

Design and Development of Modern Lighting Control and Automation System with Zigbee Network and Raspberry Pi

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Abstract:

Competitive solutions to the growing demand for home automation will most likely include the use of low cost components, open source and open hardware. Using the ZigBee protocol, a low cost lighting control actuator was developed that was battery efficient and easy to use in a home automation system environment. Raspberry Pi was used to house a Web server, which provided the user an adaptive Web application to access the lighting actuator control. Zigbee modules were chosen for their small size, low energy consumption and the large amount of documentation that exists in regard to its use. Considering the worst-case scenario, the lighting control actuator was designed so if its battery runs out of power or the ZigBee network fails, it can work as a normal light switch.

Keywords: Raspberry, Atmega, web automation, Zigbee

I. Introduction

Home and lighting automation as a distinct from what the name implies, is more a premise to the idea that the day to day functions which are carried out within a building (house or office) can be automated with the goal of simplifying the tasks of individuals. In addition to this goal, a "home automation" should attempt to introduce additional functional benefits.

The challenge to any home automation system is that in reality the humble light switch is hard to beat. It is normally located in a convenient location and enables a light to be turned on or off quickly, easily and with little effort or thought. Lighting is an integral part of

the function of a building. A home automation system must automate the function of the light switch, and introduce a fundamental benefit while at the same time, not take away from the simplicity and practicality that the basic light switch encompasses.

Many systems which proclaim "Home Automation" introduce automation for the sake of automation and sacrifice practicality and functionality. Due to this fundamental issue, Home Automation has not become main stream but rather a fringe product supported by a scattering of different companies with different ideas and solutions.

Buildings require security. Any automation system must address this issue and integrate security as a key element to the

automation that the system will bring to the building.

Heating and cooling control are also fundamental elements in all building. An automation system must be able to control these functions.

Many systems have modules capable of switching audio and video signals to different rooms. Rapid development of new technologies and formats such as High Definition TV and Blue Ray all quickly render existing home automation systems incompatible with the emergence of the new technology. Since a home automation system is integral to the core of a building and since the cost of these systems is relatively high, a home automation system must have a life span of at least 25 years. However the fast development of audio and video technologies forces the life span to be significantly less. Due to this trend it makes sense to isolate the automation system from any function than may render it pre-maturely obsolete. Our HomaGSM system is designed around stable technologies and as such does not attempt to automate audio or video switching. In fact while this type of automation looks "flashy" in reality it is not automation but rather control.

Many home automation systems have gone down the path of elaborate graphic interfaces with touch LCD screens making the systems look very high tech and elaborate. And while these systems look great and can do some practical tasks, the fundamental purpose of home automation is to reduce the complexity in carrying out these control functions. When a light has to be turned on or off by first entering a menu on an LCD display, it cannot possibly be simpler, easier and faster than flicking a traditional light switch.

Features

Computers, wireless transmitters, cell phones, and touch screens controls different features of home automation such as:

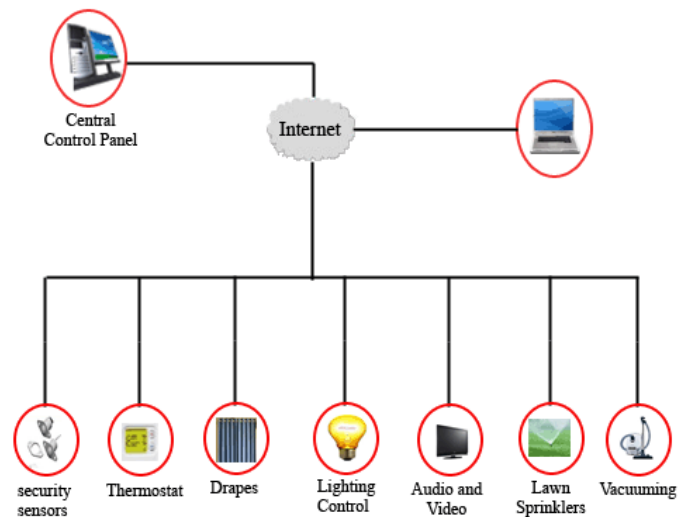


Fig 1: IOT Application Block Diagram

1. Security – With home automation, the lights of the car are turned on in order to help you to walk in the dark. In case the alarm goes off, the authorities can be alerted and a message can be sent to your cell phone by the system.
2. Thermostat – This is programmed to run the central heating and cooling system as per our own required settings. For example, air conditioner is set to an energy saving setting when the house is vacant and sets back to the normal setting when the resident is about to return home.
3. Drapes – With the help of the home automation system, the drapes of the room can be opened and closed during the night time.
4. Lighting – This can be set as per our own required settings for dim and bright light.
5. Audio/Video – The home automation system can turn on the stereo and play music or can also turn on the television to any channel.
6. Lawn sprinklers – The sprinkler system can be activated as per the schedule settings.
7. Vacuuming – Robotic vacuum cleaners automatically glides over the carpet to help you keep the house neat and tidy.

Proposed System:

Home automation systems are a result of an attempt to enhance the standards of living around and inside the house and were made possible by the breakthrough in the area of integrated circuits and microcontrollers. These systems provide the consumers with increased security and safety, economic benefit through energy control, and convenience by giving them control over every piece of domestic electrical equipment in the house.

