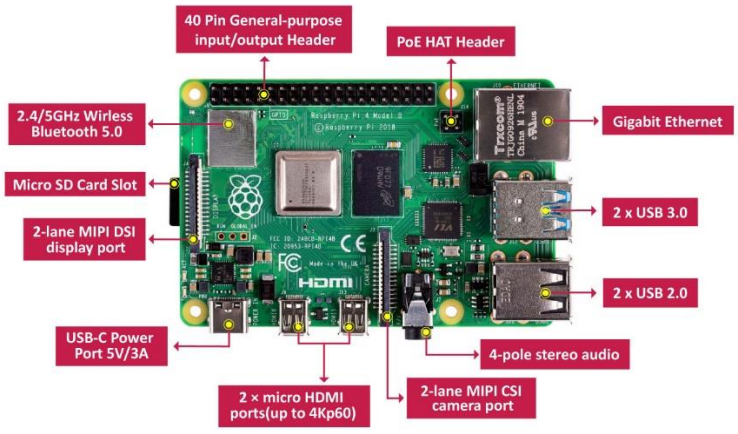


Fig 1: Schematic representation of RPI 3

Flask

Flask is a micro web framework written in Python. It is classified as a micro-framework because it does not require tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and several common framework related tools. [3]

DHT11

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use but requires careful timing to grab data. [7] You can get new data from it once every 2 seconds, so when using the library from Adafruit, sensor readings can be up to 2 seconds old.

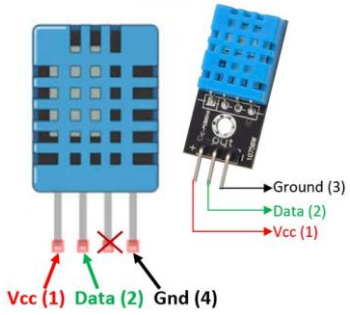


Fig 2: DHT11 Temperature & Humidity Sensor

Raspbian OS

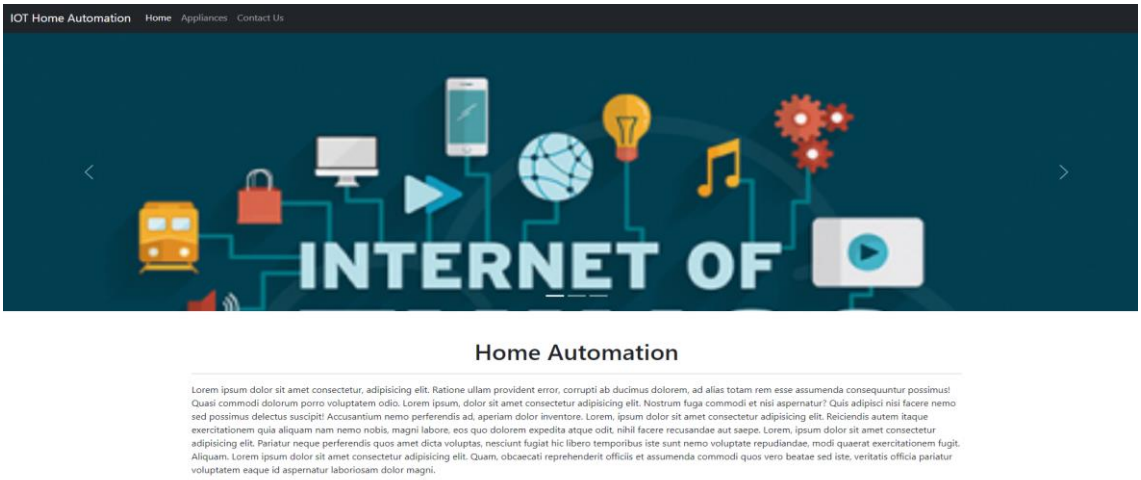
Raspberry Pi OS (formerly Raspbian) is a Debian-based operating system for Raspberry Pi. Since 2013, it has been officially provided by the Raspberry Pi Foundation as the primary operating system for the Raspberry Pi family of compact single-board computers. Raspberry Pi OS is highly optimized for the Raspberry Pi line of compact single-board computers with ARM CPUs. It runs on every Raspberry Pi except the Pico microcontroller. Raspberry Pi OS uses a modified LXDE as its desktop environment with the Openbox stacking window manager, along with a unique theme. The default distribution is shipped with a copy of the algebra program Wolfram Mathematicia, VLC, and a lightweight version of the Chromium web browser. [5]
Packages can be installed via APT, the Recommended Software app, and by using the Add/Remove Software tool, a GUI wrapper for APT.

