

AI based Home Automation System using Raspberry Pi

Ms Anjali Patil¹, Mr Torvi H.B.²

¹Master of Engineering student, Department of Computer Science and Technology, V.V.P.I.E.T. Solapur, Maharashtra, India.

²Professor, Department of Computer Science and Technology, V.V.P.I.E.T. Solapur, Maharashtra, India.

Abstract - In the world of automation we wish our lifestyle to be controlled remotely. The aim of the project is dominant of home appliances remotely once the user is far away from the place. Home Automation System gains popularity due to communication technology advancement. Smart home is one of the Internet of Things (IoT) applications that facilitate the control of home appliances over the Internet using automation system. In this project presenting a proposed system for Smart Home Automation technique with Advanced Raspberry Pi using AI and IoT and it is done by integrating cameras and motion sensors into a web application. To design this technique, we have a tendency to area unit employing a Raspberry Pi module with laptop Vision techniques. Using this, we will management home appliances connected through a monitor primarily based web. Raspberry Pi operates and controls motion sensors and video cameras for sensing and police work. For example, it captures intruder's identity and detects its presence exploitation straightforward pc Vision Technique (CVT). Whenever motion is detected, the cameras can begin recording and Raspberry Pi device alerts the owner through an SMS and alarm decision. Here present a home automation and home security technique. The sensors will be interface with Arduino. The standing of our home appliances can get uploaded to a cloud platform through wireless module. Our system and mobile ought to be connected over same wireless network. Our sensors are ready to modify or disable the sensors which are able to be up to the mark of the user. Also providing voice based Home automation system that uses Internet of Things (IOT), Artificial Intelligence (AI) and Natural Language Processing (NLP) to provide a cost-effective, efficient way to work together with home appliances.

Key Words: Internet of Things (IOT), Artificial Intelligence (AI), Natural Language Processing (NLP), MQTT (Message Queuing Telemetry Transport), Raspberry Pi.

1. INTRODUCTION

The concept of home automation has been around since the late 1970s. But with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home, and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems. A home

automation system means to grant the end-users to manage and handle the electric appliances. If we look at different home automation systems over time, they have always tried to provide efficient, convenient, and safe ways for home inhabitants to access their homes. Regardless of the change in user's hope, growing technology, or change of time, the appearance of a home automation system has remained the same. Many existing, well-established home automation systems are based on wired communication such as Arduino based and raspberry pi based home automation systems. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building. But for already existing buildings the implementation cost goes very high. In contrast, Wireless systems can be of great help for automation systems like Bluetooth, Wi-Fi and IOT based home automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

This project is intended to construct a home automation system that uses any mobile device to control the home appliances. The home automation system is based on IoT. Home automation is very exciting field when it uses new technologies like Internet of Things (IoT). Raspberry pi is credit card size computer.

The home automation is nothing but interconnection of physical devices embedded with sensors and software. The network connectivity is used to collect and exchange the data. Home automation refers to the automatic and electronic control of household features, activity and appliances. Various control systems are utilized in this residential extension of building automation. Home automation is also known as domestics or demoniac. Modern system generally consist of switches and sensors connected to a central "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, Mobile phone software, tablet computer or web interface, often but not always via internet cloud services.

Nowadays home automation system is being widely used to control devices around the home. A variety of home devices can be controlled with the help of a home automation system. All kinds of home appliances like doors, lights, fan, electric heater, surveillance systems, and

consumer electronics belong to the home automation system devices. Home automation system is adopted by using the technology available for the purpose of controlling the devices as well as the systems used in the home automatically.

In this project we are presenting intelligent home automation to control the home appliances and electrical and electronic equipment by using Smartphone. It will turn ON or OFF the home appliances and electrical equipment by using relay circuits with the concept of Artificial Intelligence and IoT. This is implemented by using Raspberry Pi. Following are the steps involved around IoT.

1.1 Data Ingestion

IoT devices/sensors collect data from the environment. The data can be as simple as temperature/humidity or it can be as complex as a full video feed. The data needs to be sent to the cloud to be analyzed.

1.2 Data Transmission

The data is transmitted to the cloud via Gateways (Telemetry Devices) the gateways use both the cellular as well as the satellite communication to transmit the data. To ensure data security, protocols such as Bluetooth, Sig Fox, Lora, NB-IoT, ZigBee, COAP, REST, DDS, MQIT, XMPP, etc. are used.

1.3 Data Processing

Once the data gets to the cloud, IoT platform processes it. The processing can be as simple as checking if the temperature is within the acceptable range or it could be very complex, such as using computer vision on the video to identify objects.

