

DEVELOPMENT OF SMART HOME AUTOMATION SYSTEM BY USING CONTROLLED NETWORK

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Abstract

Automation of daily routine systems has become a necessary now-a-days. Research has been focus to automate the basic elements of the households to make the house a more energy efficient and economical. There are number of ways to automate the home system. This study focuses on how to make a home automation system to control house hold items more efficiently. It comprises of three main hardware parts: device that transfer signals to appliances, server to support between user and components, and a mobile or computer device to operate the whole system. This proposed home automation system is advance and efficient. It has a security system and a mobile application that controls the whole system. In addition this automation system has intelligent software which helps the user to consume the energy effectively and economically.

Keywords: Home Automation, Relays, Mobile Application, Surveillance, Wireless Networks, Biometric

1. Introduction

Normally a home automation system is consisting of some automatic switches to control electric supply of the households. These switches are normally controlled or may be controlled by mean of software through computer.

The system describe in this paper, focuses on how to automate these switches [1] by considering the environment and activities in house. One of the major objectives in the development of this system is to design it in more economical way and make it more energy efficient. An extra feature of the system is surveillance system. A security system is added in the automation design in order to have a close watch at house.

Mobile base software is developed to control the whole automation system [2]. This software is capable to manage and regulate the supply to the household equipments. Security system is also connected to this software and all the information is displayed on the mobile [3].

The most considerable feature of this whole automation system is that it is totally based on sensors that make it more effective, economical and autonomous of its class. These all

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sensors interact with the brain of this system that is RASPBERRY PIE which communicates switches with sensors and mobile software [4].

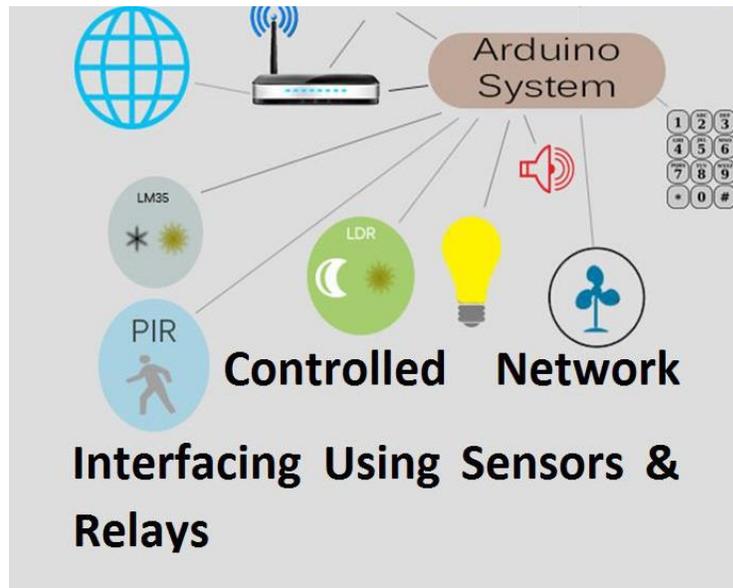


Figure 1. Overview of the proposed technique

2. Overview

Home automation system is based on sensors, relays and most important RASPBERRY PIE which control and interact between the entire systems. Basic sensors are used to receive the physical data from the environment. This data is then analyzed in the brain of the system [5]. After analyzing, RASPBERRY PIE executes the command to the drivers of the switches to operate accordingly. An additional feature is added in the system through which a user could over-ride the command of RASPBERRY PIE or set the switches manually by using a mobile application. This intelligent home automation system monitors the energy consumption of the home and helps the user to use the appliances in the efficient way. This proposed system is capable for surveillance. User can have a live streaming on mobile while using camera and can record specific shoots required by user.

