AI based Home Automation System using Raspberry Pi

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Abstract- *In the world of automation we wish our lifestyle to be controlled remotely and even after securely. The main focus of the project is operating home appliances like Tube Light, Fan, Water Pump and many, remotely. Means user can operate Home Appliances from any location. In today's Fast growing world the Home Automation system is most popular in society because of advanced IoT and Communication Systems. In this project we develop a system for AI based Smart Home Automation technique with Advanced Raspberry Pi which is act as micro-controller and other components like cameras and motion sensors, LPG Gas Sensor are integrated with a web application Remotely Connected to it. Here we are presenting Smart Home with Remotely Controlled Enable system in which user also get alarm when outsiders (intruders) are try to enter in home without permission. In advancement to existing system we include Dome Light Automation based on day and Night using LDR. Our AI based Smart Home Automation System also gives provide alarm for some flammable gas is detected in Home, so that user will take preventive action to reduce the accident chances.*

Key Words: Raspberry Pi, Gas sensor, Motion Sensor, relay module, LDR (Photoresistor).

1. INTRODUCTION

Home automation using Artificial Intelligence can be implemented by using one or more computers to control basic home functions automatically, remotely. An automated home is recognized as a smart home when its functionality is entirely remotely operated. Home automation may also allow many major home functions to be controlled remotely from anywhere in the world with the help of Mobile/Laptop's and tablets. A perfect architecture of Home Automation System includes variety of devices like a computer with the appropriate Specification. That system also includes programming and High Processing controllers which are interconnected with cables or wireless links.

The AI based Home Automation System is based on High Processing Raspberry Pi3 Pocket sized computer. Which have number of feature like real computer like built-in 1GB RAM and running at 900 MHz CPU which is over clocked at 1 GHz without damaging the board. For the security aspect of the home automation system, we have implemented a Intruder Detection or Theft Protection system. While developing this system we also consider the Gas Leak Protection System.

We developed a home automation system that uses any mobile device to control the home appliances. The home automation system is based on AI & IoT.

In this scenario user remotely connected to the micro controller and click on button provide over the GUI. This buttons sends command to the Raspberry pi and results in Home Appliances get On/Off according to command.

Various sensors are used to identify and notify to user that intrudes / outsider enters in the home without your permissions. This system is very efficient and cost effective too.

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 conception of home robotization using loT is realized using micro-controller grounded Arduino board and an Android mobile phone. Arduino is an open source platform that can be used for prototyping any tackle and software. Arduino can be programmed to admit keyboard input or detector data and control colorful electrical appliances connected to affair peripherals. For connectivity between Arduino and smart phone here we are using Bluetooth, the one of the short range wireless communication technique which can be used for communication in an inner terrain. Bluetooth is useful for short range communication. [2]

Mrs. Paul Jasmin Rani1, Jason Bakthakumar2, PraveenKumaar.B3, PraveenKumaar.U4 and Santhosh Kumar5 have presented this design is erected upon the on the conception of Internet of Effects. We've determined to apply flawless integration of all the appliances in the home via a central press. The design greatly changes the way in which we communicate with our home appliances. It also provide wireless and voice command assistance. We plan to apply this design with the aid of Arduino boards with the capability to perform IoT (Internet of Effects) 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 dont 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 that can be overcome the limitations of the previously existing home automation systems. This system can be implemented by using relatively Low Cost Micro-controller i.e. Arduino and for commanding user interface they use Smart Phone. This task can be achieved by using IoT concepts . The Arduino boards are microcontroller, not a full-fledged computer. [4]

Waheb A. Jabbar*, Mohammed Hayyan Alsibai, Nur Syaira S. Amran, and Samiah K. Mahayadin have presented This article in which they were designed and fabricated a low cost Wi-Fi based Automation System for demonstrating Smart Home prototype with the help of Arduino board and Android based smart phone. That smart phone is used to control all the electrical appliances in Smart Home such as the bulb and fan easily and effectively through Wi-Fi. And for making the Home Smart they uses different sensors like sensor can monitor the motion, humidity and temperature of the house. For improving the security and quality of life they uses Buzzer which will be ON when there is a motion detected in the house. With the help of this smart home automation system, electric bill can be reduced because the user can control the electrical appliances which are wasting the energy. [5]

