IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

Raspberry Pi Home Automation Based on Internet of Things (IoT)

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Abstract: Automation or automatic control means the use of various control systems for operating equipment. Home automation is exciting field when it is blow up with new technologies like Internet of Things(IoT). It is automation of the home, housework or household activity. Proposed implementation of home automation include centralized control of lighting, heating, ventilation and it is fully control by using any smart phone through the particular android application. The main advantage of this is small device can be part of internet so it is easy to communicate, manage and control without human interferences. Also it provides high degree of security, safety, comfort and energy saving. With the arrival of Raspberry Pi which is small, inexpensive, portable credit-size single board computer with support for a large number of peripherals and network communication like Ethernet port, USB port, HDMI port, SD card slot. Raspberry pi set of technologies now exist that combine the power of PC, communication and multimedia technologies of web and portability of mobile device.

Keywords: Home automation, Internet of things, Raspberry Pi, Sensors.

I. INTRODUCTION

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data [1]. In home automation smart devices and sensors that sense the physical experience and convert into stream of information data. The major element of home automation based on IoT is sensor network and raspberry pi. Sensor networks are used for sensing and monitoring while raspberry pi collect the data monitor the data and depends on collected mange the device like fan, light, door motion and opening-closing of curtains. Suppose the ambient light is less that I am going to feel darkness then according to ambient light its automatically open the curtains.

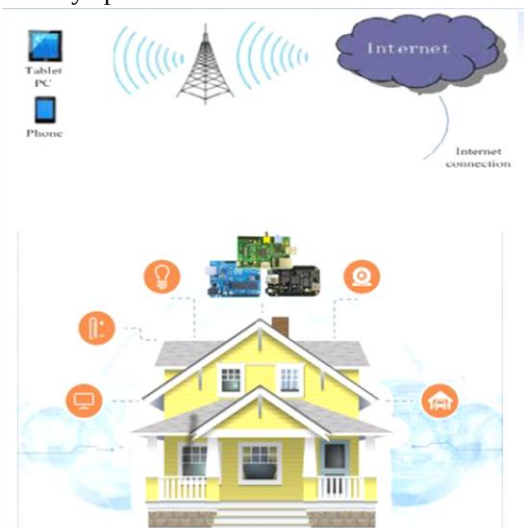

Fig. 1. Complete home automation using Raspberry pi

Thus, home automation can be defined as a mechanism removing as much human interaction as technically possible and desirable in various domestic processes and replacing them with programmed electronic systems. Ultimately it is a system that aims to heighten quality of life with the automation of household activity that may be controlled over the Internet or telephone [2].

II. HISTORY OF HOME AUTOMATION

Concepts for home automation were around for decades before becoming reality and featured in the writing of the 19th century.

The Electronic Computing Home Operator (ECHO) was highlight in the April 1968 edition of Popular Mechanics and had been expanded from a set of spare electronics. The ECHO never went commercial and a number of large companies played with the idea of computerizing the home, however it was the birth of the modern era of home automation technology.

The X10 standard was designed to allow transmitters and receivers to work over existing electrical wiring systems by broadcasting messages such as "turn off" and "turn on" via radio frequency.

X10 has a number of disadvantages

- Issues in wiring and interference
- At time of transmission command may lost
- Supporting product are less
- Available commands are in limited scope
- Signal transmission speed is slow

The dot.com boom was small step from PC to PC communication to appliance to PC communication.
With the arrival of Raspberry Pi which is small, inexpensive, portable credit-size single board computer with support for a large number of peripherals and network communication like Ethernet port, USB port, HDMI port, SD card slot. Raspberry pi set of technologies

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now exist that combine the power of PC, communication and multimedia technologies of web and portability of mobile device.

A. Raspberry Pi

The Raspberry Pi is a series of credit card–sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science [3][4][5].

The Raspberry Pi has four distinct power modes [6]:

- The run mode – the central processing unit (CPU) and all functionality of the ARM11 core are available and powered up.
- The standby mode – the main core clocks are shut down (the parts of the CPU that process instructions are no longer running) although the power circuits on the core are still active. In this mode, known as ‘‘Wait for Interrupt’’ (WFI) mode, the core can be quickly woken up by a process generating a special call to the CPU called an interrupt. This interrupt will stop any current processing and do what the calling process has asked for.
- The shutdown mode – there is no power.
- The dormant mode – the core is powered down and all caches are left powered on.

