IOT based Home Automation using Raspberry pi

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Abstract---*Internet of things is the current technology that allows us to control hardware through internet. By using IOT system we can connect the physical devices and have the ability to send data over a network with human-to-human or human-to-system interaction .This paper shows how to control home appliance using IOT. We have three loads lights, fan and refrigerator to demonstrate the working of home appliance. An AVR family microcontroller is interfaced with Wi-Fi modem for sending and receiving commands over internet. Relays are being used to switch loads. Once user passes commands over internet to switch on fan the microcontroller processes these instructions and operates accordingly. LCD display is used to display the status of the system. It also switches the fan as per the user commands. Thus IOT based Home automation system allows the user to control home appliances over internet.*

1. INTRODUCTION

In this paper, we are presenting a proposed system for Home Automation technique with Raspberry Pi using IOT (Internet of Things). In the field of home automation, devices were controlled with technologies such as ZigBee based home automation system, GPRS based home automation system and Wi-Fi connected automation system. But these technologies was limited to the device range (which was within a home). Internet (IOT) based home automation is the current technology with which we can control almost every home appliance from any place of the world with Internet Connectivity. In this project we have developed a model that controls and monitor devices through web interface when connected to the internet using an Ethernet cable or Wi-Fi dongle that can be accessed through smartphones, computers and tablets. To achieve this we are using Raspberry Pi to reduce the complexity of design and is economical cost. The main advantage of having this kind of technology is that we can have a control over our devices and home appliances throughout the globe where ever communication is possible. For instance, one morning we are rushing to our workplace and forget to switch off lights and fans then we can go to our device control interface and choose the lights and fans to be switched off and complete the task from our workplace. Also, on a sunny day we can switch ON the Air conditioner in our room while driving back home so that we don't have to wait for it to cool the room after going home. We can not only control but also can monitor devices and home appliances. IOT technology can be implemented in home, business or industrial environment based upon the requirement.

2. INTERNET OF THINGS

IOT refers to connection of devices such as computers, tablets and smartphone to internet. IOT can used in home automation system to connect appliances such as microwave, fans, lights, air conditioner, television, washing machine, fridge, computer, printer etc. as the Internet of Things grow in the upcoming years, more devices will join the list. It can be implemented in different fields such as home, schools, offices and other fields based upon their requirement.

Fig. 1: IOT based Home Automation

Any internet connected devices can be monitored and controlled from a remote location where ever internet is available. Both the ends require internet connection for receiving and sending data. The web interface from where we give input that is smartphones, computers, tablets and the Raspberry Pi which is connected to the devices such as fans, lights etc. both the ends requires internet connection might be Ethernet cable or Wi-Fi. The devices utilize embedded technology to communicate and interact with the external environment via internet. Some of the IOT Applications are

- IOT Electronic Door Opener
- IOT Home Automation Using Raspberry Pi
- IOT Liquid Level Monitoring System
- IOT Garbage Monitoring System
- IOT Based Home Automation

- IOT Based Office Automation

- IOT Based Industry Automation

- IOT Weather Reporting System

- IOT Industry Automation Using Raspberry Pi

- IOT Underground Cable Fault Detector Project

- IOT Air & Sound Pollution Monitoring System

- Energy Meter Monitoring Over IOT

- IOT Based Person/Wheelchair Fall Detection

- IOT Patient Health Monitoring Project

- IOT Heart Attack Detection & Heart Rate Monitor

- IOT Based Toll Booth Manager System
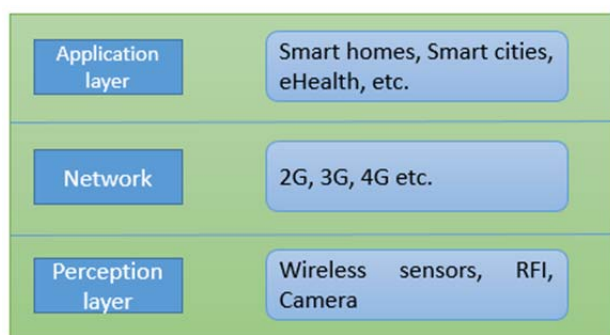
- IOT Theft Detection Using Raspberry Pi