Virtual Network Computing (VNC)

In computing, Virtual Network Computing (VNC) is a graphical desktop-sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer. It transmits the keyboard and mouse input from one computer to another, relaying the graphical-screen updates, over a network. [11]
VNC is platform-independent – there are clients and servers for many GUI-based operating systems and for Java. Multiple clients may connect to a VNC server at the same time. Popular uses for this technology include remote technical support and accessing files on one's work computer from one's home computer, or vice versa. [11]

Responsive Website

Responsive Web design is the approach that suggests that design and development should respond to the user's behaviour and environment based on screen size, platform, and orientation. The practice consists of a mix of flexible grids and layouts, images, and an intelligent use of CSS media queries. As the user switches from their laptop to iPad, the website should automatically switch to accommodate for resolution, image size and scripting abilities. One may also have to consider the settings on their devices; if they have a VPN for iOS on their iPad, for example, the website should not block the user's access to the page. [12] In other words, the website should have the technology to automatically respond to the user's preferences. This would eliminate the need for a different design and development phase for each new gadget on the market.



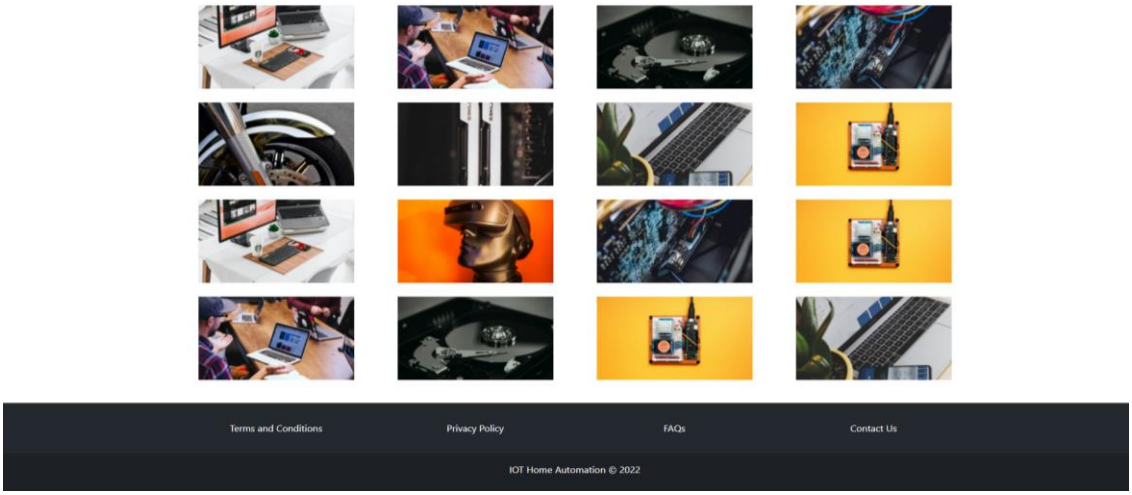


Fig 3: Responsive Home Automation Website

1.2 Motivation

Home computerization brings about a more astute home and is utilized to give a higher and more beneficial way of life. The magnificence of a home computerization framework is that it is very versatile, adaptable and its abilities are constrained just by our creative ability. With the IOT unrest practically around the bend, it's about time that we move towards boundless selection of such a prototype.

And to enhance the standard of living, the appliances need to be wholly automated without any user intervention in any form whatsoever. This enables the end user hassle-free interaction with the appliances as the appliances learn and react as per the user's requirements without him physically pressing a button. [6]

1.3 Applications

Home automation has been projected to target wide array applications for the new digital consumer. [13] Some of the areas where consumers can expect to see home automation led IoT-enabled connectivity are:

1. **Lighting**

Today, home lighting can automatically adjust to personal needs. For instance, if users start watching a movie, the lights can be programmed to automatically dim not to distract them from the plot. When you enter your home, the lighting can be turned on automatically without the necessity to press a button.

