IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 11, Issue 3, Ver. III (May-Jun .2016), PP 25-30
www.iosrjournals.org

Raspberry PI and Wi-Fi Based Home Automation System

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Abstract: *The aim of this project is to develop a system that will provide remote control of home appliances and also provide security against intrusion when the home host is not at home. This seminar is mainly concerned with the automatic control of light or any other home appliances using internet. It is meant to save the electric power and human energy. This project is made with the help of the microcontroller and Raspberry Pi. The various appliances are connected to the microcontroller and the sensor is connected using wireless network.*

Keywords: *Raspberry pi, PIR sensor, home automation*

I. Introduction

The provision for the user to automate homes remotely is the main target of this system. There was a need to automate home so that users can take advantage of the technological advancement in such a way that a person can send a control signal to the home control centre when he forget to turn off devices such as air conditioner instead of returning home. In addition to this home security has been a major issue and this issue is also dealt in this seminar. Therefore this seminar develops a system that allows user to control home appliances from wherever he is and whenever he wishes. Remote intelligent home system may include centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances and other security systems, to provide improved convenience, comfort, energy efficiency and security. The popularity of Remote intelligent home system has been increasing greatly in recent years due to much higher affordability and simplicity through internet connectivity. The concept of the "Internet of Things" is closely associated with the commercialization of Domestic/Industrial automation. As the number of controllable devices in the home rises, interconnection and communication between the devices becomes difficult. Remote intelligent home system can also provide a remote interface to Domestic/Industrial appliances or the system itself, via telephone line, wireless transmission or the internet, to provide control and monitoring via a Smartphone or browser. An example of remote monitoring , the Remote intelligent home system could be triggered when a smoke detector detects a fire or smoke condition causing all lights in the house to blink to alert any occupants of the house to the possible emergency.

Home automation can be defined as a system implemented at a residential place whereby the intention is to make the place intelligent so that energy is conserved and security is maintained. It makes the life of the residents flexible, healthy and comfortable. Initially systems were developed in this regard but those systems had to be deployed on Internet and heavy machineries like a big Personal Computer. Our system will be free from all this giant components, which, indirectly suggests that our system has a good quality of portability. Most systems would exchange data or would communicate with the help of Bluetooth, ZigBee and GSM. These systems have their own disadvantages. For example, system-implementing ZigBee has too low bandwidth for the data communication whereas the GSM implementing system has too large bandwidth for the data communication. Thus, there is wastage of the essential bandwidth, which goes without being used. The other systems, which were in use, are, for example Java Based Systems and SMS based systems. Java Based Systems still use web pages, which is a disadvantage if data intranet or Internet is off. SMS based system is more costly since it requires data transfer from the real time service provider. This Wi-Fi protocol has some upper hand benefits like its range is in the radius of 150-200m. The mobile application can also extend the security of the system via an implementation of the password protected application.

II. Works Related to System

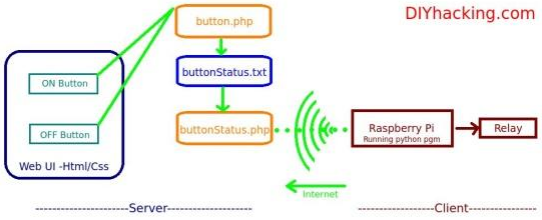

Fig.1 Raspberry Pi home automation Block Diagram

The client side consists of a Raspberry Pi with a relay circuit connected to its GPIO pin. The pi runs a python program which is used to 'Post' a url link using urllib2.That is, the pi constantly reads the contents of a url link. Here, the url link is another PHP file called buttonStatus.php. This PHP file serves as an API to read the contents of the text file buttonStatus.txt. After reading the data, the python program checks if the string obtained is "ON" / "OFF" based on which it switches ON/OFF the relay respectively via its GPIO pin.

Raspberry Pi Home Automation system:

Step 1: Preparing the html, php files:

Here, the server side of the system has to be set up. If you are having your own domain, you can use the file manager service to drop these files into your server and can be used to control your IoT systems from anywhere around the world. The files to be put in your server are : main.html , button.php , buttonStatus.php and buttonStatus.txt , download them from here : DIY Hacking – Raspberry Pi home automation system and extract it. The program raspbi.py is the python program which is to be copied to your raspberry pi. If you are new to html and php , don't worry. This project will need only a basic understanding of the two languages, spending some time on a few tutorials :HTML for beginners , PHP for beginners and reading the code would be sufficient. The html file consists of a basic UI with two buttons. On button press, it triggers a PHP program which writes a string to a .txt file depending on the button pressed. The .txt file stores information of the last button state.

However, if you don't have a domain, you can simulate a domain in your local network or wifi using a service called xampp. It is very simple, the instructions for using it are here : Xampp Web Server Emulator Windows and Xampp Web Server Emulator Linux. Using xampp you can use your pc as a local web server. However, the IoT systems gets confined to a control range limited to your home wifi network. Drop the html, php and .txt files into the /htdocs/xampp directory.

