A Multilevel Remote Supervisory and Security Network System for Smart Home

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Abstract

Objectives: Home automation is gaining more and more importance in the act of luxurious and secure life. **Methods:** We propose a system which is user friendly and also increases the level of security with the fusion of inbuilt sensor modules available in any smart phone and the blend of the Bluetooth communication and Internet of Things (IoT) to boost up the security. **Findings:** The system is designed by means of LPC2148 microcontroller with ARM7TDMI core and Android based smart phone which is used to control all the home appliances like AC, fan, light etc. All the sensors used for environmental monitoring like temperature, humidity, light intensity etc are tapped using the smart phone so as to produce a cost effective system. **Applications:** The system provides the controlling of the home appliances using Bluetooth communication with smart phone to the controlling unit. The system also provides a self adjusting lighting system with the fusion method and also includes a client server concept for the security issues using IoT for live streaming of H.264 video and G.726 audio to monitor the home environment remotely. The system result shows that the fusion method used gives more comfortable and secured system in addition to cost effectiveness and energy efficient.

Keywords: Android, Bluetooth, Home Automation, Home Appliances, LPC2148, Security, Sensors

1. Introduction

A home automation system is a technological solution that enables the electronic control of household appliances such as lights, fans, televisions, heaters etc. automatically or remotely. The combination of hardware and software technologies used by the home automation system gives access to control and manage the components within a house. Home automation is a step towards "The Internet of Things" (IoT) in which all of our household appliances will be connected with each other to get the interconnected world that allows the complete control of our home from any remote location[1]. Currently the OSGi which is modular for the JAVA platform is fully been utilized for the home automation purpose. Eclipse Equinox is the reference implementation of the base OSGi specification. It is also the runtime environment on which Eclipse applications are based with plug in bundle of OSGi helps in developing a lot of fusion systems among the networks.

This bundle can be efficiently used for fast prototyping. Accurately the term home automation illustrates homes in which almost the whole things like household electrical devices, electrical vents, lighting, temperature and HVAC systems (Heating, Ventilation and Air Conditioning Systems) are obsessed up to a interconnected controllable remote system. Regarding home safety, automatically programmed house consist of the full control for secured locks on entry and exit of the home, smoke detectors, surveillance cameras etc. Automation and remote monitoring are unsurprisingly two main personalities of cutting-edge home automation. Automation can be described as the skill to program time allied decisions, such as whether to switch on the lights or not at particular time every day and also involves unplanned events, such as to make all the lights on in the home when the safeguard alarm is activated. The remote controlling is the second core characteristic of home control system. It has been possible with the rise in smart phones and tablets

which gives access to actually hook to the home control system from the remote location. With respect to the fully equipped safeguard houses, any Internet bonded gadget can be used to look up the defense system's condition, and to verify the status of the door, lights, home temperature and also able to dump with the instantaneous videos to watch what's happening in the home from remote location with the help of the cameras as element of home control system. Furthermore programming includes simple interactions like sending a text message or email from the remote app whenever the safeguard system triggers issue on the weather condition, movement sensor alerts, and to mundane events. Moreover reprogramming can be made to reset the thermostat, scheduling, lock and unlock doors, and turn on the lights everything from remote area[2]. Subsequently sensors, controllers and actuators are the fundamental parts of a home safeguard method. Sensors are used to keep an eye on temperature variation, lightings or movement alert that leads the house control systems to take needed actions. Controllers may refer to any elements such as personal computers, smart phones or tablets that has capable of sending and receiving notifications regarding the condition of remotely secured houses. Actuators can be electronic switches or motors which is responsible for controlling the functions of a home guard system[3]. In addition to the security and monitoring features, one of the greatest advantages of home automation is to consume the energy very efficiently by controlling energy features in the home that ultimately leads to save cost. Already the smart thermostat utilizes a temperature threshold efficiently by consuming minimum energy to manage the home's HVAC system. Moreover, remote access and programming with different target temperatures makes the thermostat energy-efficient to keep the house comfortable. Smartly home automation expands the lighting programmability that minimizes the usage of energy. In the other way, home automation systems makes the user more flexible by automatically power down the electrical outlets or even individual devices during the daytime or when they're not needed. Also the scheduling can be extends to make a difference among the various seasons and also between the days of the week with isolated devices thus maximizing home's energy efficiency. The convenience and connectivity of the communication will gets increased because of the invention of fourth generation mobile communication[4]. Security management plays a vital role in designing system using wireless sensor networks[5].