3. System Design

Smart home automation system has been designed by keeping in view two main points. Firstly, this system should be networked and secondly it should be cost effective. Some technical requirements like plug and play, low cost, reliability are parts of its quality [6]. This system has following salient features:

- Atmosphere Control
- Lightning Control
- Auto appliance control
- Surveillance system
- Energy monitoring system

- Manual control using software
- Automatic Backup generator control
- Intelligent energy utilization planer (IEUP)
- Easy to assemble

This proposed Automation System works on four main sections. One is responsible for gathering physical data from environment, second is for driving the appliances, third is for controlling the whole system and fourth one is used for interact the system with user via mobile app [7],[8].

3.1. System's Brain

In this automation system RASPBERRY PIE is used as the brain of the system, each unit interacts with it and processes all the data and sends the required outputs to the appropriate units. RASPBERRY PIE is a low cost and small sized computer that has plug and play feature. It has a capability to interact with a multiple devices. Python language is used to program the RASPBERRY PIE [9].

3.2. Sensors

To make the system automatic, sensors are used to gather the information from the environment around and by using RASPBERRY PIE, appliance are adjusted accordingly. Following sensors are used in smart home systems:

- Temperature & Humid sensor DHT11
- Light Sensor (LDR)
- Motion Sensor (PIR)
- Smoke Sensor
- VGA Camera

Whole data from the sensors is also displayed on the user's device [10]. From here user can set the home appliances accordingly.

3.3. Circuitry

Electrical devices are driven by mean of an actuator/relay circuit. Data is gathered from sensors at RASPBERRY PIE and trig the relay to operate the appliance accordingly as commanded by user. This driving circuit is isolated by opto-coupler to separate it from the main system for safety purpose (fig 2). Various motors are used in order to control the curtains and main doors. Voltage regulators are also used to control the fans speed and other appliances.

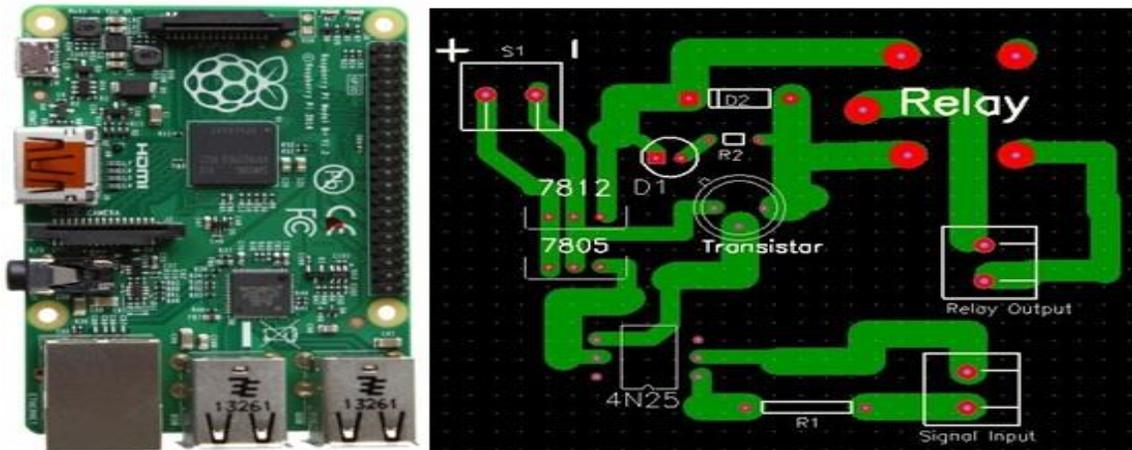


Figure 2. Raspberry Pi board with relay driver circuit for appliances

An additional energy monitoring circuit is added to measure the energy consumption of each appliance. Current Transformer is used for this purpose. Analog data received from CT is converted in digital in order to process by RASPBERRY PIE. This data is then used by the intelligent software to automate the power consumption of the home.

