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Design of Controlling Home Appliance Remotely Using Raspberry pi

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***Abstract*— The electronic device that we build as part of this paper can assist a user in controlling all the home appliances via WiFi technology. The home automation device that we build can be integrated with almost all the home appliances and can be used to control them remotely from any part of the world. Raspberry Pi is a miniature size computer that is capable of performing all the functions as that of a computer. The home appliances will be connected to the Raspberry Pi board with help of relay driver modules which will facilitate the On/Off actions based on the load given. The system will be connected to the internet through WiFi and a cloud interface will be created to control the appliances from a remote location. The device can also be connected to an Android App which we can develop on our own using some applications like MIT App inventor etc. By using this app, we can able to monitor and control the home appliances from any part of the world with ease. We can also include a PIR sensor with this paper to make it switch ON automatically the appliances whenever a person enters the room and switch OFF the appliances whenever the person leaves the room.**

Keywords-Raspberry pi, home Automation, electric/electronic appliances, GPIO, web server, temperature sensor

I. INTRODUCTION

Design of Controlling Home Appliances Remotely using Raspberry pi and security is an increasingly available and attractive option to homeowners. However, cost and ease of installation and use are still barriers to widespread adoption. The goal of this paper is to design a cheap, open source, and easy to use system.

Based around the cheap but powerful Linux based Raspberry Pi mini- computer, this project will implement several common home security peripherals. A temperature sensor will be available to monitor temperature and other security zones. A power switch will allow remote monitoring and automating the lights of the house. Automating D.C motor would help in accessing appliances working on D.C motor, through mobile device and will reduce the human load of operating them manually. These peripherals will be controlled via a web-based interface served on the Raspberry Pi and accessible from inside or outside the home. We have developed a prototype system which can have application exclusive implementations in the field.

This paper comprises of two sub- parts. The front end involves designing a web page to communicate with remote Raspberry Pi over the Internet. The back end involves building a Pi based circuit to emulate devices used at residential locations for the purpose of home automation such as temperate sensors, motors, occupancy (proximity) sensors, lighting control etc. [1-3].Things are getting simpler and easier with the technological growth and expansion. Automation can be described as deployment of either or both control systems and information technology to reduce or facilitate the human efforts in the production of goods and services inside any system. In the industrialization domain, automation is a furtherance of mechanization or a step further. Mechanization provides humans with machinery or mechanical infrastructure to assist or facilitate them with the muscular requirements of any work environment, technology took a step ahead to create this concept called "automation" which is concerned to reduce the sensory and mental efforts of humans as well. Automation have a continuously increasing and very important role in the industrial and economic world as well as in the daily experience. Home automation system for old or disabled people will offer raised quality of life forthem. [4]

Inside any general Home automation system, The Home appliances are controlled by any handheld device or any computer system in the local or wide network. The devices can be connected to the system through any network technology like internet, intranet, LAN, etc. The usecan control and monitor various electrical or electronic appliancesconnected to the system like lights, Air conditioning, etc. The user accessing the graphical user interface (GUI) which facilitates the human -system interaction on its device monitors the appliances or the connected sensors and give commands in the interface to control the connected appliances. The interface receives the commands and tell the system to perform desired function with the desired appliance. The system then informs the appliance that will perform the function. The system also tracks the current state of the appliances and other functionalities can be added to the system with simple codes and devices.

Now with the development in the automation system field, automated systems are nowhighly preferred over systems that runs on only manual and mechanical infrastructure. In this paper, we have designed a system through which the consumption of power can be reduced to an extent.It can control a bulb running on a 220v AC supply anda DC motor running on a 5v DC power via Wi-Fi device like android phones [5-8].