Chwan-Lu Tseng , Che-Shen Cheng , Yu-Hsien Hsu , Bing-Hung Yang they are representing a project in which the microcontrollers and sensors are used. The sensors were actively integrated with other modules and with Micro-controller of the Project. When the user communicates with the Chatbot through chatting, the content of the conversation is due to the security of the data. The Line Server uses HTTPS protocol to securely transmit the message to the Node-Red platform. In this project, the front-end microcontroller is actually used to communicate with the back-end platform with MQTT protocol transmission. Hence, the user can easily & directly control the request via Chatbot interface. After the message is securely analyzed by the back-end platform. Then the control command send by the user will be transmitted to the central control board (Micro-controller) to meet the requirements to control electrical equipment. [6]

Md. Sadad Mahamud, Md. Saniat Rahman Zishan, Syed Ishmam Ahmad, they designed a system which is based on on a microcontroller i.e. Arduino UNO and a Wi-Fi module i.e. ESP32. The major controlling is done with the help of microcontroller i.e. Arduino UNO. And where all required data firstly fetched from sensors and then decoded after that finally the Arduino can execute it with its execution cycle. The entire communication is controlled and done through the Wi-Fi module ESP32. The ESP32 module is directly

communication with the private server which is created for this project and update Arduino through signaling. [7]

Haoyu Liu, Tom Spink, and Paul Patras, This paper they shows the Belkin range of WeMo smart home devices. Now a days Belkin WeMo has become top market leader that commercializes smart sockets, light bulbs, video cameras, etc. for smart Home. And that devices can be controlled with just smartphone apps, or via personal assistants like as Amazon Alexa.[8]

3. PROPOSED SYSTEM

The Architecture diagram of the AI based Smart Home Automation system has been shown in fig. 1. This system consists of Raspberry pi 3 which is used as a microcontroller. Power supply of 3.3v is given to Raspberry pi 3. Several sensors are in used in this system. IR sensor is used to detect the entry of the user at the window to stop the unauthorized entry in house it will detect the presence and give alarm to avoid the thief enter in house.

The user friendly and interactive GUI is used to switch ON/OFF the appliances. In that user just have to connect the internet and type the dedicated IP address of it, click on button. Also MQ3 Gas sensor is used to detect the flammable gases in home such as LPG gas is used to notice the change in leakage of the gas. It will give alarm to user to show the Gas is leaking in house.

This System help user to be safe in Home also this system sends notification to user whenever the issue or problem occurs. The Dome lights are operated automatically without any interface with user. For this we used LDR so that it can be on and off according to Light intensity.
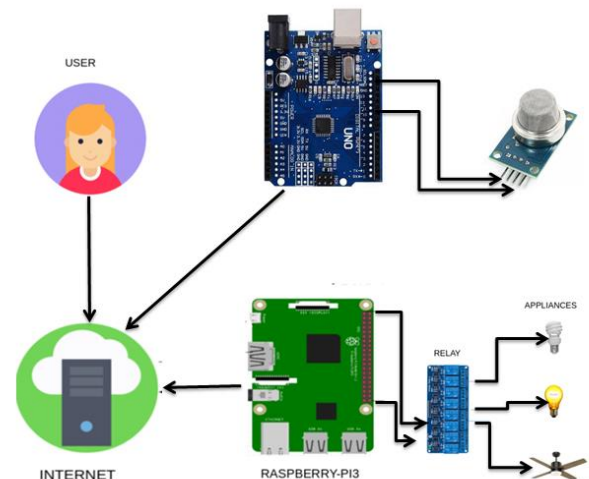

Fig -1: Architecture of Home Automation System Using Raspberry Pi

4. IMPLEMENTATION DETAILS

In our project i.e. AI Based home automation system using Raspberry Pi we are practically implementing AI and IoT technology with the help of Software and various Hardware components like sensors, micro-controllers. The hardware is consisting of different types of controllers like Raspberry pi micro controller and Arduino Uno micro controller.

Here we are considering various different types of Sensors to achieving our goal like Gas Sensor, LDR sensor, IR Sensor, Temperature and Humidity sensor.

And in the software part of this project consist of Interactive GUI based on dedicated web server designed with Python programming language embedded with Raspberry pi. Following are the detail working of our used hardware components:
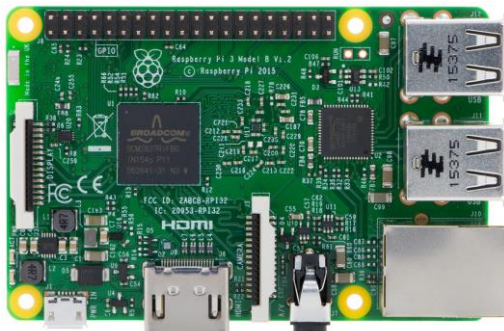
4.1 RASPBERRY PI

Fig -2: Raspberry Pi

The Raspberry Pi is a small sized computer. Which is available in market with relatively a low cost. Not just it has fewer prices also it is small in size too. This small sized computer offers many plug and play facilities like monitor, tv keyboard and mouse. It is the most powerful and high end device which offers to learn different things on it.