Fig. 2: Layers of IOT

IOT system has 3 major layers they are

1. Perception layer
2. Network layer
3. Application layer

Perception layer has real-time devices such as Camera, RFID, Sensors, Pen drive etc. Data of these devices can be accessed/monitored/controlled. Data from perception layer is sent to the next layer. Middle layer is the Network layer which acts as connectivity between physical world and the virtual world. Application layer is the application designed for like smart cities, smart homes, smart agriculture, and eHealth. This layer is the user end layer where user gets the information and according to that the user can monitor or control the devices.

3. RASPBERRY PI
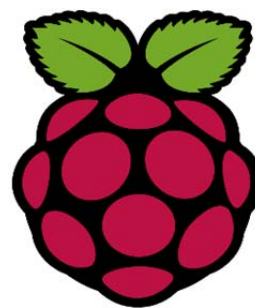
Eben created Raspberry Pi and his main goal was to create a low-cost device for students so that could they improve their programming skills and hardware understanding. It was mainly developed for education purpose. Raspberry pi is a small circuit board almost a size of a credit card. In other words it can be said it's a tiny computer on a single bard. It is a microcontroller. It is low-cost and especially designed for hobbyists and students interested in electronics and programming. The power consumed by raspberry pi is very less compared to a regular computer. Even if it is left on all the time the power consumption will be less. It can be easily connected to other peripherals and other circuit boards. The Raspberry pi can be used for many tasks like your computer does such as playing games, spreadsheets, word processing, browsing internet and play HD videos and many more. It runs on open source software and gives students the ability to try any software mix and match it according to their application. It all depends how well you utilize it. Raspberry Pi is a single circuit board and has different ports for HDMI, USB, composite video, analog audio, power, internet, SD Card.

3.1 Raspberry pi hardware

Raspberry pi comprises a RAM, processor, graphics chip, CPU, graphical user interface (GUI), UART socket (Universal Asynchronous Receiver/Transmitter), Ethernet port, GPIO pins (General purpose input output), X-bee socket, power connector and various interfaces for external devices. For mass storage we can use SD flash memory. Some of the essential hardware specifications of raspberry pi board are SD card containing Linux OS, keyboard, power supply, monitor, video cable and power supply. Raspberry pi also contains some optional hardware specifications.
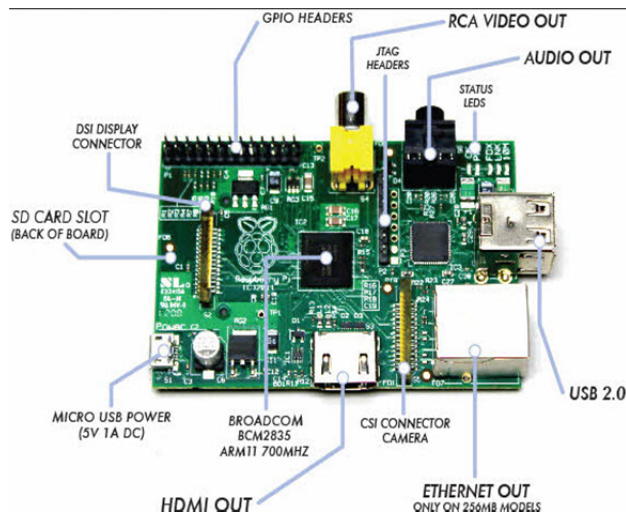
Fig. 3: Raspberry pi Hardware

Memory

Memory Raspberry pi Model A is designed with 256MB of SDRAM and Model B with 51MB of SDRAM. Raspberry pi is small size PC compared to other computers. The normal PCs RAM has memory of gigabytes whereas raspberry pi board RAM memory is more than 256MB or 512MB.

