Home Automation using Raspberry PI

By Syeda Jamala Fatima

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GJRE-A Classification: DDC Code: 004.678 LCC Code: QA76.9.B45

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I. Introduction

The internet-based functioning of physical devices (also known as "connected devices" and "smart gadgets"), buildings, and other items integrated with electronics, software, sensors, actuators, and network connectivity, allowing these objects to gather and share data, is referred to as the Internet of Things (IoT). Home automation is defined as the interconnection of physical things via sensors and software. Network connections are used to acquire and share data. Home automation refers to the automated and electronic control of household features, activities, and appliances. Home automation systems are becoming more popular as a way to control objects around the house. All forms of home equipment, including doors, lights, fans, electric heaters, surveillance systems, and consumer electronics, are included in the household automation system.

The goal of the home automation system is to automate the control of equipment and systems in the house by utilising existing technologies. This project shows a prototype of an intelligent home automation system that uses the Telegram application to operate household appliances, electrical equipment, and other devices from smart phones, computers, tablets, and other devices with an active internet connection. It will use relay circuits, Raspberry Pi, and Node MCU with the concept of IoT to turn on or off and operate household appliances and electrical equipment remotely as well as manually. Home automation offers a lot of promise for exchanging data among family members or trusted persons for personal security, and it might lead to energy-saving measures in the future. When one of these automated systems is used in a residential installation, it is referred to as a home automation

system. All electrical and electronic equipment and devices are monitored and controlled via the Telegram application. The rest of the paper is laid out as follows: Section II examines some key aspects of related works, section IV elucidates the proposed methodology, section V presents experimental results, and section VI concludes with a discussion of future work.

II. Literature Survey

In [1] The project development includes an Internet of Things-based secure home access solution. Using the Raspberry Pi controller, camera, and numerous other connected sensors, this presents a smart, creative, and secure access. The system is a synthesis of all previous work, for which an IR sensor is used to identify objects, which then triggers a camera for facial recognition. The technology is intended for secure remote access and control of household equipment.

In [2] A Smart Home Application with Wi-Fi module prototype and implementation are shown. As a Wi-Fi module, the ESP8266 is utilised. A hardware interface and a software interface make up the system. The integration of ESP8266 Wi-Fi technology for managing home appliances and sensors is represented in the hardware interface, and a software interface is given for controlling numerous users of the house. The output of this system is reached by utilising the blynk app for smart home automation. The temperature and humidity is depicted, along with a Wi-Fi connection. GSM and GPS modules are used to send messages on a mobile phone.

In [3] The system provides smart wireless home security by sending an email with a photo to the house owner if intruders enter the residence and also by sounding an alert if a fire occurs. From anywhere in the world, the system can regulate and monitor the house temperature, humidity, flame status, and other home equipment. The technology updates data every three seconds, allowing speedy decisions to be made. The Pi-camera immediately sends an email with an intruder photo or a fire mishap to a concerned person, improving the safety of the property and the home owner. The system is also capable of controlling household appliances.

In [4] The goal of the study is to create an IoT-based system that allows users to operate electrical appliances remotely using an Android mobile application. The mobile application was put to the test, and the reaction in terms of turning on/off appliances

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and locking/unlocking doors was noticed. Thing Speak cloud provides a web access for monitoring data logs and signal transmission. The technology performed as intended in terms of lowering energy use.

In [5] The appliances are managed by the Raspberry pi server, which runs according to the user command received from the phone through an android app. Smart home automation is suggested for the elderly, based on python, OpenCV, raspberry pi, and android applications. Face identification and recognition from a camera positioned outside the main door, which can be accessed from the phone, is used to create a unique door monitoring system. The hardware for regulating the intensity of light using the Raspberry Pi's PWM output is presented. For home security, an automatic door monitoring system based on an Android mobile is presented.