3.4. Networking

In the proposed method, home appliances are connected to a RASPBERRY PIE, with wireless communication [11]. There are many popular ways of communication which could be used to interact between devices in home automation system, such as C-Bus, Z-Wave, Zig-Bee. WI-Fi is the most favorable for the home system [12]. RASPBERRY PIE is connected to DSL home router and act as a server. User devices (i-e mobile, tablets etc) are connected through WI-Fi with the server to communicate with the appliances connected with RASBEERY PIE. More than one device can be connected with this server by an authorization code.

3.5. Operating System

To work the whole system a web base (Php) software is developed for RASPBERRY PIE. It is easy to handle and could be use on any operating system. For the user device (smart phone, tablet etc), a mobile application (fig 3) is developed [13]. This application is friendly and helps the user to interface with the whole home automation system. This software can be accessed by username and password. Software running on RASPBERRY PIE collects data from sensors and displays the data of active and inactive devices on the user device.

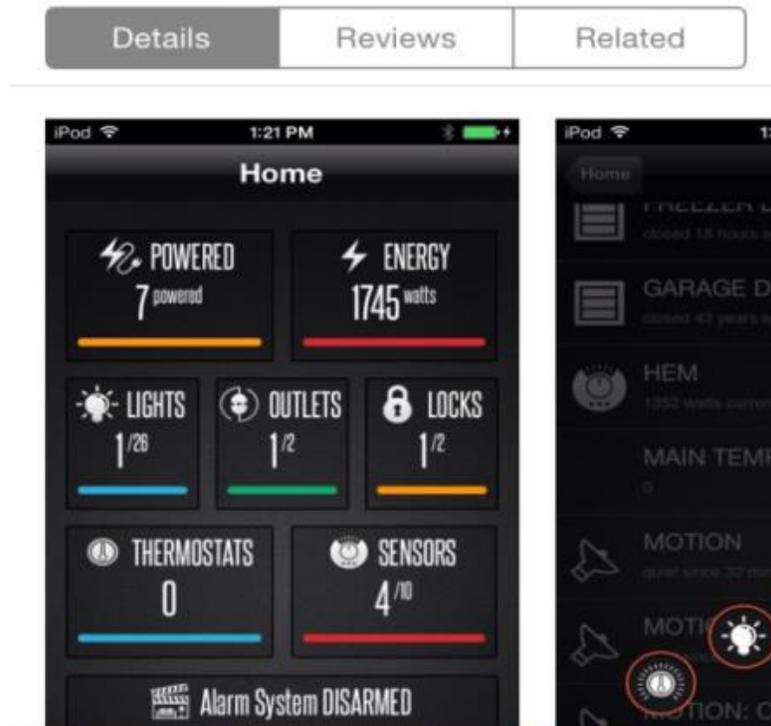


Figure 3. Mobile Application

4. Working

This system is able to provide a user-friendly interface to the user so that automation system could be setup easily and user can monitor and control the whole system. This “home automation system” is designed by considering wireless networking, so it is fast enough to exploit the full potential of wireless technology.

This automation system works for two main purposes to make a home system smart and efficient i-e automation and security.

4.1. Automation

All the data that is collected from the sensors are directed to the main central unit from where each appliance is controlled according to the settings set by the user. Each appliance is connected to the RASPBERRY PIE through a relay circuit which operates that circuit as instructed from the processor.

An override system is implemented to operate the appliances manually in case of emergency. During the manual override, all automation is shut down and the whole system is disconnected from the network. To protect the manual override system from misuse, this system is protected by a valid authenticated code.

a. Intelligent Power Consumption

This Home Automation System is equipped with intelligent power consumption software, which optimizes the power utilization by calculating the trends of the usage of different equipments attached to it [14]. This software automatically records the routine of the appliance and switches it smartly as the software records the trends (fig 4). [15]