CPU (Central Processing Unit)

Central processing unit (CPU) is the main component of Raspberry pi board and uses ARM11 series processor.

GPU (Graphics Processing Unit)

Graphical processing unit is a specialized chip. This unit is designed to speed up the operations of image calculations. This particular board is designed with a Broadcom video core IV. It supports OpenGL.

Ethernet Port

Ethernet port in the raspberry pi board is used for communicating with additional devices. Ethernet port is used for the internet purpose to plug your home router to access internet.

GPIO Pins

GPIO pins are used in raspberry pi to associate with other electronic boards. They are used to connect other electronic components. Other electronic components such as a temperature sensor to transmit digital data. Raspberry pi has digital GPIO pins. These pins carry information and can accept input and output commands based on programming.

XBee Socket

Xbee socket is used for the wireless communication purpose.

Power Source Connector

Power source connector is a small switch used to enable an external power source.

UART

UART is a serial input and serial output port. Universal Asynchronous Receiver/Transmitter can be used to transfer serial data in the form of text. It is also useful for converting the debugging code.

Display

Raspberry pi board has two types of connection options such as HDMI and Composite. LCD and HD TV monitors can be attached using an HDMI cable and low cost adaptor. HDMI 1.3 and 1.4 Versions are supported by raspberry pi. HDMI 1.4 Version is highly recommended. The outputs of Raspberry pi audio and video are through HMDI but HMDI does not support input. Old model TVs can be connected using composite video and the audio is available by connecting a 3.5mm jack socket to send audio to your TV. A cable is required which adjust from 3.5mm to double RCA connectors.

4.   SYSTEM DESIGN AND IMPLEMENTATION

Hardware Specifications

- Atmega Microcontroller
- Wi-Fi Modem
- Transformer
- Relays
- Capacitors
- Resistors
- Diodes
- LCD Display
- Voltage Regulator
- Crystal
- Small Fan
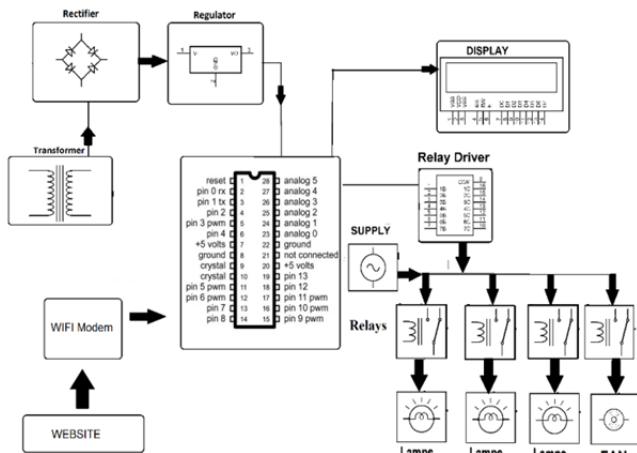- Motor
- Relay Driver IC

Fig. 4: Block diagram of Home Automation

The circuit consists of a microcontroller which is used to control 4 loads. 3 lights and 1 fan is considered as load. LCD display is used to display the status of the system. Wi-Fi model is used to connect the internet then to Wi-Fi based system online. Power supply is used to supply power to the system. Step down transformer, rectifier and regulator is used to regulate 5V DC. 5V DC because relays are designed to operate from a particular voltage from 5V or 12V DC. Relay has three terminals NO, NC and COM. Relay is an electromagnetic circuit and the two main configuration of relays are Normally open (NO) and Normally close (NC). If COM is connected to NO then it is a closed circuit and loads go to ON Mode.
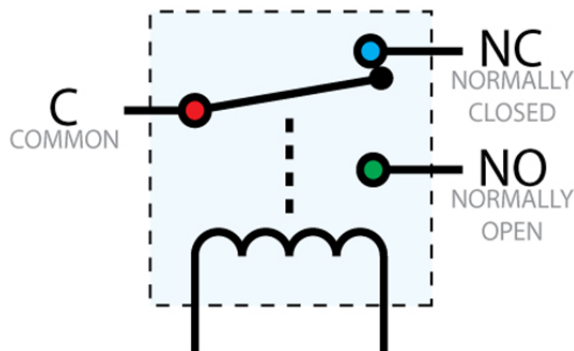