In [6] Smart home automation particularly for old age people is proposed based on python, OpenCV, raspberry pi and android application, the appliances are controlled by the Raspberry pi server, which operates according to the user command received from the mobile phone. A unique door monitoring system is designed based on face detection and recognition from a camera installed outside the main door, which can be accessed from the phone using android application. The hardware implantation for controlling intensity of light using PWM output from Raspberry Pi is depicted. An automatic door monitoring system using USB camera, python, OpenCV, raspberry pi, and android device is proposed for monitoring and security purpose. IoT provides more flexible and low-cost solutions for daily life problems which ultimately improve the user's life. Although many previous researchers proposed many home automation systems by using different concepts, there are some reasons for the motivation to design an efficient home automation system. Previously proposed home automation systems are expensive and complex, Bluetooth based home automation systems required intrusive installation [6] and some of the senior citizens does not use G-mail, Twitter or web server as it requires the account creation as well as additional wi-fi module [2,3,5] and find it difficult to operate as it requires additional learning [4].

III. Problem Statement

The high cost of ownership, inadequate administration, and difficulty in attaining security are the four primary issues that home automation systems confront. The main goal is to create and construct a low-cost, open-source home automation system that can manage and automate most household appliances using a simple interface. Our suggested system has a lot of versatility since it connects its modules to the Telegram Application utilizing wi-fi technology. Secure wireless communication protocols between user and telegram server, will be used in the system.

IV. Methodology

The System Architecture includes a set of hardware components such as the Raspberry Pi, Node MCU esp8266, MLX Sensor, and relays. As well as a set of software components like Raspbian operating system, Arduino IDE and Tele-gram application as shown in the figure. The system receives the commands from the user via the Telegram application. The command from the user can be received from anywhere through the internet.
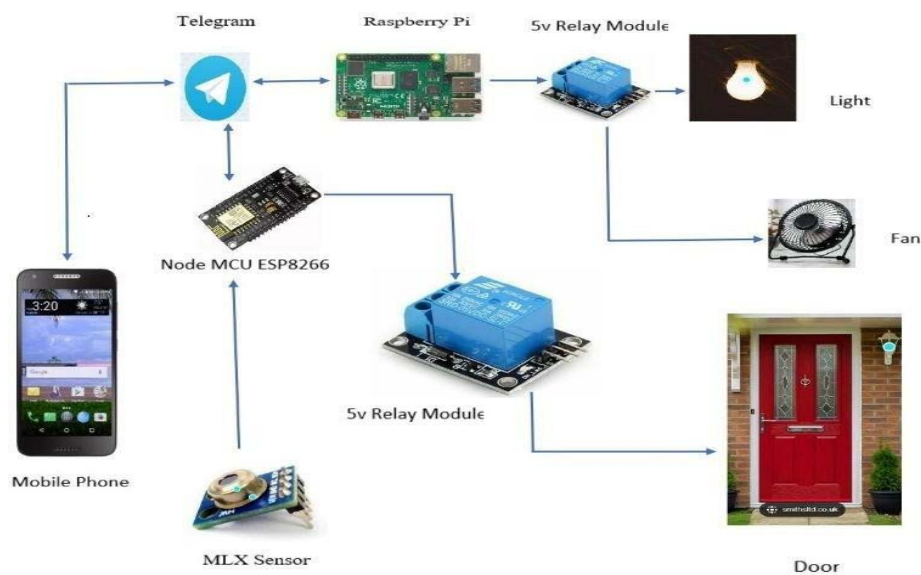

Figure 1: System Architecture

The Raspberry Pi and Node MCU process the instructions received and operates the loads (light and fan) to switch them ON/OFF and, the door lock to lock/unlock according to desired user commands respectively. Thus, we automate light, fan and door over the internet using Raspberry Pi and Node MCU. Raspberry Pi, Node MCU esp8266 hardware, MLX90614 sensor, and Telegram application are at the core of smart home automation. The system is divided into two halves based on Raspberry Pi and Node MCU. For the initial half, Because of its user-friendly features and cost-effectiveness, the Raspberry Pi was chosen as the system's processing unit. A python-coded programming has also been put into the Raspberry Pi, which is connected to the internet through a wireless wi-fi inter-face and can access and send data to the Telegram application. The Household Electrical Devices to be monitored were interfaced with the Raspberry Pi using a relay driver circuit due to the different power ratings of the devices and the Raspberry Pi. The latter half contains the microcontroller, Node MCU esp8266 that connects the user to the door lock system through the Internet. This allows the user to lock or unlock the door lock from anywhere in the world using the Telegram application. The MLX sensor detects the person's body temperature and sends the information to the Telegram application through the Node MCU microcontroller embedded telegram server.

a) *Raspberry Pi*

The Raspberry Pi is a credit card-sized computer that plugs into a computer monitor or TV and comes with a standard keyboard and mouse as shown in Fig. 2. The Raspberry Pi is an open-source ecosystem for controlling electrical components in physical computing and exploring the Internet of Things. It's Linux-based and features GPIO (general-purpose input/output) pins (IoT). It provides individuals with low-cost, high-performance computers with which to research and resolve issues.