When you leave your home, the system can turn the lights off automatically to save energy, and you don’t have to worry about it. All the home lighting can be connected to your smartphone, laptop, and other connected devices. Consequently, you can configure your app so that your light turns on when your alarm rings in the morning.

2. **Bathrooms**

IoT technologies in the bathroom can make your home routine more entertaining and convenient. Smart mirrors can connect to other devices like laptops and smartphones, recognize the faces of family members in front of them, and display the information those people find interesting, such as news articles, weather forecasts, or specific websites. Special sensors can monitor movement in the bathroom and turn off the water automatically if no one is there. [13]

3. **Kitchen**

With artificial intelligence technology, IoT devices can make the cooking process safer and easier. Smart sensors can ensure that everything is OK in your kitchen: they can check for smoke and carbon monoxide, or that the temperature and humidity levels are right.

Special built-in programs monitor if the users have enough products in the fridge (and reorder them if needed), give advice on recipes, and calculate the nutritional value of meals. There are even smart spoons that remind users to be mindful of eating slowly.

4. **Security Systems**

These controllers can automatically lock the door when you go out, close the shutters, turn off electronic devices and make sure that your home is protected against human and animal trespassers. Users can check their home state remotely through the app on their phones, and control the temperature, humidity and lighting. Moreover, you can monitor your elderly relatives and help them if needed.

5. **Safety Sensors**

Safety sensors are smart devices that can identify when there is something wrong at your home. They can notify users of potential threats immediately and even take necessary action to prevent them. [13] All they need is a smartphone connected to the Internet and sensors installed at their home.

There are temperature, humidity, and gas controllers that can regularly check the air in your home and send you alerts on the Internet if the indicators are outside the optimum range. Safety sensors help protect your home from natural disasters, fires, water and gas leakages. Proximity and video sensors can identify if a burglar makes an attempt to enter your home, and automatically turn on the alarm and call the police.

6. **Temperature Control**

With temperature control automation, you can adjust the home temperature to the level that suits you best. Smart thermostats control the temperature based on configurations set by

users in accordance with their preferences. These controllers can check your current activity and change the temperature accordingly.

For instance, users can configure the app so that when they take a bath or a shower, the temperature would automatically go up. If they decide to work out, practice yoga, pilates, or any other physical activity at home, the temperature will decrease to help keep them cool.

7. **Doors**

The doors of our future will not need keys. To unlock your house, the smart door can use facial recognition. Any people that are not recognized as residents at the premises will need to be let in by a resident. The doors can further be programmed to open when you approach your home and close when you leave. [13]

8. **Windows**

Smart windows can be configured so that they react to the signals from other appliances or to triggering events. You do not have to worry if you have closed the windows when you leave home – the system will check this automatically, and close them if needed.

Windows can close or open at a preset time, and shutters can also open or close depending on the time of day. Thus, the shutters can be lifted in the morning and lowered in the evening. These devices can also respond to weather conditions such as rain, snow, storm, or strong wind.

1.4 Benefits and Limitations

Technology has enabled us to automate numerous aspects in business. Now, we can enjoy that within the four walls of our homes. Technology is allowing homeowners to run, manage and monitor their homes through their smart phones. [13] Such homes are known as automated or smart homes. Let us look at some benefits of automating your home:

1. Appliance Safety and Lighting Control

Through automation, you get the ability to control appliances in your home from any location with the touch of a button. You can control the lighting too. This allows you to ensure that the lights and appliances are turned off when you are not home, to save on electricity. You can also turn on the lights at specific times to make it look like you are home, thus increasing the safety of your home.

2. Security through Automated Door Locks

There must have been times when you or your kids rushed out of the house in a hurry and forgot to lock the door. With automated door locks, you can lock your doors with just one touch on your smart device from any place. You will also be alerted whenever someone enters the house allowing you constant monitoring, even when you are away from home.

3. Increases Awareness through Security Cameras

Security cameras make your home safer. You cannot be home or monitor everything always happening in and around the house, but you can automate the security system to provide the kind of security you desire. You can record clips, detect movements and view the activities around your house.

