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Raspberry Pi Home Automation Using Android Application

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Abstract: *The project presents a low cost and flexible home control and monitoring system using a Raspberry PI module and a Static Relay, with internet connectivity for accessing and controlling devices and appliances remotely using Smartphone android application. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility and effectiveness of this system, devices such as Static relays and a wifi router can be integrated with the home control system.*

Keywords: *Home Automation, Raspberry Pie, Android.*

1. INTRODUCTION

Today the technological worlds centralize principle is to automate each conceivable thing for simplicity in life, providing security, saving electricity and time. In that home automation is one of the prior things to automatically on and off the home appliances. Home automation can be characterized as a method for doing something without human inclusion. It may incorporate brought together to control of lighting, machines, heating, ventilation, air-conditioning, and security door locking and different systems, to provide improved convenience, comfort, energy efficiency and security. The idea of automating each appliance in the home is done from many years ago, it started with connecting two electric wires to the battery and close the circuit by connecting load as a light. Later it can be developed by different organizations, which creates its own automation systems with different devices like sensors, controllers, actuators, buses, and interfaces. In present days most of the automation systems utilize the combination of hardwired and wireless systems for controlling the appliances. It should have both equipment and programming set up for proficient systems. The popularity of home automation has been expanding incredibly because of much higher reasonableness and straightforwardness through Smartphones and wireless networks. Internet of Things is interlinked through these networks; because of the popularity of the home automation is improved by the quality of service provided by the devices. Different home automation systems are developed by different authors for automatically on and off the appliances with different applications.

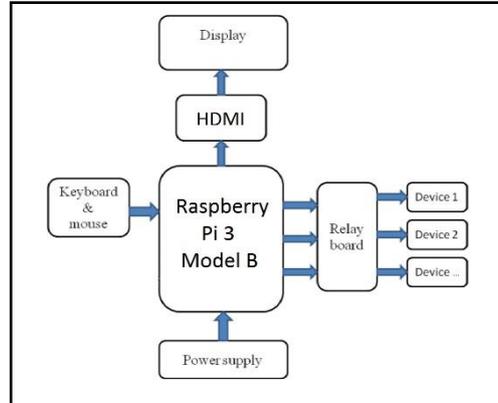
In this project, we discuss Design and Development of Activation and Controlling of Home Automation System via the web or android application using Microcontroller. It predominantly concentrates on the control of home appliances remotely when the person is far from the home. This project is primarily concerned with the programmed control of light or whatever other home machines, Control of Door and Home Security through Android mobiles or web application using the Internet as communication protocol interfaces and Raspberry Pi as processing unit. This project intends to control the system with the web by either turning device on or off so that the entrance control that system can be controlled from anyplace on the planet.

2. SYSTEM ARCHITECTURE

Overview

Home Automation is needed to be without new wiring and to be very easy installation. Field of home appliance network is still young, many initiatives and standardization efforts have already been made. This new kind of system brought the android application and raspberry-pi into home automation implementation. The proposed system architecture generally incorporates a raspberry pi computer for the purposes of network management and provision of remote access. It can be configured according to our home system.

Figure1: Proposed System Block Diagram.



The user will communicate to raspberry-pi through the Internet via Wi-Fi network. This system is flexible and scalable, allowing additional home appliances designed by multiple vendors, to be securely and safely added to the home network with the minimum amount of efforts. The Wi-Fi network must be having adequate strength also. we can use a Wi-Fi-modem for steeping a Wi-Fi. The serial data coming from Wi-Fi is connected to the raspberry-pi circuit. The main part of the home automation system consists of raspberry-pi board. The user can have an Android interface for using the system. It can be seen as a mini computer capable of doing many functions. The raspberry-pi board is configured for each home appliances. So according to the user intervention they can control over relay circuitry by the user interface which turns the pin command corresponding to relay switches on and device start function. The system is scalable and allows multi-vendor appliances to be added with no major changes to it. This project mainly consists of three modules as follows.

- 1) Raspberry Pi
- 2) Relay Circuit
- 3) Wi-Fi Router Configuration
- 4) Keyboard & Mouse
- 5) Interfacing
- 6) Working

3. DESCRIPTION OF MODULES

i) Raspberry Pi:



Figure2: Raspberry Pi Model.

As we know that the Raspberry Pi is a credit card-sized single-board computer developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and developing countries. Raspberry Pi features Broad com system on a chip (SoC), which includes central processing unit(CPU) and a non-chip graphics processing unit(GPU).It has1.2GHZ64/32-bitquad-coreARMCortexCPUand onboard memory of 1 GBLPDDR2 RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or Micro SDHC sizes. The B-model that

ean Ethernet port and the Pi 3 has on board Wi-Fi and Bluetooth .One powerful feature of the Raspberry Pi is the row of GPIO pins along the edge of the board. These pins are a physical interface between the Raspberry Pi and the outside world. At the simplest level, you can think of the mass switches that you can turn on or off (input) or that the Pi can turn on or off (output).