Figure 2: Raspberry Pi

b) *Node MCU*

Node MCU is an open-source platform based on the ESP8266 that enables the connection of devices and the trans-mission of data through the Wi-Fi protocol.

Furthermore, by offering some of the most important microcontroller functions such as GPIO, PWM, ADC, and so on, it may be able to manage many of the project's demands on its own. The system's Node MCU esp8266 is shown in Fig. 3.

Figure 3: Node MCU ESP8266

c) *Relay Module*

The relay in Fig. 4, is essentially a control switch that employs electromagnetic to swap the switch, allowing it to be readily activated by a low voltage signal. It's utilised to keep the load from being supplied when it's needed.

Figure 4: Relay Module

d) *Electric Door Lock*

The motor is controlled by an electrical impulse, which may be activated in a number of ways, including an electronic card reader, a keypad, or a wireless remote control sensor, as shown in Fig.5. The electronic door lock is configured to engage the motor-driven actuator only after receiving the right electrical input in either instance.

Figure 5: DC 12V Solenoid Electric Door Lock

e) *MLX Sensor*

It is a contactless infrared temperature sensor with exceptional precision. Due to its great accuracy and precision, it may be utilised in a number of business, health-care, and home applications, such as room temperature monitoring and body temperature measuring. The MLX90614 sensor, which is used to monitor body temperature, is shown in Fig. 6.
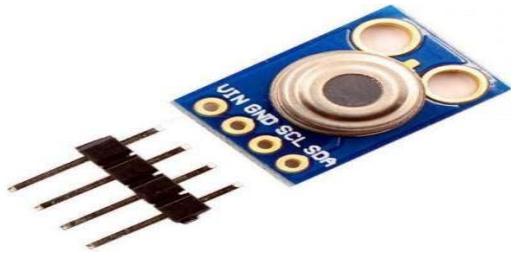
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Figure 6: MLX90614 Sensor

f) *Telegram Bot*

A Telegram Bot is a software that works in the same way as a conventional chat partner but adds extra functionality. It does predetermined tasks on its own, without the user's involvement. Bots are Telegram accounts that are controlled by software rather than humans, and they commonly incorporate artificial intelligence elements. It could also use the Internet of Things to teach, play, search, broadcast, remember, connect, interact with other services, and even transmit instructions.

V. RESULTS

The Fig 7 and Fig 8 shows the photograph of the experimental setup while performing the actual experiment. The system uses Telegram mobile application to control the light, fan and door lock. Experimental results of Home Automation System corresponding to the commands received from the user and response from telegram bot is shown in Fig 9 and Fig 10. It shows that the light, fan and door lock functioned accurately with the proposed idea.
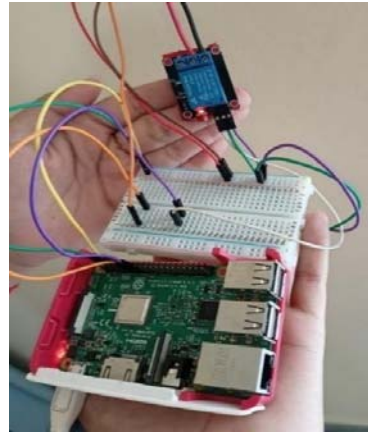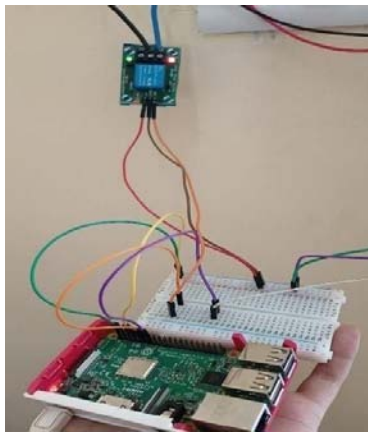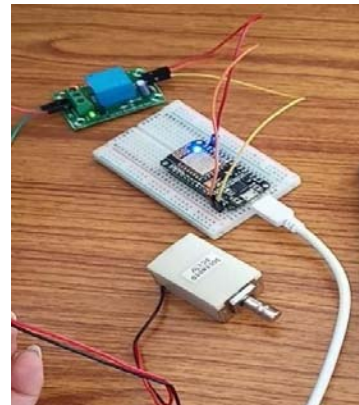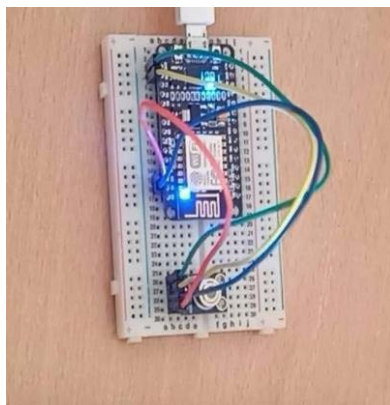