4. Allows you to Adjust Temperature

One of the most unpleasant things is coming to a house that is too warm or too cold. You can bring the temperature to your desired level by controlling the HVAC system but it would take time for the room to reach the desired temperature. With a home automation system in place, you can adjust thermostats from any place so that it is at a comfortable temperature by the time you reach home. [13]

5. Saves Time

Life has become really busy these days and various household chores keep you on your toes. Imagine running back home for a few minutes just to adjust some household item or opening the door for your kids after their school ends. You can manage all that through automation without having to go home. This helps in saving a lot of precious time and promotes productivity.

But no matter how good and efficient a system is, it's always better to consider the Disadvantages of Home Automation which are listed below:

1. Privacy issue

There is always the possibility of hackers breaking into the system and stealing the data. And one might want some personal space in life. So staying connected with

family and friends always giving them every detail of our life activity is not good. [13] There is every possibility of misusing your information.

2. Control of life

Our lives will be completely handled by technology and will be dependent on it. The younger generation is already addicted to technology for every little thing and going towards a lazy environment.

3. Unemployment

The Automation of IoT will have a devastating impact on the employment prospect of less-educated workers. People who are working in lower like security guard, house servant and laundry service may lose their occupation. [13]

CHAPTER-2. Literature Survey

2.1 Problem Definition

The **Internet of Things (IoT)** has been facing many areas like Information Technology, Healthcare, Data Analytics and Agriculture. The focus is on protecting privacy as it is the primary reason for other challenges including government participation. [4] Integrated effort from the government, civil society and private sectors would play a vital role in protecting the following values given below in to prevent IoT from getting hampered:

- **Scalability:**
  Billions of internet-enabled devices get connected in a huge network, large volumes of data are needed to be processed. The system that stores, analyses the data from these IoT devices needs to be scalable. In present, the era of IoT evolution everyday objects is connected with each other via Internet. The raw data obtained from these devices need big data analytics and cloud storage for interpretation of useful data.

- **Interoperability:**
  Technological standards in most areas are still fragmented. These technologies need to be converged. Which would help us in establishing a common framework and the standard for the IoT devices. As the standardization process is still lacking, interoperability of IoT with legacy devices should be considered critical. This lack of interoperability is preventing us to move towards the vision of truly connected everyday interoperable smart objects. [4]

- **Lack of government support:**
  Government and Regulatory bodies like FDA should come up and bring up regulations by setting up a standard committee for safety and security of devices and people.

- **Safety of Patients:**
  Most of IoT devices are left unattended, as they relate to real-world objects. If used on patients as wearable devices, any technical error in security can be life-threatening for patient.

- **Security and Personal Privacy:**
  There has been no research in security vulnerabilities and its improvements. [4] It should ensure Confidentiality, Integrity and Availability of personal data of patient.

- **Design Based Challenge:**
  With the development in technology design challenges are increasing at a faster rate. There have been issues regarding design like limited computation power, limited energy and limited memory which need to be sorted out.

2.2 Related Work

- *Bluetooth based home automation system using cell phones:*
  In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of Arduino BT board is based on high level interactive C language of microcontrollers; the connection is made via Bluetooth. The Bluetooth connection is established between Arduino BT board and phone for wireless communication. In this system the python script is used and it can install on any of the Symbian OS environment, it is portable. One circuit is designed and implemented for receiving the feedback from the phone, which indicate the status of the device. [9]

- *Smart home based on Zigbee:*

  Constructing the efficient, convenient, and cosy home environment has become the current hot spot by using ZIGBEE wireless communication technology. This system uses ZIGBEE Wireless Technology to build home internal Network and connect a variety of sensors and home appliance controller to ZIGBEE network node. Various signals collected by a few end-nodes may be delivered by this system to the main control module, which will analyze and process them. Then the main control module transfers this information to internet through the Ethernet and GSM/GPRS network to remotely and locally monitor and control family inner environment and household appliances. Furthermore, the working condition of the system can be traced into SD Cards.[8]