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II. RASPBERRY PI SPECIFICATION

Raspberry pi is a small minicomputer which is embedded on a single board. It was first developed to promote teaching and learning of basic computer science. Raspberry Pi Foundation develops these high performance, low cost computers in United Kingdom. Raspberry Pi have several generations of computer systems which have different configuration. The latest version of Pi 'Raspberry Pi 3' have on-board Wi-Fi and Bluetooth. We have used Raspberry Pi 2B which includes Broadcom BCM2836 SoC (system on chip) including 900 MHz 32-bit quad-core ARM Cortex-A7. It has Broadcom VideoCore IV GPU and I GB SDRAM. The board have 4 USB port and an Ethernet slot. It has Micro SDHC card slot as all the boot media and storage is done in the SD card only. It works as ROM to the system. The Raspberry Pi Foundation provides Debian and Arch Linux based Operating systems for download. We are using Debian based OS called Raspbian Jessie. Rapbian's previous version was 'Wheezy'.

A monitor screen can be connected to the raspberry pi via HDMI port as well as keyboard and mouse are connected via USB. It works as a regular desktop computer after booting. Everything and anything that can be done on a PC can be performed on raspberry pi. Raspberry Pi board includes a 40 Pin header which includes 26 GPIO (General Purpose Input Output) pins which are used to interact with the outside world. These pins can be programmed to receive or transmit digital signals to or from any connected sensor or device. The
off state (state '0') of the pin transmits 0v while the on state (state '1') transmits 3.3v DC supply. The header includes 2 3.3v pins, 2 5v pins and 8 ground pins.

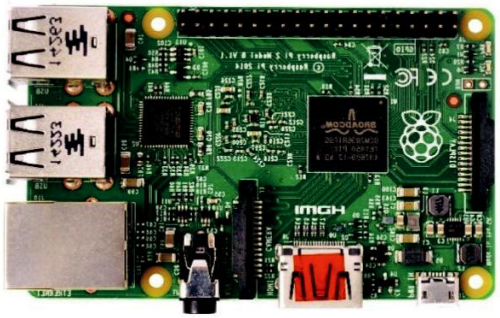
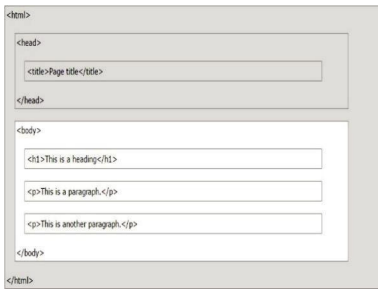


Figure 1.Raspberry Pi Model B

B. WEB PAGE AND SERVER

To control the home appliances remotely by web page, we have used HTML and PHP. Html is a markup code for display on a World Wide Web browser page.

Figure 4 shown as complete Description of Html page there are different part in this such as head, title and body and enclosed by the html tag.



III. DESIGN MODULE

A. DS18B20 TEMPRATURE SENSOR

The DS18B20 is a thermometer with a built in 12bit ADC as shown in Figure 1.The sensor have a quoted accuracy of +/Ğ0.5 deg C in the range Ğ10 deg C to +85 deg C.in this sensor thermistor as a temperature device[9].

Figure 2.DS18B20 temperature sensor

Pin configuration is shown below in Figure 3. The pin 3 is connected to sensor to the 3.3V GPIO pin. Thepin 1 is connected to the ground GPIO pin**.** The 4.7kΩ resistor is connected between pin 2 and pin 3 of the temperature sensor to get result

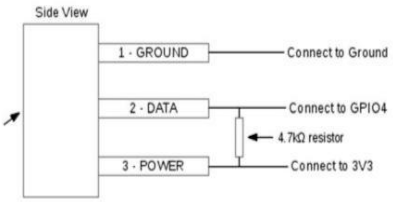


Figure 3. Temperature Sensor pin configuration

Figure 4 Html Description

In this paper, apache server is used to make raspberry pi as a web server to host the web page. PHP is used for communication or sending/receiving messages between the web page and the pi as well as between the user and the web interface.Apache server and php support can be installed with the help of a few commands.A web server is like a restaurant host. When you arrive in the restaurant, the host greets you, checks your booking information and takes you to your table. Similar to the restaurant host, the web server checks for the web page you have requested and fetches it for your viewing pleasure. However, a web server is not just your host but also your server. Once it has found the web page you requested, it also serves you the web page. A web server like Apache, is also the Maitre D' of the restaurant. It handles your communications with the website (the kitchen), handles your requests, and makes sure that other staff (modules) are ready to serve you. It is also the busboy, as it cleans the tables (memory, cache, modules) and clears them for new customers. So basically a web server is the software that receives your request

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to access a web page. It runs a few security checks on your HTTP request and takes you to the web page.