1.4 Data Visualization

The processed data (Information) is made to the end-user by providing alerts to the user (E-Mails, text, notification). The user might have an application (interface) that allows him to proactively check-in to the system.

1.5 Data Analysis and prediction

To utilize the data collected over the time, data analytics makes use of the historical data to provide actionable insights. Insights help in predicting future events that may occur. You can make intelligent business decisions based on the insights and predictions generated from the data.

2. LITERATURE REVIEW

Harsh Kumar Singh¹, Saurabh Verma², Shashank Pal³, Kavita Pandey⁴ have presented the proposed system consists of web server, web interface, database, NodeMCU and Solid State Relays. Server controls and monitors appliance state and user command, and can be easily configured to handle more hardware interface module. The web server is running on NodeJS which in turn running on AWS (Amazon Web Services). Beauty of this Automation System is that it can be accessed from the web browser remotely from any PC or mobile handled device connected to the internet. Wi-Fi is chosen to improvise system security, mobility and flexibility. The problem is that if the lights or any electrical appliances are left ON can be checked and turned OFF remotely through logging into that web portal which is designed in NodeJS, Web Application in angular and Mongo DB as the database. [1] Kumar Mandula, Ramu Parupalli, CH.A.S.Murty, E.Magesh, Rutul Lunagariya have presented, the concept of home automation using IoT is realized using 10w cost micro-controller based Arduino board and an Android mobile phone. Arduino is an open source platform that can be used for prototyping any hardware and software. Arduino can be programmed to receive keyboard input or sensor data and control various electrical appliances connected to output peripherals. Since mobile phone is a wireless communication device, connectivity between Arduino and smart phone is established using Bluetooth, one of the short range wireless communication technologies that can be used for communication in an indoor environment. Bluetooth is useful for short range communication. [2]

Mrs. Paul Jasmin Rani¹, Jason Bakthakumar², Praveen Kumar³, Praveen Kumar⁴ and Santhosh Kumar⁵ have presented this project is built upon the on the concept of Internet of Things. We have determined to implement seamless integration of all the appliances in the home via a central console. The project greatly changes the way in which we communicate with our home appliances. It also reduces the need for any personal contact with any of them as it delivers a wholesome experience of wireless, voice controlled system. We plan to implement this project with the aid of Arduino boards with the capability to perform IoT (Internet of Things) operations. Installing the boards in every appliance of the house will allow us to establish real-time communication with them via Wi-Fi. But the Arduino boards are microcontroller, not a full-fledged computer and they don't run a full operating system. [3]

Waheb A. Jabbar, Mohammed Hayyan Alsibai, Nur Syaira S. Amran, and Samiah K. Mahayadin have presented a new system to overcome the limitations of the existing home automation systems. This can be achieved by design and fabricate a low cost Wi-Fi-based Automation System for Smart Home prototype using Arduino microcontroller and

Android-Based Smartphone. The system is developed to control all the electrical appliances at home easily and efficiently and enable the remote control by supporting the IoT concept. The Arduino boards are microcontroller, not a full-fledged computer. [4]

Waheb A. Jabbar*, Mohammed Hayyan Alsibai, Nur Syaيرا S. Amran, and Samiah K. Mahayadin have presented This research project has proposed, designed and fabricated a low cost Wi-Fi based Automation System for Smart Home prototype using Arduino and Android smart phone. It enables the control all the electrical appliances such as the bulb and fan at home easily and efficiently via Wi-Fi. The sensor can monitor the motion, humidity and temperature of the house. Buzzer will be ON when there is a motion detected in the house. The Smart Home Automation System provides a comfortable, intelligence, good security and improves the quality of life. By using this smart home system, electric bill can be reduced because the user can control the electrical appliances anytime without using human energy. This proposed home automation system presenting more reliable and faster than existing system. [5]

Chwan-Lu Tseng, Che-Shen Cheng, Yu-Hsien Hsu, Bing-Hung Yang, in this paper, the microcontrollers and sensors were placed in home and the sensors were integrated with other modules. When the user chats with the Chatbot, the content of the conversation is due to the security of the data. The Line Server uses HTTPS to transmit the message to the Node-Red platform. The front-end microcontroller is used to communicate with the back-end platform with MQTT transmission. Therefore, the user can directly control the request through the Chatbot interface. After the message is analyzed by the back-end platform, the control command will be transmitted to the central control board (development board) to meet the requirements of the control equipment. [6]