Designing a home automation system for monitoring and controlling various devices in remote locations can be done through a variety of communications options such as wireless LAN technologies, dial-up modems, private radio networks, satellite communication, internet, cellular network and so on. Different studies on home automation work on different types of these controlling methods.

Since the first step of the home automation is real-time monitoring of the status changes of the devices that we control in the house, the system that we design should have the capability of warning the users no matter where they are right at the time at which the changes occur.

Block Diagram: Architecture

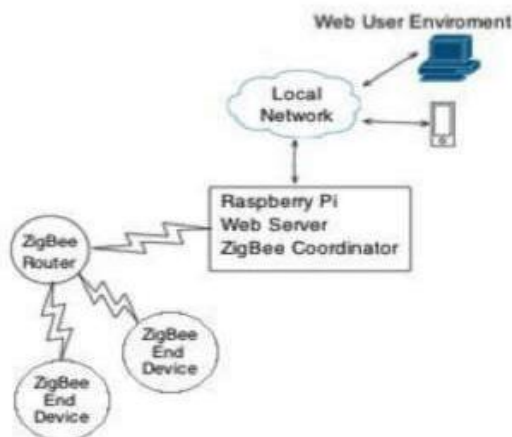


Fig2: Zigbee Interfacing with Webservice using Raspberry Pi

Description

In this paper we are proposed an automation system which will be implemented based web browser. In this paper we have two sections, one is transmission section and second one is receiver section. Transmission sections consists of raspberry pi board with Wi-Fi module and Zigbee module. In receiver section consists of ARM7 processor along with associated modules like LCD and Zigbee, relay circuitry and AC appliances.

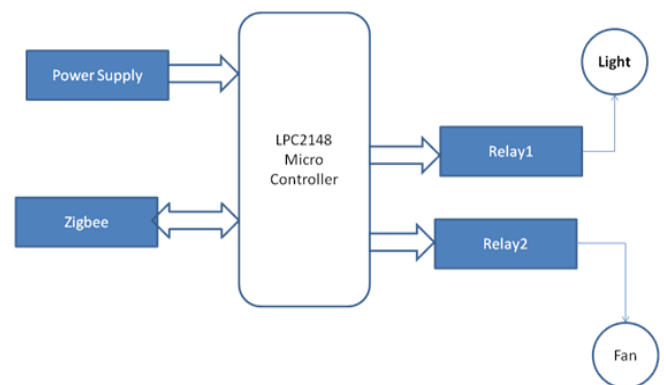


Fig3: Block Diagram of Receiver Section

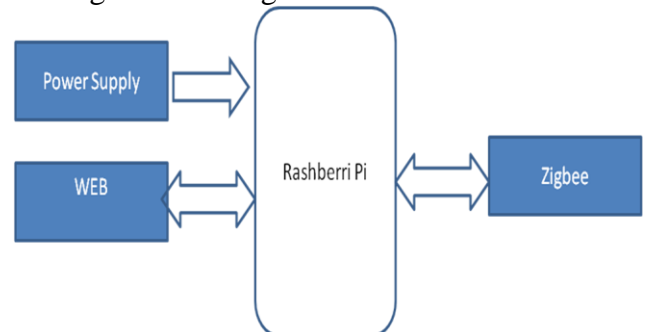
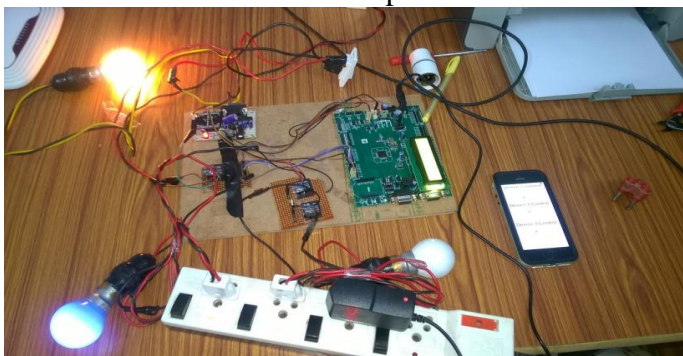


Fig4: Block Diagram of Transmitter Section

In transmission section initially we have to establish a connection between mobile/Laptop and raspberry pi board through Wi-Fi. After connection established, we have to open the web page through IP address. Now we will give the commands to raspberry pi board through mobile. The web page displays the name of the loads and its switching operation buttons like ON button and OFF button. From this web page if we select any load

for ON or OFF function that corresponding command will send or transmit through Wi-Fi of mobile and at the other end raspberry pi board will receive that command through Wi-Fi module. Raspberry pi board received command will be sent to Zigbee module to transmit out to Receiving Unit.

At receiver section Zigbee module will receive the command and gives the input to ARM7 processor. ARM7 will give the instructions to relays to control the appliances based on the command received from web portal



Status Conditions while carry out Research Device 1 OFF condition, Device 2 and Device 3 ON condition



All Three Devices are ON condition

Fig5: ZIGBEE NETWORK SETUP AND DEVICES FUNCTION

Conclusion:

The Project will be developed with low cost. The applications used the in the paper will be controlled by simple architectures like Zigbee which is user friendly to operate under long distance communication. In this we were used ARM7 processor and Raspberry Pi which will provide Secured Transmission control and more reliability. The Reliability of the

Application will be more consider to other Applications.

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