4.2 ARDUINO UNO

Fig -3: Arduino Uno

The Arduino UNO is a microcontroller based on ATmega328 as a controller in it. The Arduino UNO board is very easy to use and it is used for most of the beginners to electronics world. This board contains 14 digital input/ output pins on it in which 6 are analog input pin and one power jack one USB connector, one reset button is also available. The board is charged through USB port or can be directly charged by the DC supply to the board.

4.3 GAS SENSOR – MQ2

Fig -4: Gas Sensor – MQ-2

MQ2 gas sensor is an electronic sensor which is basically used for sensing the concentration of gases in the air i.e. environment. It can sense number of gases like LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide. Etc.MQ2 gas sensor is has another name also i.e. it is known as chemiresistor. Because It contains a sensing material whose resistance will get changed when it comes in contact with the gas. This change in the value of resistance will help to identify the presence of Gas.

4.4 LDR

Fig -5: LDR

The LDR is nothing but photoconductivity. The working principle of LDR is; when the light is absorbed by the material then after the conductivity of the material get enhanced. As we can say that , when the light falls on the LDR, then the electrons in the valence band of the material are eager to the conduction band. But, the photons which are in the incident light ray must have energy superior to the band gap of the material to make the electrons jump from one band to another band (valance to conduction).

4.5 IR SENSOR

Fig -6: IR Sensor

IR LED sensor is one like a transmitter which emits the IR radiations. These LED's on sensor are looks very similar to a standard LED. It generated IR radiation which is not visible to human eyes. Different types of infrared receivers are available which are based on voltage, wavelength, package, etc. In this sensor , both the LED will act as , the transmitter is IR LED and the receiver is IR photodiode. The infrared photodiode is responsive to only infrared light that is generated through an infrared LED.

4.6 TEMPARATURE & HUMIDITY SENSOR

Fig -7: DS18B20 Sensor

Maxim integrated provides DS18B20 temperature sensor which is having just one wire and it is programmable sensor. This sensor can be used in environment like chemical solutions, mines or soil etc, this sensor offers large scale of temperature sensing range i.e. **-55℃ to +125°** with a most accuracy of **±5℃**.

5. RESULT

Here, after successfully implementation of AI based Home automation system using Raspberry Pi. We developed & successfully tested our prototype from hardware as well as software perspective. Two separate micro-controllers are used to process the user request and one common GUI is designed to show the result.

Fig -8: AI based Home Automation Working Prototype

We Designed one interactive & user friendly GUI using Python and Flask framework. With the help of that GUI user and get the clear visionary surveillance of home and can easily operate the appliances.
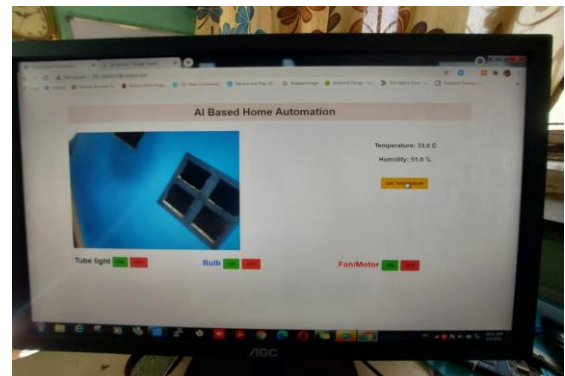

Fig -9: Interactive GUI

The micro-controller is used i.e. Arduino Uno for the Artificially Identification of Intruders / Unauthorized entry in House. In that, IR sensor is placed in the window side and connected to the arduino and one alarm / buzzer is connected to the micro-controller.

Fig -10: Sensor and Micro-controller

Dome Lights are placed in front of prototyped House that are controlled automatically based on light intensity of the environment. Here we used the temperature and Humidity sensors to indicate the accurate and current temperature and Humidity of environment i.e. Room.

Fig -11: Automatic Dome Lights

6. CONCLUSION

Here, we are designing & implementing the most advanced Home automation system which provides multiple benefits like, it offers surveillance system and effectively reduces human interactions, with the help of 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.

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