2. Proposed System

This paper presents the concept of home automation with a fusion of LPC2148 microcontroller from NXP Philips and Android based smart phone which can be used for controlling various home appliances and also provides the security. The blended system is operated by sending the command from android based smart phone for switching the home appliances on or off with Bluetooth communication with the control unit and also gives the whole environmental condition data from the inbuilt sensor of the smart phone and the same sensor is used to provide a self adjusting lighting system and also provides the security by triggering the camera module available and streaming the live video to the end user. The designed system is discussed in five sections. The first section gives the overview of the fusion system .The second section deals with all the sensor modules used for measuring the environmental conditions. The third section deals with GUI created in the android based phone for the controlling purpose. The fourth section addresses the main control unit designed using the LPC2148 microcontroller. The fifth section deals with the security measure taken when all are away from the home.

2.1 Fusion System Overview

Figure 1 shows the overall flow chart of the fusion system designed for the home automation an android phone installed with our designed android apk is used for controlling the operation of the home appliance. The phone with the apk installed acts as the remote which can send the required command to control the home appliance with Bluetooth communication[6] to the base control unit. The said control unit is designed by using ARM processor based microcontroller. A fusion method is been used for designing a self adjusting lighting system in which the light intensity sensor data from the smart phone is used to control the light intensity of home environment by generating the appropriate PWM from the control unit to adjust the light intensity which in turn with the help of this fusion technique saves the energy consumption leading to power efficiency. The accelerometer sensor module available with the smart phone is used to find the intruder peeping into the locked house when the family members are on outing and no one is present inside the home upon detecting the third party presence the fusion system sends an SMS indicating the owner of the house about the intruder and also makes a

call. This method takes care of the security issues with the locked house when no one is present inside the house. The accelerometer sensor not only detects the intruder, it also triggers the camera available in the smart phone and starts the live streaming of the home environment which can be visualized remotely through the IoT with OSGi gateway in client side.
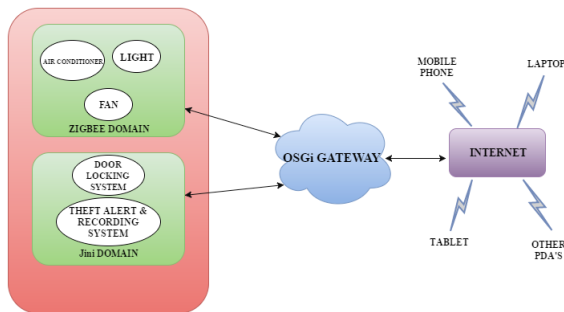

Figure 1. Block diagram for the designed fusion system.

2.2 Sensor Involved

The sensors involved in the design are available with the smart phone which is used as the remote for controlling the home appliances. There are many inbuilt sensors integrated along with the smart phone which are easily available in the market and are very cheap cost wise. As a part of the fusion system we have used the temperature sensor, light intensity sensor, accelerometer sensor. The accelerometer sensor is used for detecting the intruder the threshold taken for detecting the intruder is taken as Z-axis when the value in the Z-axis goes beyond 8-g it triggers a SMS sending function ,when we use the client server model. In the client server model the smart phone installed with server will be attached to the locked door in such a way that server module will not be visible to any intruder. So when an intruder tries to open the door the accelerometer sensor detects it and sends the SMS followed by a phone call to the end user. The end user system is considered as a client, upon receiving the SMS followed by a call from the server system the client system can see the live streaming of the video captured from the home environment from server side. Once the SMS is received the owner can view the video through the appropriate http: using TCP/IP protocol with IoT. The web server is created using Java Websocket library via websocket between browser[7] and android phone. The light sensor values in the step of 5 –flux clubbed with PWM module is used for creation of smart self adjusting light system.