Fig. 5: Normally Closed (NC) Closed Circuit

An AVR family microcontroller is interfaced with Wi-Fi modem for sending and receiving commands over internet. Once user passes commands over internet to switch on fan the microcontroller processes these instructions and operates accordingly. Devices such as fan, light, washing machine, microwave, television, air conditioner, printer located at home can be remotely controlled/monitored by implanting devices with wed servers, such web servers are called embedded web servers.
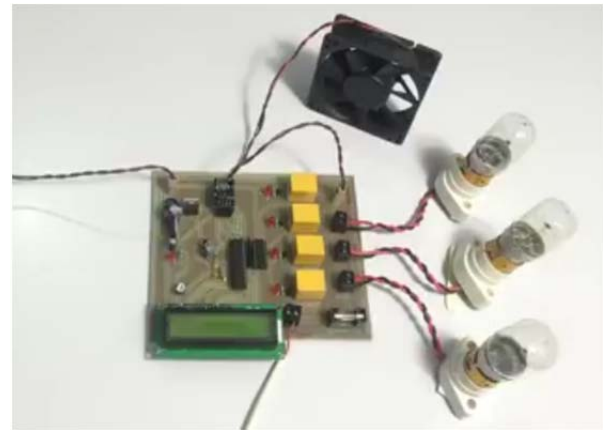

Fig. 6. Hardware system design

One such kind of web server is IOTGecko. Register to IOTGecko free of cost and then login to the page and go to Home Automation page. There you find the panel from where you can control/monitor loads.
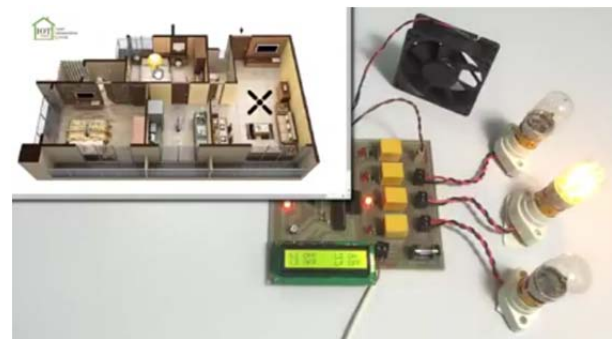

Fig. 7. One bulb is Switched ON in IOT Gecko

Fig. 7 has image of the circuit and the web page of IOTGecko. On web page you find if the light is switched on or off and you can manually switch it ON and OFF. Same way you can switch on and off other devices from any part of the world. Commands are used to switch ON and OFF of devices. The status is shown on the LCD display. Your device such as smartphone, tablet or computer whatever your using should be connected to internet and the system i.e. Raspberry pi must also be connected to Wi-Fi modem.

5.   SOFTWARE IMPLEMENTATION

By using IOTGecko we can develop our own IOT based system. IOTGecko is a web page where we can register free of cost and connect through server to Raspberry pi and monitor/control all the devices connected to it. It is platform that provides support over Microcontrollers, Arduino, Raspberry pi and other controller boards. Any desired IOT systems can be implemented using this open source internet of things development platform. You just need to setup your devices and run them on IOT Cloud. IOTGecko is a platform

for students, developers and researchers. IOTGecko has different templates and tools for the user to choose and handle with ease. Operate motors and other physical devices using IOT Gecko by simple clicks. Its development doesn't require much coding knowledge.

Fig. 7: Register now in IOTGecko Web page

Fill in your details the name, email, country, city, etc. And select the application for which you are going to develop IOT system. Visit your inbox and get login credentials. With which you can login into the system. Choose your desired layouts for data display from Home automation to liquid level display layouts and more, IOT Gecko has new layouts to display your data online every month.

