

# ENHANCEMENT IN HOME AUTOMATION USING RASPBERRY PI

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## ABSTRACT

*Abstract— Home Automation System being one of the most upcoming applications of Internet of Things deals with overall computerization of the electronic appliances installed for home purposes in a simplified, user-friendly, and efficient manner. The key objective of the system is to reduce the power consumption and use the power with the minimum wastage. This objective can be achieved by use of Raspberry Pi as the main structural base for the system because of its low power consuming technical capabilities including Wi-Fi and multiple connection ports. The property of the system for being user-friendly can be achieved by the use of an Android application for creating an interface between the system and the user, possessing the capability of controlling all the interconnected appliances using the internet from any place. Home Automation refers to the subdivision of automation that deals with the approaches devoted to the decrease in human efforts and engrossment in attaining tasks. Our system involves the appliances system controlled by Raspberry Pi which is operated by an android application using Wi-Fi technology.*

**Keywords:** Android, Home Automation System (HAS), Internet of Things (IoT), Wi-Fi.

## 1. INTRODUCTION

The scenario of consumption, distribution and wastage of the non-renewable energy is being continuously evolving. The need for creating a system which reduces the consumption of energy without affecting the performance of the system is on an upsurge. For facing the growth requirements, the demand of technical advancement is high whether it would for industrial or for a general-purpose use. Automation of such systems allows increase in efficiency and comfort also reduces the risk of wastage of the energy resources. Home Automation System being one of the elegant applications of the concept of Internet of Things proves to be an essential step towards the concern of saving and efficient use of energy. This refers to the application of computer and information technology for control of home appliances easily and reducing the power consumption or the power wastage associated with the manual system. Its application varies from a simple remote control of lighting to complex micro-controller based networks involving varying degrees of intelligence and automation.

Nowadays, multiple technologies are looking forward to developing such home automation systems involving technologies like Zig bee, DomoNet, Bluetooth-based systems like FGPA, Arduino, but these technologies to limit the potential of an entirely automated home system. For such a system, long range, secure and undisturbed connectivity is most important for which one of the efficient method is the use of a Raspberry Pi involving the most advanced Wi-Fi connectivity for creating an interface between the user and the system. An interactive user interface plays a major role for which the most recently advanced technology of Android application system suits the best for the easy interaction of the user with the system.

## 2. LITERATURE REVIEW

Abhay Kumar and Neha Tiwari [1] developed an energy proficient smart HAS. The system controlled the appliances in the home by sensing the number of people which enter and leave the room. By checking the count of people present inside the room, the system power on or power off the appliances. Authors had used RS232 IC as a transmitter and receiver and 16F877A PIC microchip to feed c programs in the system. Vittorio Miori and Dario Russo [2] wrote a paper Home automation devices belonging to the IoT world. They brought together two concepts Home Automation and Internet of Things. They did this by connecting electronic devices to sensors which were self-configured. And they managed those devices using the Internet by developing their own IP gateways. B. Murali Krishna, et al [3] developed Bluetooth-based wireless HAS using FGPA. The system contained FGPA board as a

processor board and used Bluetooth as connectivity between user's mobile phone and the system. The limitation was that the system worked only in the 10m radius.

S. Anusha, M. Madhavi, R. Hemalatha [4] developed HAS using ATmega328 microcontroller. The system on the GSM system. The android phone of the user should be a GSM handset which sends a text message(commands). This message is received by GSM modem which interprets the command from the message and sends it to system board i.e. ATmega328 which further processes it. Daniele Sora [5] had written a technical report on a topic 'Energy Switch: a Home-Automation System for Renewable Energy Self-Consumption Optimization'. In this report, she had concentrated mainly on a device called Energy Switch, that enables the change of the electric energy source of a system such as one linked to both photovoltaic and classical energy grid. Shirisha Tadoji and J. Mahesh [6] designed Bluetooth remote HAS using android application. This system used Bluetooth as an interconnecting medium between system and user's android phone. Microcontroller LPC2148 is used as a system controller.

Archana N. Shewale, Jyoti P. Bari [7] developed Renewable Energy based HAS using ZigBee. This system worked in two main sections Energy consumption and Energy Generation. Energy consumption was done by simply measuring the consumption of energy at each appliance. And solar energy generation techniques were used to generate the energy needed. Thus, the system reduced the overall consumption of energy. Pallavi Suradkar, et al [8] designed an automated system using Raspberry pi. This system consisted of web frame work which used to pass signals to raspberry-pi for controlling the relay circuit. This frame work is based on frame work named Django Rest. They also made an android application using which they controlled raspberry pi when access to the website was not possible. Suma L, Rajeshwari R and Vivekananda [9] designed Raspberry pi HAS using Arduino. This system was based on a combination of both raspberry-pi and Arduino. Raspberry pi microprocessor interfaced with the android module to perform the automation and Arduino built digital devices and interactive objects that sensed and controlled objects in the physical world. They also used light sensor, temperature sensor, and water sensor.