Step 2: Setting up the relay circuit for the Raspberry Pi home automation system:

Fig.2. Relay Circuit for the Raspberry Pi home automation system

A small relay circuit is to be made , to switch an appliance ON/OFF. It consists of a BC547 transistor, which acts like a switch. The transistor triggers the relay when it receives a voltage at its base from the GPIO pin of raspberry pi. A 1N4001 diode is used to protect the transistor from reverse voltages created in the relay coil. The circuit can be powered either using the 5V supply from the raspberry pi or using an external battery. Use the schematic and pinout diagram below to make the connections for the raspberry pi home automation system :

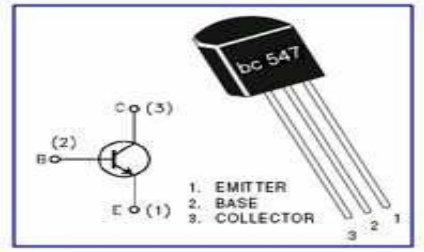

Fig3. BC547 pinout

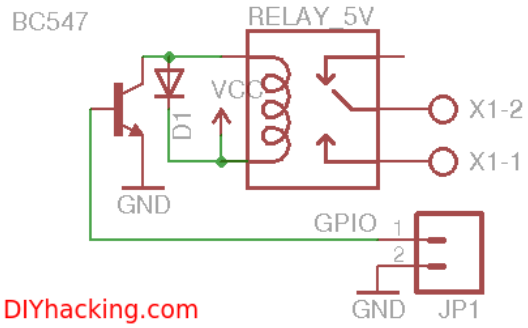

Fig4. Relay Schematic

Step 3: Setting up the Raspberry Pi:

If you have a brand new raspberry pi and are looking for instructions to load the OS into the SD card please follow this tutorial: Installing the OS for raspberry pi. The default OS used with the pi is the raspbian. To use the GUI for pi, use the command "startx" in the terminal. You can use an Edimax wifi dongle for wireless connectivity, use the wifi config application in the desktop of your pi to scan and connect to the wifi network. The raspberry pi is used to continually run a python program called raspbi.py , copy this file to your pi. Before executing this file , open the file using "nano raspbi.py" and edit the line that says : "response=urllib2.urlopen('http://diyhacking.com/projects/IOTautomation/buttonStatus.php')" by replacing the link within ' ' , by your own link generated either through xampp or your own domain. On using the command "sudo python raspbi.py", it will initiate the program.

Fig5. Edimax Wifi Dongle EW 7811UN

You can use the raspberry pi without a monitor by using ssh. SSH (Secure Shell) can be used to control the pi remotely from a pc in the same home network, if you know the ip address of your pi. Use "ifconfig" command on your pi to find the ip address. Use "sudo /etc/init.d/ssh start" to initiate the ssh service. Then, from a remote pc using putty software (for windows) , open the terminal and enter the command "sudo ssh ipaddress -l pi" , "ipaddress" is replaced with the actual ip address you obtained for the pi in the range 192.168.1.1 – 192.168.1.254.

III. Proposed System

Every user United Nations agency is full-fledged within the existing system might imagine of a system which will add additional flexibility and run with some common applications like humanoid. The projected system is meant in such how to avoid the restrictions of the prevailing system. The projected system supports additional flexibility, comfort ability and security. The projected home automation system is functioning with very hip humanoid phones. it's having chiefly 3 components; the humanoid enabled user device, a LAN router having a decent ascendable vary, and a raspberry pi board .Here the users have provision to regulate the house appliances through humanoid enabled device. this can improve the system quality since there's no would like for a wired association, net etc. The directions from the user are transmitted through the LAN network. The raspberry pi board is organized in step with the house system and it'll change the relay circuit as per user request. The relay circuits will management the house appliances additionally. We will add appliances to the system can also add extra security measures. The main objectives of the projected system is to style associate degree to implement an inexpensive and open supply home automation system that's capable of dominant and automating most of the house appliances through an humanoid device.

IV. System Overview

Home appliance network (home automation) is needed to be while not new wiring and to be terribly simple installation. Field of household appliance network continues to be young, several initiatives and standardization efforts have already been created. The new reasonably system brought Google and raspberry-pi into home automation implementation. The projected system architectures usually incorporate a raspberry-pi pc for the needs of network management and provision of remote access .raspberry-pi are often designed in step with our home system. The user can communicate to raspberry-pi through local area network. The system is versatile and climbable, permitting further home appliances designed by multiple vendors, to be firmly and safely adventitious to the house network with the minimum quantity of effort. The local area network ought to be having adequate strength additionally. We will use a local area network-modem for steeping a wi-fi. The user will have a pleasant golem interface for mistreatment the system. The serial knowledge coming back from local area network unit is connected to raspberry-pi circuit. The core of the house automation system consists of raspberry-pi board. it are often viewed as a mini PC capable of doing several functions. The raspberry-pi board is designed for every home appliances .so in step with user intervention the matched out can build high and therefore the corresponding relay can turn on and device begin operate. The system is climbable and permits multi-vendor appliances to be adventitious with no major changes to its core.

