Power Consumption in Smart Home Using Raspberry Pi

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Abstract – Controlling home appliances by controlling electrical or electronic appliances remotely, things can be done automatically in the desired environment. Very first few implementations of Automation included simple security systems like alarms, but today automation can be applied in every system of gadgets. Using Home automation can make you do some very important things very easily and with higher controllability. Other than combining sensors and code to make things work automatically, Home automation can also be applied as an implementation of remote computing by giving remote access of the system to the user so that the user can monitor and control the system according to the need. In this project we have automated a 220v supply which can have the load of a bulb or any electrical device, we have used a temperature sensor to monitor the room temperature and the temperature can be seen on the web interface on any mobile device and we have also automated a small 5v D.C supply which can be used to attach a motor or can have various applications like controlling the latch of a door or it can be made to work sporadically by integrating it with sensors and readings. In this paper we developed project using raspberry pi as a server for operating the home electronic/electrical appliances automatically.

Keywords: Raspberry pi, home Automation, electric/electronic appliances, GPIO, Omron sensor.

1. INTRODUCTION

Home surveillance system is becoming one of the key factors of the home security systems. A fully remotely controlled surveillance of home is going to be the future. Everyone is worried about the security of the home when they are not at home.

With the advancement in the technology; the home surveillance systems are becoming popular and implementation of it is becoming quite easy. The need for it is thus increasing. The various ways are present in the market like the closed circuit cameras, wireless surveillance cameras, IP cameras which are being used. But still a lot of improvements are required in the present systems. The system through which we will be able to control the surveillance systems from anyplace on the earth is needed. The cost effectiveness and the efficient systems are required. The ability to get the live footage of the place under surveillance is needed.

Home automation is the control of any electrical devices in our home or office. There are many different types home automation systems are available. These systems are typically designed for different purposes. In fact, one of the major problems in the area is that these different systems are neither interoperable nor interconnected. There are number of issues where designing a home automation system. It should also provide a user friendly interface on the host side, so that the devices can be easily setup, monitored and controlled. In smart home systems, the internet is also use to ensure remote control. For years, the internet has been widely use for the processes such as surfing on the pages, searching information, downloading chatting, and installation. By the speedy developments of new technologies, monitoring, controlling services have been started to be served along with internet as an instrument providing interaction with machinery and devices. The system can be use in several places like banks, labs, hospital and other sophisticated automated system, which reduces the hazards of unauthorized entry. The main motive to develop this system is to save time and man power along with precautions and convenience.

BLOCK DIAGRAM:

The block diagram of our proposed system is given below.
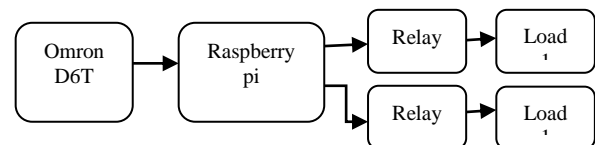
Design of Controlling Home Appliances Remotely and automatically using Raspberry pi and security is an increasingly available and attractive option to homeowners. However, cost and ease of installation and use are still barriers to widespread adoption. The goal of

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 Omron 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. We have developed a prototype system which can have application exclusive implementations in the field. 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. Things are getting simpler and easier with the technological growth and expansion. Computerization can be described as operation 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 has 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 for them. 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 user can control and monitor various electrical or electronics.

Appliances connected 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 gives commands in the interface to control the connected appliances. The interface receives the commands and tells 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 now highly 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.

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 performances, low cost computers in United Kingdom. Raspberry Pi has several generations of computer systems which have different configuration. The latest version of Pi 'Raspberry Pi 3' has 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 is 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.1.1 Raspberry pi 3 model B

CHARACTERISTICS:
• Controller: 700MHz ARM1176JZF-S core
• Operating rate: 1GHz
• 512MB of SDRAM
• 4USB ports for accessing external memory
• 40 GPIO pins
• Ethernet port for internet connectivity
• 3.5mm stereo jack for audio out.

OMRON SENSOR:
Omron sensor series are mainly used to detect the thermal value. Unlike typical pyroelectric human presence sensors that rely on motion recognition, the D6T thermal sensor is able to detect the presence of stationary humans by detecting body heat, and can therefore be used to automatically switch off needless lighting, air conditioning, etc. when people are not present. As the D6T sensor is also able to monitor the temperature of a room, it can also be used to continually retain optimal room temperature levels, immediately sense unusual changes in temperature thereby detecting factory line stoppages, or discover areas of overheating for early hindrance of fire outbreaks.

Figure 1.2 Omron D6T

FEATURES:
•Power supply voltage: 4.5 to 5.5 VDC
•Storage temperature range: −10 to 60°C (with no icing or condensation)
•Operating temperature range: 0 to 50°C (with no icing or condensation)
•Storage humidity range: 85% max. (with no icing or condensation)

•Operating humidity range: 20% to 85% (with no icing or condensation)

RELAY CIRCUIT:
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 valuable, as the name suggests, many sensors are incredibly susceptible 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 activate larger ones. That way relays can act as switches or as amplifiers.

Figure 3 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.
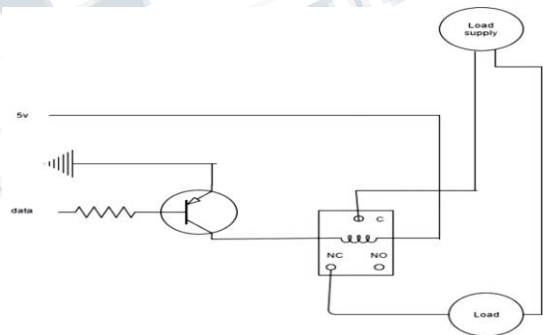

Figure 3 Relay Circuit

WORKING FLOW:
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 interpret as a logic one while a voltage near 0 volts is a logic 0. 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.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". The "changegpio.php" works on the POST method and sends the values of form when a user triggers submit button.

RESULT AND DISSCUSSION

Home appliances are successfully controlled by the proposed system. This system efficiently performs the automation. This proposed solution, which allows the user to monitor and control different home appliances connected. The home system looks feasible to enter this arena. Fully automated home automation system for the benefit of senior citizen and handicapped people.

CONCLUSION

We can conclude that raspberry pi is a great platform to deploy Controlling Home Appliances automatically. 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. The prototype can be made in into product very easily and at very low cost also with very application exclusive functionality. 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.

FUTURE WORK:

In future implementation we can use camera instead of Omron sensor. Using image process techniques we can able differentiate human and animals clearly.

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