2.3 GUI for the Fusion System

The graphical user interface required for the fusion system and the apk is created using Android Studio. Figure 2 shows the GUI for the designed system. There are in all 7 buttons available, two edit text window and three text widows is used. The sensor output is shown in text window and individual buttons are used for sending the commands to the control unit. The edit test window is used to enter the phone number and the message body, which has to be sent through SMS to the end user when client server mode is activated.
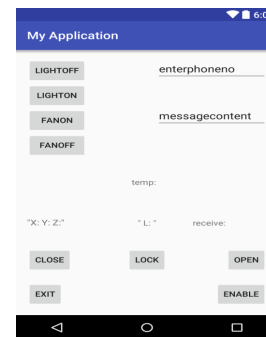

Figure 2. GUI for the designed fusion system.

2.4 Control Unit

The main control unit as shown in Figure 3 is designed using LPC2148[8]. The communication between the control unit and the smart phone is done using Bluetooth. The receiving and transmitting from the control unit is done using HC-05 module[9] which receive the commands sent from smart phone with RF communication channel created using SPP UUID based. The command received by the control unit is processed and it does the respective task like switching the appliance on or off. The relay unit shown in Figure 3 is totally controlled by the control unit by using its own IO module. The PWM channel[10] of the control unit along with the light intensity sensor data obtained from the smart phone takes care of controlling the light intensity of the home environment.
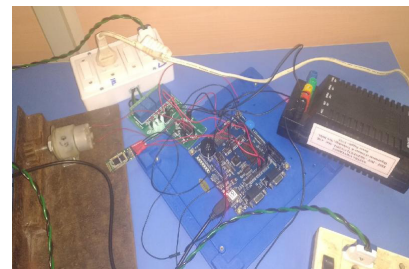

Figure 3. LPC2148 development kit, Motor driver and relay unit connected to the mainline 230V AC supply.

2.5 Security Measure

The security issues for the secured home are taken care by using client server model. If all the family members in the home are out and the house is locked with no one in, then this mode can be enabled to address the security from the intruder. The server which is again a smart phone has to be positioned near or on the door in such a way that it should not be visible to the intruder the hidden server using the accelerometer sensor data detects the presence of the intruder when he tries to open the door and server smartly send the SMS to the client followed by a call which confirms that an intruder is trying to break up. Upon receiving the SMS the client opens up the live video streaming from the server smart phone with the format of H.264 video, G.726 audio and can witness the home environment captured lively[11]. Figure 4 shows the screen shot of the fusion system demo.
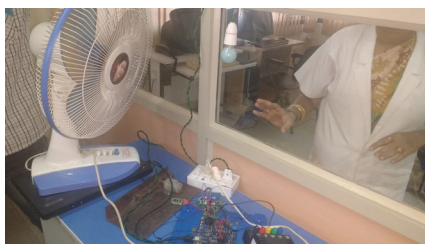

Figure 4. Screen shot of the fusion system demo.

3. Conclusion

In this paper the design and implementation of a fusion system based home automation has been established. The blended system logic used for self adjusting lighting system provides the concept of reduced energy consumption and also takes care of security with the IoT using client server model. Upon using the OSGi framework it can be seen that not only the integration of different network is possible but it also drastically reduces the time for prototyping the system which in turns take care of reduced time to market. As a future enhancement of this system we can try integrating the same with the cloud computing for better data security.

4. Acknowledgements

5. References

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