- *Wi-Fi based home automation system using cell phones:*

  Wi-Fi based home automation system mainly consist of three modules, the server, the hardware interface module, and the software package. The figure shows the system model layout. Wi-Fi technology is used by server, and hardware Interface module to communicate with each other. The same technology uses to login to the server web-based application. The server is connected to the internet, so remote users can access server web-based application through the internet using compatible web browser. Software of the latest home automation system is split to server application software, and Microcontroller (Arduino) firmware. The Arduino software, built using C language, using IDE comes with the microcontroller itself. Arduino software is culpable for gathering events from connected sensors, then applies action to actuators and preprogramed in the server. Another job is to report the and record the history in the server DB. The server application software package for the proposed home automation system, is a web-based application built using asp.net. The server application software can be accessed from internal network or from internet if the server has real IP on the internet using any internet navigator supports asp.net technology. Server application software is culpable of, maintain the whole home automation system, setup, configuration. Server use database to keep log of home automation system components, we choose to use XML files to save system log.[10]

CHAPTER-3. Objectives

3.1 Project Objectives

- The aim is to create a home automation system that performs all basic functions of a virtual assistant like telling the time, date, temperature and controlling the electrical appliances that it is connected to.

- The entire system is aimed to be operated through a website so that there is no need to type anything at all. Apart from the button operated commands, the system will also take the help of certain sensors to provide automation to certain appliances.

- To facilitate the wireless connectivity with the system, the Raspberry Pi will be embedded with a WiFi module. This establishes the internet connection to the system and all the home appliances can in turn be connected and controlled by internet.

- The main objective that must be kept in mind for this work is that it is developed for making everyday life of a user easy. Getting things done without having to try to do it is the main motto.

- The system also aims to provide for efficient utilization of electricity. This is achieved using IOT technology and Raspberry Pi kit and appliances like lights turn off without any explicit command by the user.

CHAPTER-4. Methodology

4.1 Project Development

4.1.1 Frontend Development

The website contains all the information regarding home automation and a user panel to control the LEDs in the breadboard via the buttons present on the website. Another webpage is designed to display live temperature and humidity readings retrieved from the DHT11 sensor.

4.1.2 Backend Development

The backend of the website is designed using flask python framework to connect the On/Off buttons of the website to their respective LEDs present on the breadboard as well as the DHT11 sensor variables to the sensor.html page to display temperature and humidity.

4.2 Circuit Representation

The Circuit connections set out using a Raspberry Pi Kit which includes [2]

- Raspberry pi 3 micro-controller
- Male-to-Female Connecting Wires
- Jumper Wires
- HDMI cable (For Display)
- Laptop
- Temperature and Humidity Sensor (DHT11)
- LED light bulbs
- Resistors
- Bread Board