Md. Sadad Mahamud, Md. Saniat Rahman Zishan, Syed Ishmam Ahmad, The full System is based on a microcontroller Arduino UNO and a Wi-Fi module ESP32. Main controlling is done by the microcontroller where all the data first fetched than decode and finally Arduino execute is commented execution cycle and the communication controlling is being done with the Wi-Fi module ESP32. ESP32 module is directly communication with the private server and update Arduino if any changed or update was made by the register author. Here, we just used two loads as a prototype. But, in future system multiple numbers of load or home appliances can be connected with this system as per user requirements. [7]

Haoyu Liu, Tom Spink, and Paul Patras, This paper shows the Belkin range of WeMo smart home devices. Belkin WeMo has become a market leader that commercializes smart sockets, light bulbs, video cameras, etc. that can be

controlled with smartphone apps, or via personal assistants such as Amazon Alexa. But is Wemo device loses settings.[8]

Jayant Dorve¹, Manish K. Samarth², Swapnil R. Jais³, Md. Danish S. Sheikh⁴, Pawan Kumar⁵, Hanuman Korde⁶, In this paper controlling household devices through voice when we are in home. But the automation kept within a range of 10-30 meters. Also it has limited communication possible.[9]

3. PROPOSED SYSTEM

In this system we will use some sensors like gas detector sensor and temperature sensor which help to create a home as a smart home. We are implementing a scheduling mechanism in this system. The Raspberry-pi is act as computer and is connected with Wi-Fi. Home Automation System can be accessed from the web browser by using any locally, or remotely from any PC or mobile handheld device connected to the internet with appropriate web browser through server real IP. Wi-Fi technology is used to select the network infrastructure that connects sensors and the servers. IFTTT or similar to IFTTT tools we have placed the server on cloud. That server is communicating with IOT enabled micro communication which may NodeMCU or Raspberry Pi or any other. In this project the communication is made by MQTT protocol. Different types of sensors of connected are microcontroller for auction of data also switches are connected to the microcontroller for connecting appliances.

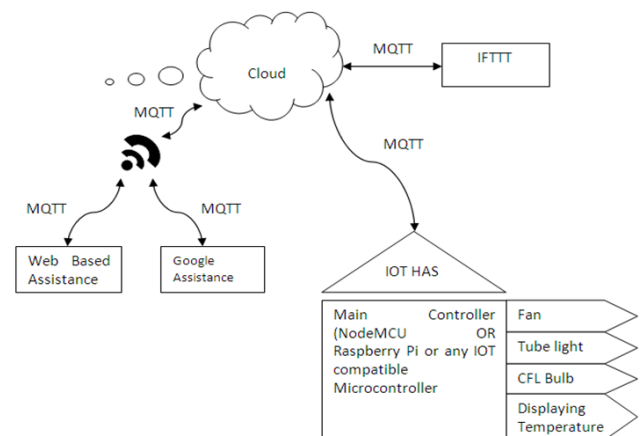


Fig -1: Architecture of proposed Home Automation System Using Raspberry Pi

Microcontroller collect all the data from gadgets on the cloud server simultaneously the Interface and Google assistance is connected to our cloud server that all together communicating with each other send, Receive the commands and the process according to this commands. 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. 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. In this project Speech is one of the most important inputs used for man machine interaction. Therefore, to make smart home more users friendly, Google assistance along with web based application can be used to control the home system. The advantage of multimodal is that in the presence of the noisy background surrounding the performance of the Google assistance degrades. Hence, in such scenario web based application can be helpful in controlling the appliance of the system. Thus, the proposed model is designed to provide better flexibility and making the system more robust.

The smart home can be implemented with main controller unit (Main switching of the home circuit) that is connected with the 24-hour available Wi-Fi network. To ensure, that the Wi-Fi connection do not turn off, the main controller is programmed to establish automatic connection with the available network and connected to the auto power backup.

NodeMcu (ESP8266) is an open source firmware that provides the flexibility to build the IoT based application. NodeMcu has gained its popularity due to its low cost and Wi-Fi enabled features. It also provides the Nodejs that require less computation time to perform the task and use Lua script. Thus making the device to operate much faster and making it as a first choice for IoT applications.