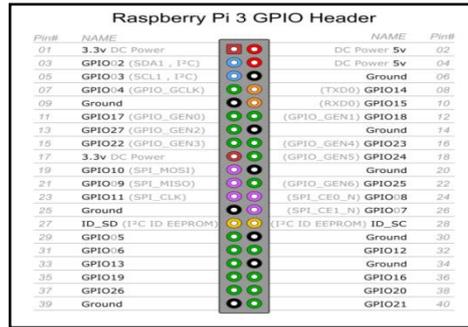


Figure3: GPIO pins of Raspberry Pi

ii) Relay Circuit

A solid-state relay (SSR) is an electronic switching device which switches on or off when a small external voltage is applied across its control terminals. SSRs consist of a sensor which response to an input signal (control signal), a solid-state electronic switching device which switches power to the load circuitry, and a coupling mechanism is there to enable the control signal to activate the switch without consisting of mechanical parts. The relay may be designed to switch either AC or DC to the load. Packaged solid-state relays use power semiconductor devices such as Transistors and Thyristors, to switch currents up to around a hundred amperes. Solid-state relays have fast switching speeds compared with electromechanical relays, and have no physical contacts to wear out. In SSR higher voltage power supply is totally isolated from the low voltage digital circuit.

Advantages of using SSRs over Mechanical relays are as

- Slimmer profile, allowing tighter packing.
- Totally silent operation.
- SSRs switch faster than electromechanical relays; the switching time period of a typical optically coupled SSR is dependent on the time needed to power the LED on and off - of the order of microseconds to milliseconds.
- Increased lifetime, even though it gets activate much time, as it doesn't contain any moving parts to wear and no contacts to pit or build up carbon.
- Output resistance remains constant regardless of the amount of use.
- Clean, bounce less operation.
- No sparking, allows it to be used in the explosive environment.

iii) Wi-Fi Router Configuration

The Wi-Fi unit provides the medium for communication. It can be also configured to make security services. The Wi-Fi should be configured with a certain address and user commands will be directing through Wi-Fi unit. The latest Model of Raspberry Pi has inbuilt Wi-Fi and Bluetooth connectivity.

iv) Keyboard & Mouse

Keyboard and Mouse are used to operate the Raspberry Pi, just like our normal computer (PC). Keyboard & mouse are used to program and operate the raspberry Pi.

v) Interfacing

Interfacing comprises of various steps, these steps are as

- First, write the Raspbian OS into an SD card by using —Win32Disk Imager, and put it on Raspberry Pi board, and then give power to the Raspberry Pi.
- Connect HDMI to view the display of the Raspberry Pi operation, and it will show as a figure.
- Connect keyboard and mouse to the Raspberry Pi USB ports for operating the raspberry pi and to change the keyboard settings by typing —Sudo nano /etc/default/keyboard on LX-terminal from the UK' to US', then reboot it by sudo reboot.
- Configure the Raspberry Pi by using a command raspi-config according to the need of the project requirements, then reboot it.
- Write the code for the corresponding application in python IDLES.

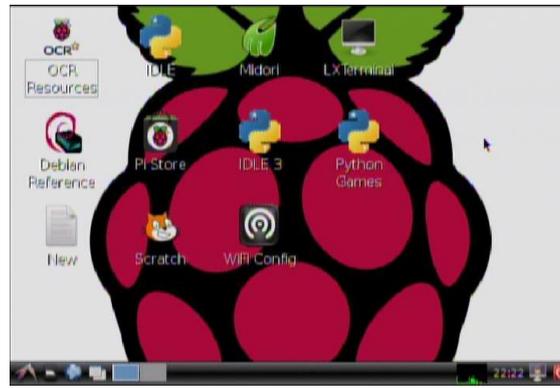


Figure4: Desktop of Raspberry Pi.

4. SYSTEM OPERATION

- The User Interface of the application (Web or Android) allows the user to communicate with the Raspberry Pi over the internet.
- The end user gives the command of turning ON or OFF the specific appliance by pressing the ON/OFF button in the application.
- The application interacts via the internet and transmits the code to the Raspberry Pi.
- Raspberry reads the command and sends the signal to the respected SSR via GPIO.
- The respected relay operates and turns the appliance ON or OFF.

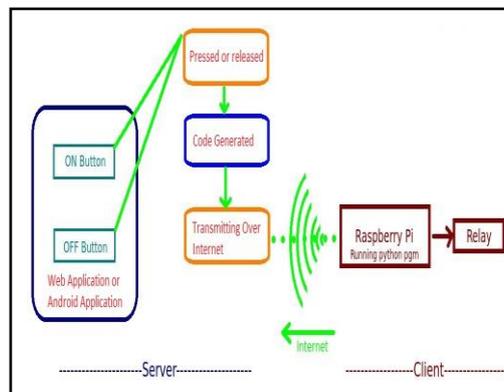


Figure5: Flow of Information.

CONCLUSION

The prime objective of our project is to use the Smartphone to control the home appliances effectively. This project is based on the Raspberry pi, Android platform Java and PHP. These platforms are Free Open Source Software. So the overall implementation cost is low and can be easily configured. The user can easily interact with the android phone/tablet. The user can send commands using an android application. The data are being analyzed by the application and are sent over a network. The Raspberry pi acts as a server, analyses the data and activates the GPIO (General Purpose Input Output) Pins. The GPIO Pins are connected to the relays switch which activated the required home appliances. In this way, automation process is carried out. This is a simple prototype. Using this as a reference further it can be expanded to many other programs.

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