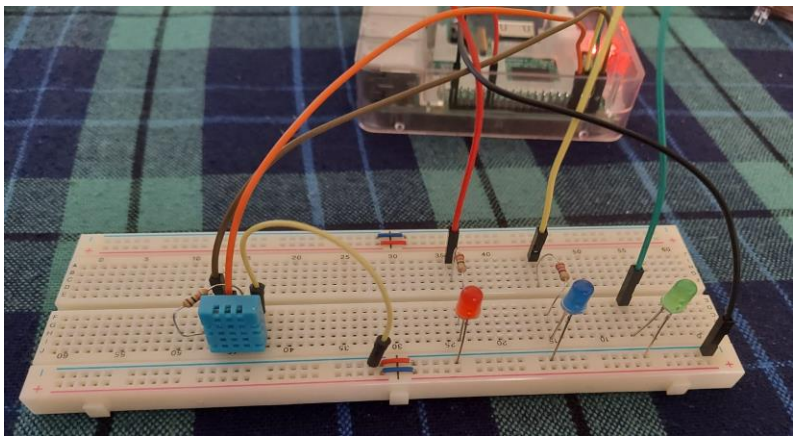


Fig 4: Real World Circuit Connections

4.2 Roadmap and Design

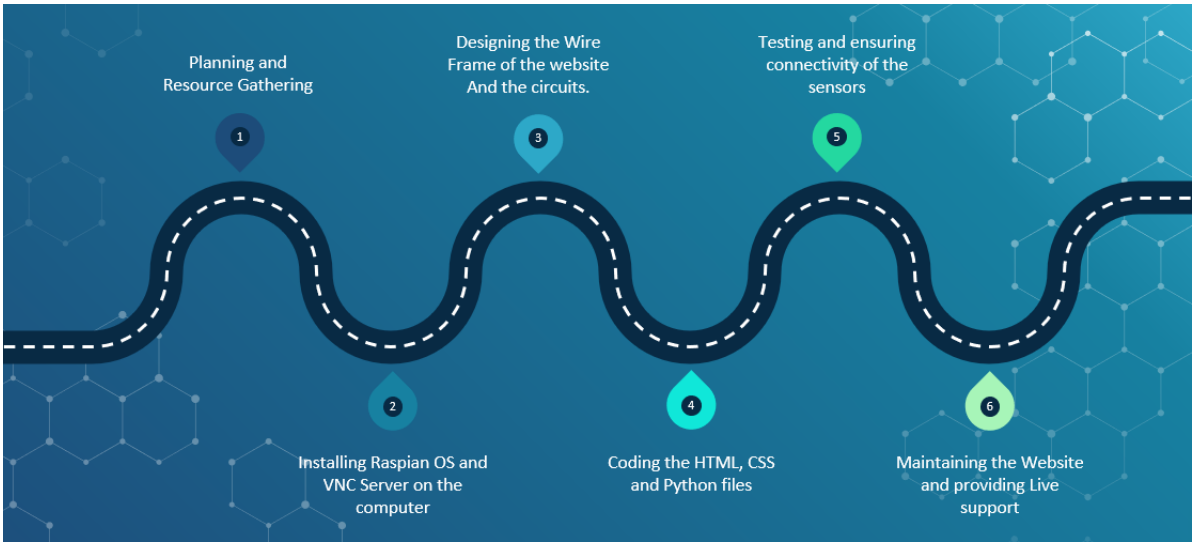


Fig 5: Project Roadmap

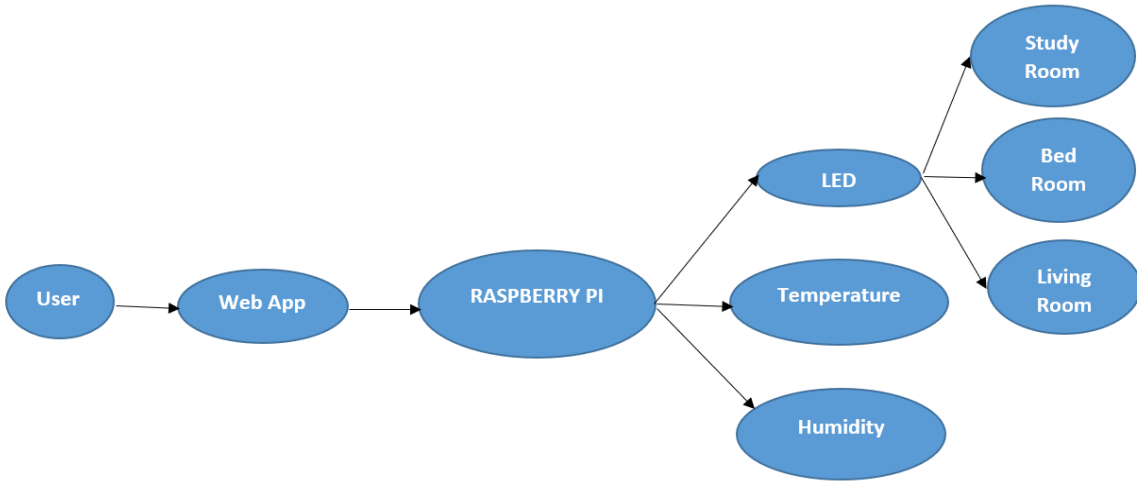


Fig 6: Data Flow Diagram of Home Automation System

CHAPTER-5. Results

5.1 LEDs Result

On clicking the ON button of the different lights present in the room the respective LED light switches ON at the bulbs present on the breadboard.