C. RELAY CIRCUIT CONTROLLING STRUCTURE

A relay is an electromagnetic switch. It operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). You can think of a relay as a kind of electric lever: switch it on with a tiny current and it switches on ("leverages") another appliance using a much bigger current. It is that useful,as the name suggests, many sensors are incredibly *sensitive* pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of appliance that use bigger currents. Relays bridge the gap, making it possible for small currents to activatelarger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones)

Figure 5 shows how load supply can control by 5v device.There are three terminal in relay circuit normal connected,
Normal open and common. And data can send via raspberry pi using transistor.

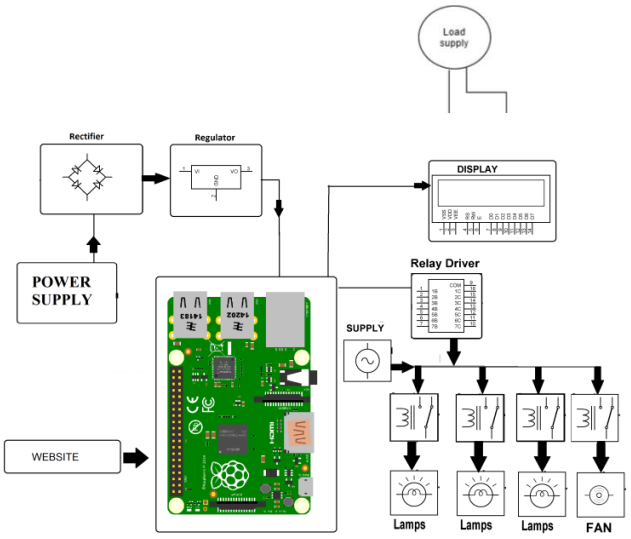

Figure 6 Implementation

Diagram E. WORKINGPRINCIPLE

There are four files that complete the work. First file is "setupgpio.php" file is used to activate the raspberry pi gpio pins which respond on the request made by client on the web server using web interface. The Button named "setup pins 23
& 24" sends request to the apache server installed on Raspberry Pi to run "setupgpio.php". This file contains a function called "exec ()", which is used to execute an external program. Here, the gpio pins 23 and 24 are used for the output which are used to give an output value of "logic 0" or "Logic 1" i.e. a voltage near 3.3 V is interpreted as a logic one while a voltage near zero volts is a logic zero. The "header ()" function is used to send a raw HTTP header to a client which redirects the user to homepage in this case which is "mobi3.php.

Figure 5 Relay controlling structure

D. IMPLEMENTATION DETAILS

A complete detail of our designis shown in Figure 6. In the design, we have connected two relay for bulb and DC motor. The blub connects to GPIO pin 23 of raspberry pi via the transistor and 1 kΩ resistor. DC motor is connected to GPIO pin 24 of raspberry pi with same component. The temperature sensor is connected to GPIO pin 4 via 4.7 kΩ resistor.Using theIPaddress,wecanaccesstothe Web page through aset ofbuttons.When one of thesebuttonsispushed, the signalissentto theRaspberry pito get the specific result[7].