Fig. 8: Login page of IOTGecko

Login Credentials will be sent to the mail and access the IOTGecko. Access the dashboard and look through the Profile and update your details. You can change the application type between Home automation, Office automation, Industry automation, Liquid level monitor, Garbage monitor and many more from profile module. Seamlessly integrate your electronics systems to our online servers from Arduino, Raspberry pi, ARM, 8051, PIC, AVR controllers and more with ease. Start using IOT Gecko to get your IOT system online in minutes.

Features

- Efficient GUI builder
- Operate Motors Over IOT
- Develop Enterprise Level IOT systems
- Easy Debugging
- Process Sensor Values over IOT
- 2 way Communication
- Online Development Support

6. RESULT

Home appliances can be monitored and controlled by using IOT. IOT can be used in several places like banks, schools, offices, hospitals, labs, colleges, super market and other sophisticated automated system. By using this system in various places we can easily know the status of devices if it is switched ON or OFF and can easily control it from anywhere. This system provides an interaction with machinery and devices. As Fig. 9 shows the web page can be operated on any internet accessible devices such as smartphones, laptop, tablet and desktop.
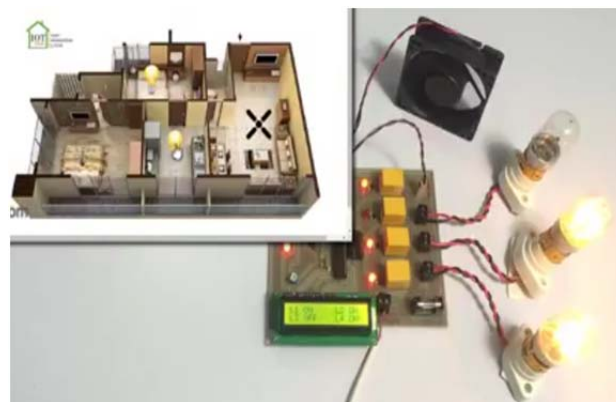

Fig. 9: Two bulbs are Switched ON

As shown in Fig. 9 the demonstration of two bulbs are being Switched ON using IOT Gecko portal and the bulbs glows in the house. Home appliances can be switched ON and OFF whenever required by the user.

7. CONCLUSION

Present paper has demonstrated a smart home appliances to be controlled by the Raspberry Pi using Internet of Things. Raspberry pi plays a very important role in designing smart home at very low cost. The power consumed by Raspberry pi is also very less compared to other PCs. It is cost effective and power efficient. The main objective of this paper is to show how home appliances can be remotely monitored and controlled through the internet using web interface from

anywhere in the world. This kind of project helps aged person and physically challenged people to control home appliance as it might be difficult for them to move to the switch they want to ON or OFF it. By using this IOT technology it can be implemented for various application and for easy accessibility.

REFERENCES

[1] http://nevonprojects.com/iot-home-automation-project

[2] http://efxkits.com/blog/raspberry-pi-technology-with-applications/

[3] K. Ashton, "That 'Internet of Things' Thing", RFID Journal, 22 June2009.

[4] Y. Liu, "Study on Smart Home System Based on Internet of Things Technology," in Informatics and Management Science IV. vol. 207, W. Du, Ed., ed: Springer London, 2013, pp. 73-81.

[5] Dr.Ovidiu vermesan and Dr.Peter fries, "Internet of things-from research and innovation to market development", River publication, 2014.

[6] Somayya Madakam, R. Ramaswamy, Siddharth Tripathi, "Internet of Things (IoT): A Literature Review", in Journal of Computer and Communications, 2015, 3, 164-173.

[7] Home automation system using raspberry pi 2 using huckster.iot

[8] Iot based home automation using IBM BLUEMIX diyhacking.com

[9] Rajeev Piyare "Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone.

[10] Raspbery Pi, "Raspberry Pi Help," Raspberry Pi Foundation, Cambridge, UK. [Online]. Available: www.raspberrypi.org/help/.