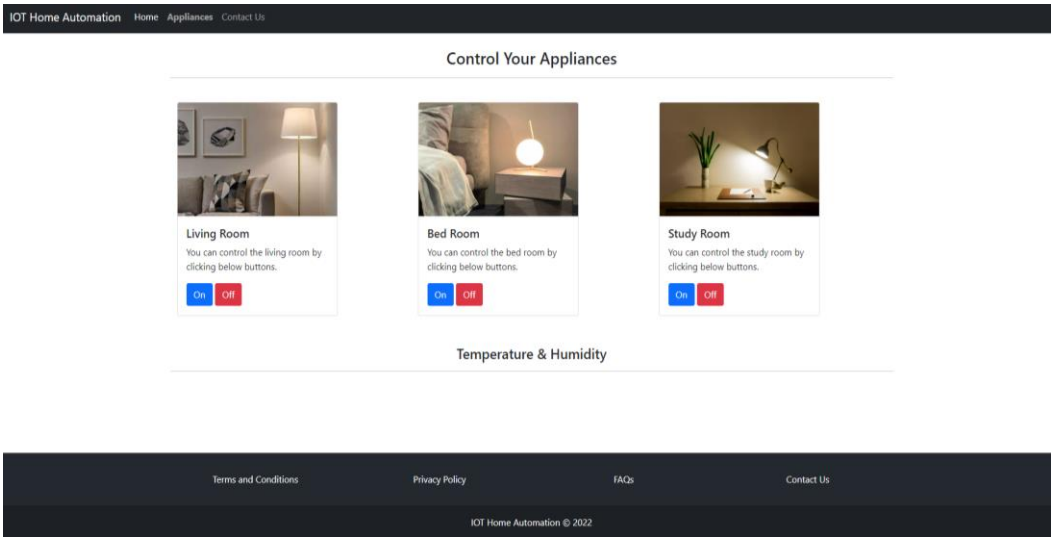


Fig 7: Appliances Website to trigger responses

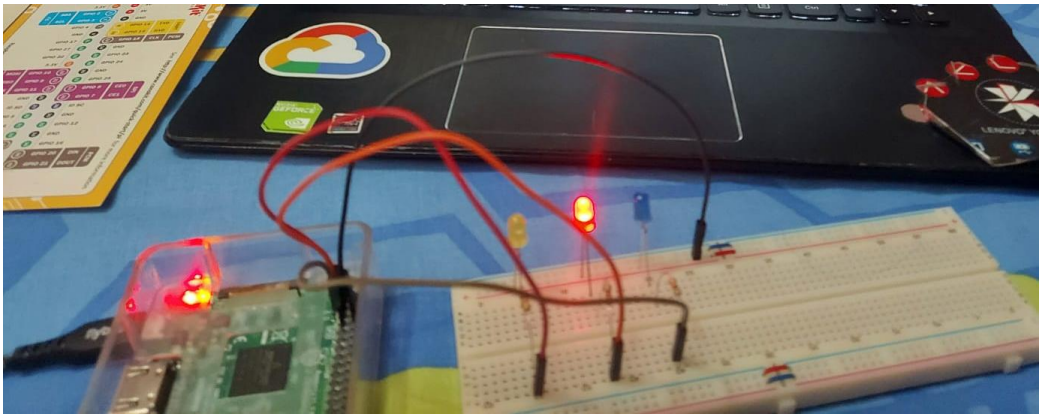


Fig 8: LED bulb switching ON at the breadboard

5.2 DHT11 Result

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller to measure humidity and temperature instantaneously. DHT11 temperature range is from 0 to 50 degrees Celsius with +-2 degrees accuracy, while the DHT11 humidity range is from 20 to 80% with 5% accuracy [7].