Second one is "changegpio.php" file works when a user hits the submit button. The submit button send the response of the radio button to the server. The radio buttons used in the form tag is assigned with a POST method which will only send input values to the server when the submit button is pressed.
The file "changegpio.php" contains the function named "exec ()" same as "setupgpio.php" but here this function sends request to server to change the output value of the gpio pin i.e. "logic 0" or "logic 1". On the selection of "ON" and "OFF" option the POST method will send the value "1" and value "0" respectively to the server to switch on and off the appliance.
Third file "temp.php" file is used to read the temperature using "DS18B20" temperature sensor connected with the raspberry pi. This file automatically sends request to server every time the webpage loads. The function "fopen () "is used to open the file "w1_slave" to read the sensor configuration which is stored in directory "/sys/bus/w1/devices/". The "thermometer Reading" variable reads the value returned by sensor and used to convert the value into degree Celsius or Fahrenheit and the value is displayed on the webpage to the end users.
Last file is the "mobile.php" file works as the main user interface file which is scripted in html and connected with bootstrap and css files for designing. In this two form tags are used for the "setupgpio.php" and "changegpio.php".

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The "changegpio.php" works on the POST method and sends the values of form when a user triggers submit button.

F. USER INTERFACE DESIGN DESCRIPTION

Through the Internet or by remote controller. The concept of project presented by Muhammad Fahim [8].

The user interface is designed by using "mobirise" web development desktop application which works on the drag and drop mechanism of designing. Mobirise is an offline app for Window and Mac to easily create small/medium websites, landing pages, online resumes and portfolios, promo sites for apps, events, services and products. Mobirise is perfect for non-techies who are not familiar with the intricacies of web development and for designers who prefer to work as visually as possible, without fighting with code. Also great for pro-coders for fast prototyping and small customers' projects.

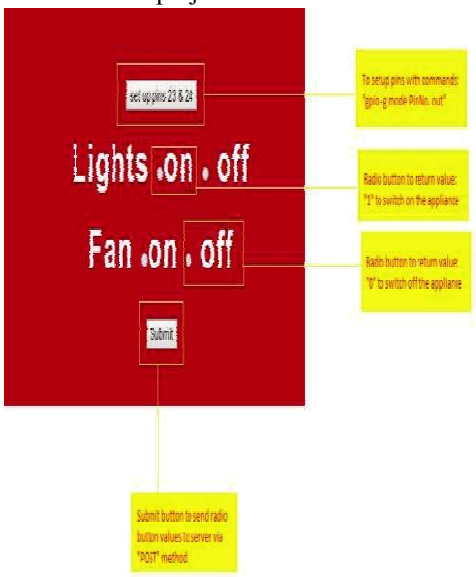

Figure 7. User Interface Design

IV. RESULT AND DISSCUSSION

Home appliances are successfully controlled by the proposed system. This system efficiently perform the automation.This proposed solution, which allows the user to monitor and control different home appliances connected over a Wi-Fi network. The home system looks feasible to enter this arena. Efforts in such direction will help to realize a truly Wi-FiSystem, fully automated home automation system for the benefit of senior citizenandhandicapped people.

V.CONCLUSION

The button labelled "set up pins 23 & 24" is used to send request to the server installed on raspberry pi to activate the gpio pins 23 & 24 for the output by executing "gpio – g mode Pin No. out" command on raspberry pi using php in the backend. Once the button is pressed the user need not to activate gpio pins every time the page load, it only required when the server restarts.

Here, four radio buttons are placed two are used to switch on the appliance and other two are used to switch off the appliances connected to raspberry pi gpio pins via relay circuit. Another button mentioned here is the submit button which sends the data mentioned by the user through radio buttons. The submit responds on the POST method as the user fill up there choice will only delivered to the server when submit button is triggered. Figure 7 shown as complete description.

Figure 8. Control Web Page

We can conclude that raspberry pi is a great platform to deploy Controlling Home Appliances Remotely. It has more flexibility than any of the other platforms. Home automation is a great way of conserving electricity at homes and also a great way of monitoring you home for security purposes. The system has great applications at Home and industrial use and can be extended very easily to add more and better functionality. A naïve user with no technological knowledge can easily operate the system as it is very user friendly and easily accessible. The prototype can be made in into product very easily and at very low cost also with very application exclusive functionality. The user interface is quite simple and friendly making the system more relevant. The device is very small and very easy to install anywhere and also is a plug and play device i.e. there is not any installation issues that need to be tackled.

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