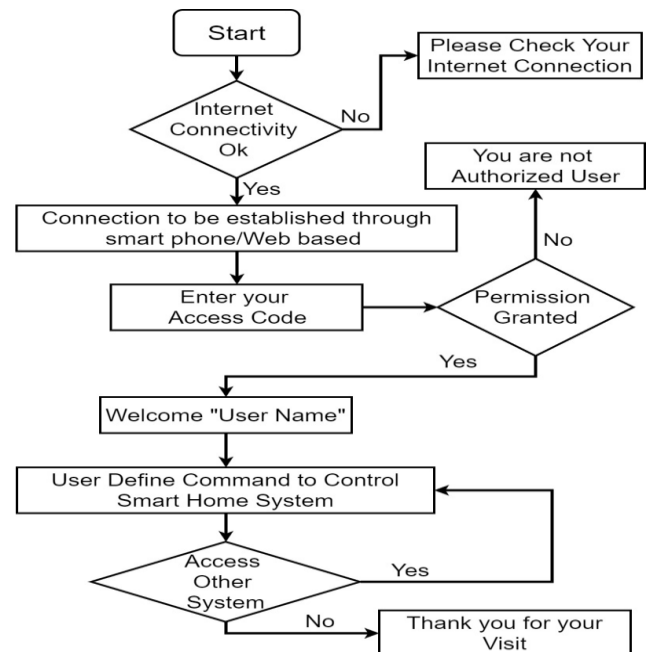


Fig -2: System flow on the smart home automation system using NodeMCU or Raspberry Pi

The working of the smart home automation is shown in Figure shown initial requirement is the Internet connectivity to access your smart home. One can access their smart home either through the web based service or through Google assistance. Initially, Google assistant is used for controlling/monitoring our smart home and in case of noisy background home automation can be connected through web based service. For security purpose we have provided the user access code that will be asked by the Google assistant to verify which will prevent unauthorized smart home access.

4. CONCLUSION

In this project, we are designing an advanced automation system which has surveillance system and which in turn reduces most of the human interactions, by supporting this system using Internet of Things (IoT) and Artificial Intelligence (AI). Finally, it is absolutely an affordable system. It can be associated with various other options like -energy monitoring systems etc., soon, as an extension to this project a system may be developed which warns the user about the excess usage of energy.

REFERENCES

[1] Harsh Kumar Singh¹, Saurabh Verma², Shashank Pal³, Kavita Pandey⁴, " A step towards Home Automation using IOT",2019,September.

- [2] Kumar Mandula, Ramu Parupalli, CH.A.S.Murty, E.Magesh, Rutul Lunagariya," Mobile based Home Automation using Internet of Things(IoT)", 2015 International Conference on Control, instrumentation, Communication and Computational Technologies (ICCICT),2016,May.
- [3] Mrs. Paul Jasmin Rani1*, Jason Bakthakumar2, Praveen Kumaar.B3, Praveen Kumaar.U4 and Santhosh Kumar5," VOICE CONTROLLED HOME AUTOMATION SYSTEM USING NATURAL LANGUAGE PROCESSING(NLP) AND INTERNET OF THINGS (IoT)",2017Third International Conference on Science Technology Engineering & Management (ICONSTEM),2018,January.
- [4] Waheb A. Jabbar*, Mohammed Hayyan Alsibai, Nur Syaira S. Amran, and Samiah K. Mahayadin," Design and Implementation of IoT-Based Automation System for Smart Home", 2018, November.
- [5] Waheb A. Jabbar*, Mohammed Hayyan Alsibai, Nur Syaira S. Amran, and Samiah K. Mahayadin," Design and Implementation of IoT-Based Automation System for Smart Home", 2018, November.
- [6] Chwan-Lu Tseng , Che-Shen Cheng , Yu-Hsien Hsu , Bing-Hung Yang ," An IoT-based Home Automation System Using Wi-Fi Wireless Sensor Networks", 2018 IEEE International Conference on Systems, Man, and Cybernetics,2019,January.
- [7] Md. Sadad Mahamud, Md. Saniat Rahman Zishan, Syed Ishmam Ahmad," Domicile - An IoT Based Smart Home Automation System", 2019 International Conference on Robotics,Electrical and Signal Processing Techniques (ICREST),2019,February.
- [8] Haoyu Liu, Tom Spink, and Paul Patras," Uncovering Security Vulnerabilities in the Belkin WeMo Home Automation Ecosystem", SPT-IoT'19 - The Third Workshop on Security, Privacy and Trust in the Internet of Things, 2019.
- [9] Jayant Dorve1, Manish K. Samarth2, Swapnil R. Jais3, Md. Danish S. Sheikh4, Pawan Kumar5, Hanuman Korde6," A Review on Home Automation using Voice Via Bluetooth Through Raspberry PI 3", International Journal of Research in Engineering, Science and Management, Issue-3, March-2019.