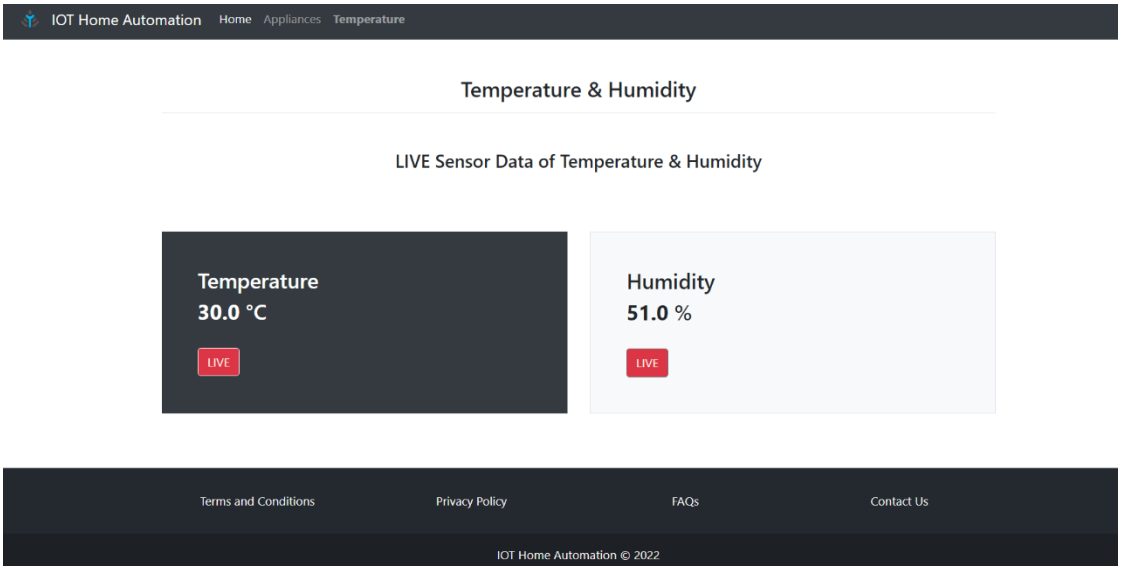


Fig 9: Live Sensor data relayed on the Website

CHAPTER-6. Conclusion & Future Scope

6.1 Conclusion

Home Automation is one of the important applications of IoT. It provides easier and leisure living for every person. Building automation can be used to conserve energy and reduce overhead costs using valuable feedback methods and intelligent ground-up design. [14] Safety is another key reason why building automation should become a more common practice.

- In this project, an approach for developing an IoT software-based smart home automation system was implemented and tested through the built model presented by integrating relays and devices to Raspberry pi board for controlling the devices from a remote location in a real scenario.
- The proposed home automation system includes control and regulation of lights, and live sensor data of temperature and humidity.
- Raspberry Pi proves to be a smart, economic, and efficient platform for implementing the home automation.
- The system is Flexible and programmable and has wide range applications and supports wide Varity of peripherals and accessories.
- The system can be accessed from any internet-based device including handheld devices such as mobile phones.

6.2 Future Scope

IoT is having tremendous attention recently and its various applications are growing, changing the way we live and work. This project's focus was on security and safety perspective of smart home automation, which is a small part of what can be automated and controlled inside a smart home. [14] Future work focus would be working on actual AC devices to implement what was simulated in the model in a real house, developing a more advanced motion detection algorithm on surveillance cameras, and surveillance car moving autonomously avoiding obstacles.

As there are various appliances that can be controlled and automated while being away from home, the same approach used in implementing this project will be used to enable control over various appliances before reaching home, saving time and effort. Such application examples can be, monitoring temperature and humidity, and being able to control them, controlling stoves and microwaves, locking and unlocking doors autonomously depending on the visitor face recognition and confidence level, surveillance car moving autonomously reaching for a security breach or safety issue to live stream what happens so that the user can act accordingly and many others that would combine IoT with smart appliances autonomy. [13]

Home of the future is a space for the digital natives. With the invention of lots of automation technologies featuring IOT and AI, home automation has become a reality. These technologies can used to build fully functional home automation system and control smart home devices including smart lights, connected thermostats, and appliances. [14]

There are several new technologies which can become a part of home soon:

- **Increased efficiency, control, and customization**: Artificial intelligence is set to make you lazy soon. Technology will become much more efficient, and one will be able to control everything from volume to security from one central place. The devices will work automatically, and you don't need to waste your energy it will act upon user's preferences. AI would revolutionize home by automatic threat detection and proactive alertness.

- **Integration of Smart home devices**: One can command it to control small things of home through voice and Smartphones. All the tech giants are working in the field of IoT to bring advancements in the home automation devices. Also, more recently, Google launched two more Google Home speakers, Home Max and Home Mini.

- **Smart spaces outside homes**: Smart parking through sensors will help to recognize whether the parking is available or not. Camera monitoring can be done and with the help of artificial intelligence and computer vision, both parking facilities and security can be provided. It would be a faster and smoother process and act as a reference for other smart systems to be built accordingly. Streetlights can also be automated through sensors and build for effective use for the people nearby.

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