### 3. COMPARISON OF VARIOUS TECHNOLOGIES FOR HAS

The table 1 given below describes the comparison of various technologies used in HAS and highlights the pitfalls we found which include wide range connectivity, appropriate user interface, energy efficient system, cost-effective installation, and efficiency. These flaws can be overtaken by using a Raspberry Pi as a system processor, Android based application as a user interface, the Internet as the mode of connection between Home environment and a Remote environment. Wi-Fi will be used as a mode for accessing Internet, Relay circuit is used to connect the Home appliances like lights, fans etc. and sensors like heat sensor, light sensor etc. to the raspberry pi. Our system also gives power managing mode to the user which when switched on will make all the appliances connected to the system to consume a minimum amount of energy and thus reduce the power consumption by entire home.

**Table 1: Comparison of various technologies for HAS**

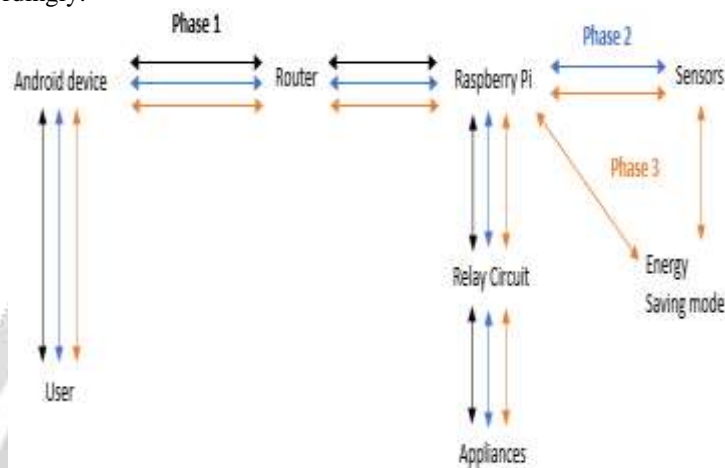
Name of paper	Authors	Journal of publication	Year and month of publication	Technology used	Remarks
Energy Efficient Smart Home Automation System	Abhay Kumar, Neha Tiwari	International Journal of Scientific Engineering and Research	January 2015	RS232(USART), 16F877A PIC microchip, relay circuit, C language	Complex and outdated technology is used.

Bluetooth based wireless Home Automation System using FGPA	B.MuraliKrishna, V.Narsimaha Nayak, K.Ravi Kishore Reddy, B.Rakesh, P.Manoj Kumar, N.Sandhya.	Journal of Theoretical and Applied Information Technology	31 <sup>st</sup> July, 2015	FGPA board, Bluetooth module HC-05, Xi link EDK	Use of Bluetooth system limits the area of use of the system.
Home Automation Using ATmega328 Microcontroller and Android application	S.Anusha, M.Madhavi, R.Hemelatha	International Research Journal of Engineering and Technology	September 2015, Vol 02, Issue 06	ATmega328 Microcontroller, GSM, Short Service Message(SMS), Android application	Better options of the technology used is available in the market
Bluetooth Remote Home Automation System using Android Application	Shirisha Tadoju, J.Mahesh	International Journal of Advanced and Innovative Research	August 2015, Vol 07, Issue 10	LPC2148 Microcontroller, Power supply circuit, LCD, L293D Driver	The system is complex, costly and Bluetooth limits the area of use.
Renewable Energy based Home Automation System Using Zig Bee	Archana Shewale, Jyoti Bari	International Journal of Technology and Electronics Engineering	June 2015 Vol 05, Issue 03	ZigBee, Solar Power System (PLC modem, solar panel and REG), Relay circuits	Not much concentration was shown towards ease of use.
Automated System using Raspberry-pi for remotely Controlling Devices using Android	Pallavi Suradkar, Anant Singh, Ameya Gokhale, Prasanna Jadhav, Manveet Khanuja	Imperial Journal of Inter Disciplinary Research	2016 Vol 02, Issue 05	Raspberry Pi, Django Framework, Relay circuit, Android	An effort was not made to manipulate energy consumption to save energy
Raspberry Pi Home Automation using Arduino	Suma L, Rajeshwari R, Vivekananda	International Journal of Innovative Research in Science, Engineering and Technology	May 2016 Vol 05, Issue 10	Raspberry Pi, Arduino, Android Application, LDR, PIR Sensor, Dth11 Sensor, Water Sensor	The only concentration was given to the security of the system.

#### 4. PROPOSED SYSTEM

Home Automation System refers to converting a manual home appliances system to an easily accessed, energy and cost efficient system. In this project, we are concentrating on the objective of reducing the power consumption and the wastage of electricity.