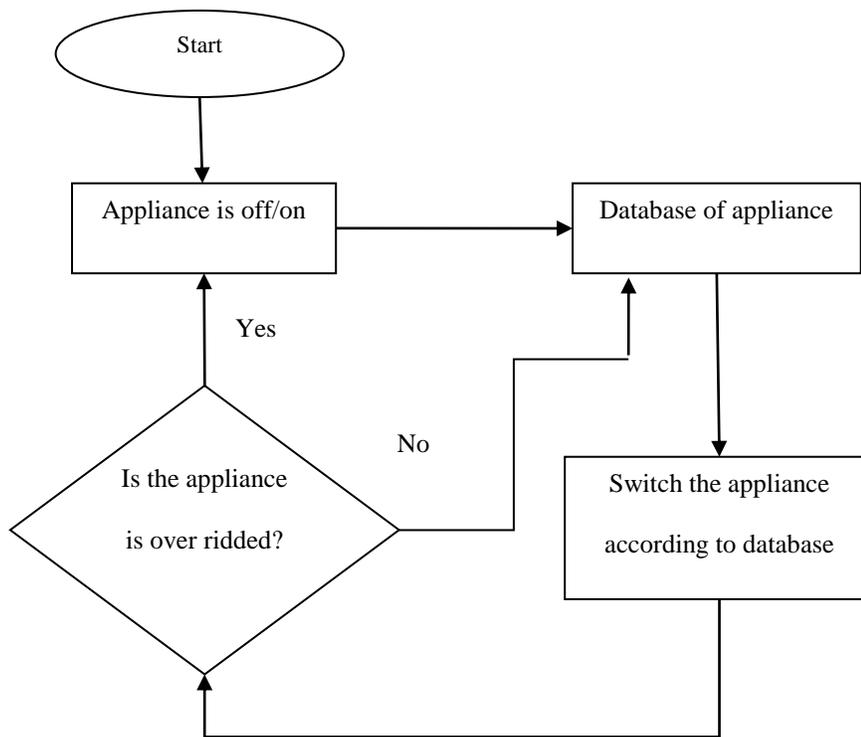


Figure 4. Flow diagram for the intelligent power consumption software

4.2. Security

One of the big purposes of home automation is security. This system is such design that it gives back the video data of surveillance to the user. It also prohibits unauthorized entrance into the home.

Security system is consists of two main modules:

- Passive Infrared Sensor (PIR)
- VGA Camera
- Digital Door Lock

a. *Passive Infrared Sensor (PIR)*

For the purpose of Home Automation System a special type of PIR sensor is used known as PET Immune sensor. It only detects the motion of human being. As the sensor is armed by the user, it will trigger the alarm and alert the user as well on his/her device as it detects any human motion.

b. *VGA Camera*

Without a surveillance system, a home automation system is incomplete. For this purpose a simple VGA camera is used by the help of a USB port. Raspberry Pie is such configured with surveillance system that it can be accessed from network by the user. These cameras are equipped with motion sensors, and records the data for a specific period of time when triggered by a motion otherwise they remains on streaming mode [16].

c. Digital Door Lock

Main door is secured by a digital lock which can only be access by a secured password. Password of the door can only be changed by a valid biometric identification. An additional feature of alarm system is also installed in the door. When the door opens, a SMS is generated and alert the authorize user. If door kept open for a long period, an alarm rings which alerts everyone around.

5. Conclusion

A successful prototype was developed and implemented to test all the features and objectives that are required for Home Automation System. This system is easy to install and user friendly. This system can accommodate up to 64 users at time, having one user with administrative rights. This system is able to stream 2 VGA cameras at a time on the user device.

Above all, it is more economical, scalable and easily extensible with new or extra modules for different features which may include:

- HVAC control according to the atmospheric temperature by environmental monitoring.
- Opening and closing of Curtains, Windows and Window blinds.
- Remote controlled opening and closing of Garage door.
- Lawn Sprinklers control.

Much more improvements and features can be added since the advancements in technology can allow more and more options and prospects to be studied and explored thus allowing to evolve dreams and ideas into reality which were previously deemed impossible.

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