Figure 7: Smart Light and Fan

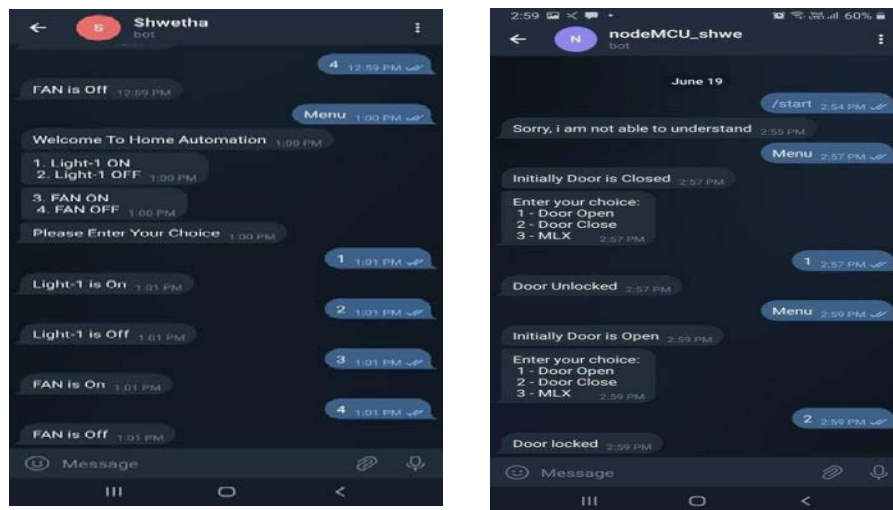*Figure 8:* Smart Door and MLX sensor

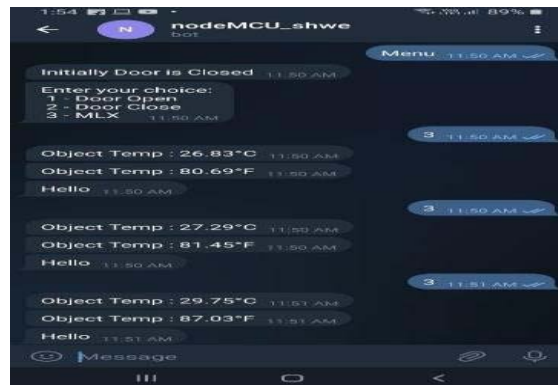*Figure 9:* Commands given by the user via Telegram

Figure 10: Commands given by the user via Telegram

VI. CONCLUSION AND FUTURE WORK

The Raspberry Pi and Node MCU ESP8266 with internet through mobile phones, tablets, and computers have been operating effectively for home automation. Telegram notification is one of the proposed system's benefits. Telegram notifications are simple to use for older generations because they do not require an email address or a Twitter account. In addition to this, it has MLX sensor which can be used for detecting body temperature. The designed method is smart, inventive and secure, as well as low-power and inexpensive. It may be used to cut down on electricity waste by properly scheduling and monitoring equipment. The proposed system may be utilised to dramatically minimise the danger of unwanted entry in a range of places, including banks, hospitals, labs, and workplaces. The system might be enhanced in the future to include fan speed adjustment, smart doors with identification, and a voice assistant.

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