The system possesses both control as well as the automation of the appliances. The user controls the system and sends the control signals to the raspberry pi using the internet connectivity, these control signals are processed on the server side of the system where the raspberry pi forwards the processed signals through the relay circuit to the appliances and act accordingly.



**Fig 1: Overview of HAS**

Our system works in three phases as shown in the Fig 1 :

**Phase 1-** In this phase, the main objective is to control the power switch of basic appliances using an android application. In which the Raspberry Pi acts as the main interface provider between the hardware and the application. Black arrows in the figure represent phase 1

**Phase 2-** In this phase, the system is introduced with the sensors which will check and keep a record of the atmospheric change and would adjust the entire home system automatically. Blue arrows represent phase 2.

**Phase 3-** This phase is the most important phase of this project in which an energy saver mode is introduced on just one click in the application. The main objective of this mode is to save the energy consumption of the entire system which includes adjusting the appliances in such a way that it uses less power depending on the change in climate and disabling the unwanted features of the Raspberry Pi so that the system would be more power efficient and cost effecting. Orange arrows represent phase 3.

#### 5. IMPLEMENTATION

The actual working of the project involves the complete technical evolvement of the hardware as well as the software concepts and methods.

##### 5.1 Parameters used are shown in Table 2

**Table 2: Parameters used in the project**

Integrated Development Environment	Raspbain Operation system
Memory	1GB
Clock Speed	700Mhz
On Board Network	10/100 wired Ethernet RHJ5, Build in Wi-Fi , Bluetooth
Input Voltage	5 volts
Programming Language	Python,Java

##### 5.2 Hardware components

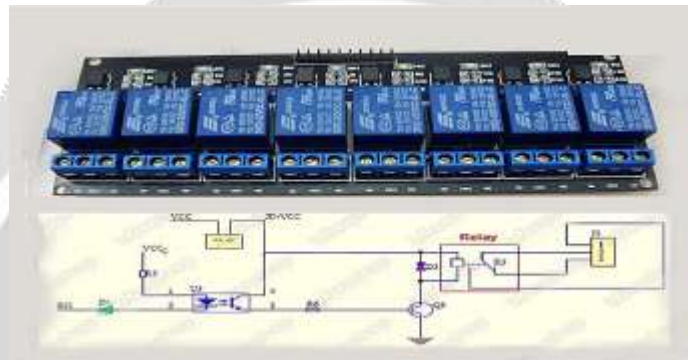
Hardware components include the Raspberry Pi model 3B components toolkit and the 8channel relay circuit which is connected to the appliances which are been controlled.

### 5.2.1 Raspberry Pi toolkit

The Raspberry Pi consists of Broadcom 2837 ARMv8 64bit processor the Raspberry Pi 3 model B is faster and more powerful as compared to other versions. It has upgraded power control to sustain more powerful USB devices and now is introduced with Wi-Fi connectivity. To take the entire use of Pi it is provided with 2.5A power adapter. RS components holds the official license of Raspberry Pi.

### 5.2.2 Relay Circuit

A Relay circuit shown in fig.2 is a switch, which allows low power consuming circuits to convert it into a comparatively high voltage. For a relay circuit to function an appropriate pull in and holding current should be transferred through its coil. Relay coils are designed in such a way that it requires more over 5V or 12V. Its job is to provide the required current to the relay coil, when a LOGIC 1 is assigned on the PORT PIN thus resulting in turning the relay ON. The relay is turned OFF when LOGIC 0 is assigned to the port pin. In our system, eight relay are used for device control [8].



**Fig.2:** Relay Circuit

Features of 8 Channel 12V Relay Board:

- Converts low power circuit to the high-power voltage.
- Used to connect multiple appliances in one go.
- Contains LEDs for indication.
- Uses 12V power for its working.

### 5.3 Software Components

The backend includes the use of Android Application Development tool and other software tools like Putty, VNC viewer for connecting the Raspberry Pi to other components of the system. In order to connect the software and the hardware part, Raspberry Pi connectivity libraries are being installed. Fig.3 shows the basic layout of the android application



**Fig.3:** Android Application

## 6. RESULT

We have completed the essential hardware and software connections of the system which indeed results into the complete working of the project. The goal of effectively consuming power and effective connection between the system and its user is achieved.

## 7. CONCLUSION

The generated system possesses the potential to control and manage the entire home appliances system using the pre-existing technologies but in an efficient and a convenient manner. Involvement of the sensor based system created a base for the actual automated system where in the main concept of an IoT-based system where the machine interacts with another machine and takes the decisions accordingly is achieved. The main objective of the project to generate such an interconnected, long range system which reduce the entire power consumption and reduce the wastage of power is also achieved by involvement of the energy saving mode with the help of Raspberry Pi involving the feature of Wi-Fi connectivity. The Android-based user interface also proved to be the great support to the entire system. Hereby, the Home Automation System Using Raspberry Pi is the ideal replacement for the home appliance system.

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