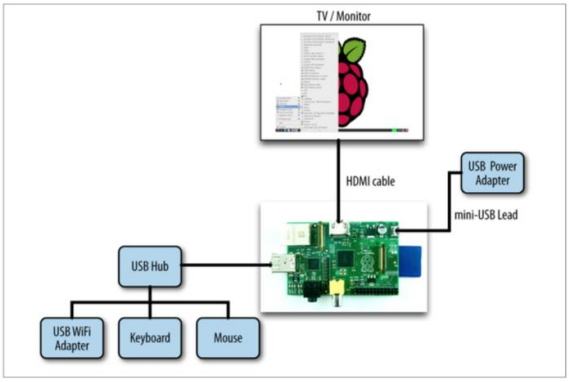

Fig. 2. Typical Raspberry pi system

Raspberry Pi is an open source hardware technology combined with a programming language and an Integrated Development Environment (IDE).

The Raspberry Pi platform allows the user to create custom hardware and applications to control it via its namesake programming language.

Many software languages are available on the Raspberry Pi and I am interested in four. These are the C++, Python, SQL, and HTSQL. C++ uses for programming Arduino. HTSQL (Hyper Text Structured Query Language) to provide a web interface to database that is easy to query via the web browser. Operating systems that are available to install the Raspberry is Raspbian. Raspbian is based upon the Debian Wheezy Linux operating system and has been optimized for use with Raspberry Pi. The Raspberry Pi is connected to the Raspberry Pi's GPIO pins, and with the inclusion of the software, I will be able to communicate between our electronic devices, the Raspberry Pi's operating system, and web-based propose model.

III.MODULES

The proposed system modules are as follows

A. Thermometer

A thermometer is a device used for recording temperatures and changes or difference in temperatures. The introduction of microelectronics has allowed us to build our own digital thermometers. This can be useful for checking the temperature in parts of our home. Our thermometer will return its readings in three types of temperature, namely Celsius, Kelvin, and Fahrenheit to the Raspberry Pi and display them in the terminal window.
From a software standpoint, I will also be introduced to the Geany IDE and the Linux make command. Using these tools, I will write an application that converts the resistance returned from the circuit.

Hardware items for Thermometer are as follows:

- Raspberry Pi
- A thermistor
- The breadboard and wires used to test the LED
- A 10k resistor

B. Thermostat

A thermostat is a control device that is used to operate other devices based upon a temperature setting. This temperature setting is known as the setpoint. When the temperature changes in relation to the setpoint, a device can be switched on or off. For heating effect I am going to use hair dryer and for cooling effect ice will use. I am going to use relay. A relay is a type of switch controlled by an electromagnet. It allows us to use a small amount of power to control a much larger amount, for example using a 9 V power supply to switch 220 V wall power. Relays are rated to work with different voltages and currents; for example, the Seeed Arduino shield's relays can work with up to 130V of AC power.

Hardware items for Thermostat are as follows:

- Raspberry Pi
- The thermometer device
- Arduino compatible relay shield/component
- A small low voltage electric desktop fan
- A way of stimulating the thermistor for both cold and hot temperatures, for example, some ice and a hair dryer.

Screen allows us to run multiple "windows" within a terminal session that are not shut down when close this session down.

C. Curtain Automation – Open and Close the Curtains Based on the Ambient Light

For this I am going to use a photoresistor and a motor shield in conjunction with Raspberry Pi. Once these are combined into a single device, it can be used to open and close blinds or curtains. I can use a photoresistor as part of our circuit to tell when it is getting dark in a room and send this information back to the Raspberry Pi. The Raspberry Pi can then process this data and use it to control an electric motor. When I am going to attach motor to the blinds/curtains will need to calculate the number of seconds required to open/shut the blinds and also adjust

DOI 10.17148/IJARCCE.2015.41269

IJARCCE

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the values either speed up or slow down your motor. For example, I may decide I never want the blinds fully closed or open and can adjust the setting so that the closed and open state is 75 percent of the open and closed state of the physical curtain. For this need to attach the DC motor to the curtain drawstring. The preferred method for doing this is via a pulley wheel.