V. Block Diagram

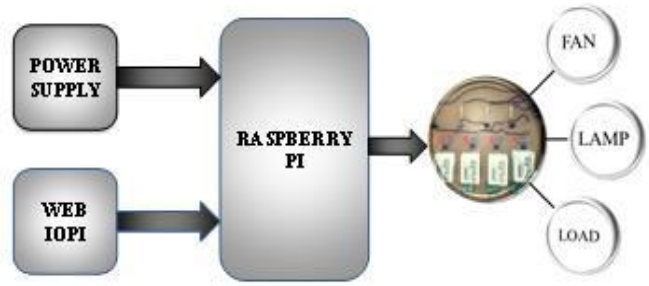

Fig 6. Block diagram of the Raspberry Pi and wifi based home automation system.

Raspberry Pi:

The Raspberry Pi is of a credit card-size, single-board computer launched in the United Kingdom by the raspberry pi foundation. The main objective of this is to encourage basic computer teaching in institutes. The Raspberry Pi has a broad com BCM2835 SoC, which comprises of an advanced RISC Machine 76JZF-S 700 MHz processor, video core IV GPU, and was originally distributed with 256 megabytes of RAM, later it is improved (Model B & Model B+) to 512 MB. It does not contain any built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage, with the Model B+ using a Micro SD.

The Raspberry Pi Foundation provides Debian and Arch Linux ARM distribution for downloading. Besides tools are available for Python as the main programming language, with support for **BBC CLONE** (via the RISC OS image or the Brandy Basic clone for Linux), C, C++, Java, Ruby and Perl.

Power Supply

The device is powered by a 5V micro USB supply. Exactly how much current (mA) the Raspberry Pi requires is dependent on what you connect to it. We have found that purchasing a 1.2A (1200mA) power supply from a reputable retailer will provide you with ample power to run your Raspberry Pi. Typically, the model B uses between 700-1000mA depending on what peripherals are connected; the model A can use as little as 500mA with no peripherals attached. The maximum power the Raspberry Pi can use is 1 Amp. If you need to connect a USB device that will take the power requirements above 1 Amp, then you must connect it to an externally-powered USB hub.

VI. Methodology

The methodology of this project design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the main controller, sensor networks and the smart home while the software implementation focuses on the programming of the microcontroller using Embedded C

6.1 Hardware Implementation

Main controller is the most important part of the system in this project. Main controller will be the interface between the user and the system.89C52 microcontroller is used as the „brain" of the main controller. It has 32 general I/O port and the clock speed can be up to 24 MHz .This microcontroller is a CMOS technology IC which enable the low power consumptions.

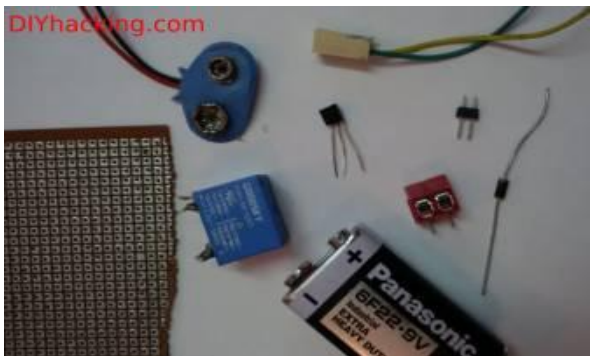

Fig.7. Relay circuit components

1. Raspberry Pi model B with memory card preloaded with an OS.
2. Bc547 Transistor.
3. 5V SPDT relay.
4. 1N4001 diode.
5. Solder dot prototyping board.
6. 9V battery
7. (Optional) WiFi dongle : Edimax EW 7811UN.
8. USB keyboard.
9. HDMI monitor.

6.2 Software Implementation*:*

The software part consists of programming 89C52 microcontroller using Embedded C using Keil µVision. The Graphical User Interface is designed by using PHP.

Software (Programming languages and OS involved):

1. PHP.
2. HTML/CSS.
3. Python.
4. Linux/Rasbian

VII. Conclusion

These kinds of home automation systems are required because human can make mistakes and forgot to switch off the appliances when there is no use and in this case, they are useful in order to utilize the power effectively and also in a secured manner.

This project describes raspberry pi module and presents its potential deployment in smart home environment. Examples of prototype applications in home automation utilizing a pir wireless sensor network are

illustrated. This system has attractive features such as intruder alerts. In this perspective, raspberry pi is emerging network technology.

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