A photoresistor is similar to the thermistor in that the device's resistance changes as some ambient property of the room changes. With the thermistor, this was temperature and with the photoresistor, it is light. I can use a photoresistor as part of our circuit to tell when it is getting dark in a room and send this information back to the Raspberry Pi. The Raspberry Pi can then process this data and use it to control an electric motor.

Hardware items for Curtain Automation are as follows:

- Raspberry Pi
- Breadboard
- Wires
- 10 K resistor
- Photoresistor
- Arduino Motor Shield or electric motor
- 9 V battery and battery connector
- A flashlight
- 9 V DC motor and an optional 12 V DC motor

D. Opening and closing of door for authentic people

For opening and closing of door I am going to first authenticate the people by NFC card. After authentication for only the authenticated people door opens. Those authentications fail in that case I could not open the door. Here I am going to use Stepper motor.

Hardware items for door motion is as follows:

- Raspberry Pi
- NFC card
- Breadboard
- Wires
- 10 K resistor
- Arduino Motor shield
- 9 V battery and battery connector
- Stepper motor

E. Switch off or on of light

Switch off or on of light and according exterior light brightness may increase or decreases and it can also handle manually because in some case I require bright light such as reading.

To control LEDs remotely from our web UI, including customizing LED brightness, as well as emulate a fireplace by flickering the LED (using Raspberry Pi's digital signal with pulse width modulation (PWM)).

What is Pulse Width Modulation (PWM)?

Pulse width modulation [7] is a technique controlling power. By PWM I get analog results using a digital signal, which forms square waveforms that a signal is oscillating between on and off.

On-again, Off-again Relationship with Duty Cycle[8]

Let's say, the digital signal pulses rapidly between 0V and 5V. When I turn the LED on for 100% of the time, it is at full brightness, while when turn it on 50% and off 50%, the LED will appear half as bright.

The total amount of time a pulse is 'on' over the duration of the cycle is called duty cycle, and by changing the value, I can change the brightness of the LED.

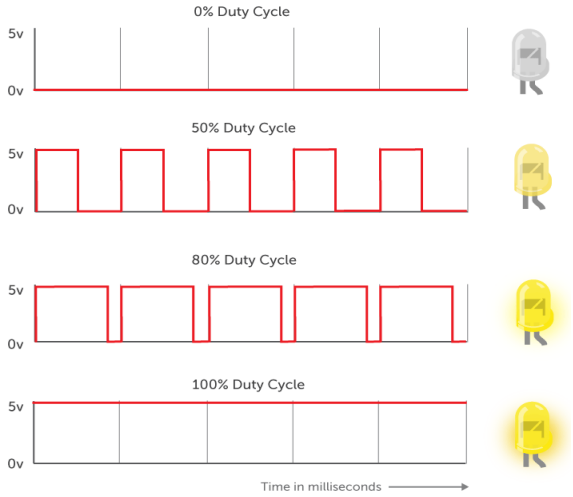

Fig. 3. Duty cycle of LED

IV. CONCLUSION

The application of the IoT technology, in home automation means combination of all electrical devices like smart mobile phone, personal computer, tablet and their monitoring, controlling and alerting in ways not possible before. This proposed system provides many advantages including, safety, security, improved comfort, energy and cost savings. In order to address the issues of flexibility and functionality, a novel, standalone, flexible and low cost home controlling and monitoring system using Web services as an interoperable layer for communicating between the remotely present user and the home devices, have been designed. Performed research have shown that by using the Raspberry Pi and open source software it is possible to programmatically control many devices in a home in such a way that user can create his/her own solution customized to meet his/her individual needs. Thus, the proposed system is better from the scalability, flexibility and security point of view than the commercially available home automation systems.

ACKNOWLEDGMENT

I would like to thank Head of Department of Computer Engineering **Dr. N. F. Shaikh** who gave me opportunity to do this research project. Last I would like to thank various authors of reference materials mention in the reference for their commendable research.

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DOI 10.17148/IJARCCE.2015.41269