Development of a Raspberry Pi Secured Management System for Home Automation

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ABSTRACT

Due to its friendliness and ease of use, we have chosen to incorporate home automation and home security into one application. This integration also enables the final product to be customized, since both parts are mutually enhanced. Since PIR sensors and cameras are implemented to notify the user. For instance, if an intruder reaches the room, the PIR sensors detect the movement and switch on the lights and the camera records the pictures that would give a live video feed to the user to see who was interfering. We have also given an internal storage system and email services to help the user see later on, which offers the user with better retrieval equipment. The phones of the user are the Home Safety System that the web application can enable or disable. This paper is concerned with the design and execution of Secure Home Automation with Raspberry Pi for mobile devices using mobile technology to ensure our homes and related control activities are essentially secure. Our new incorporation of camera and movement detector into the website is the key to our suggested Home Security solution. Raspberry Pi works and regulates remote sensing, live video streams and documents for future reproduction, and lastly manages activities on home devices, such as switching ON / OFF onto a TV or Microwave. For example, the cameras automatically start recording when motion is detected and the Raspberry Pi device warns the homeowner of potential intrusion. Raspberry Pi has two primary interaction parts: the web applications running on the browser of a portable device; the server scripts running in a cloud operated by the hardware element Raspberry Pi.

Keywords: Buffer, Home automation, Motion detector sensor, Raspberry Pi, Relays.

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1. INTRODUCTION

Household security always pays a high price that a middle-class individual is unable to afford at such a cost. This document therefore leverages a safety advance over the household at an extremely inexpensive price and which can also ensure that it can say,' He can be the ironman of his house.' This research work gives anyone more advantage to buy a cheap item that could provide any device carrying a browser with home automation characteristics. The home automation system uses the Internet as a master and the hardware Raspberry pi as shown in figure 1.1 on the next page. Each power points or switch panels shall be equipped with a customized Raspberry Pi. It serves as the control unit for all electrical devices (lighting, ventilation, air conditioning, etc.). The user won't have any job with his / her device. At the moment the system is set up, you must initialize the necessary configurations. The scheme will then be self-supporting and individual. The customized Raspberry Pi is equipped with relays that regulate all lighting and fans or other electrical equipment.

This board has a wireless link to an Internet hub. A LAN or Wi-Fi connection to this Internet hub depends on the user's decision. As previously stated, the Internet acts as a master since an online server-side program (ASP or PHP modules) handles the whole control process. During initialization, the user only needs to log in to the designated webpage and if the automation settings are needed. The website is encrypted to give the user complete control over the automation process such as time and automation conditions.

Figure 1.1: Expression Tree (Source: Design with Proteus)

Specifically Raspberry Pi provides the following (a) cameras are operated and motion sensors are used for safety reasons (b) home applications operation (c) to calculate the electricity bill, which provides effectiveness for user (d) storage via the cloud as well as servers using external hard disk as shown in figure 1.2

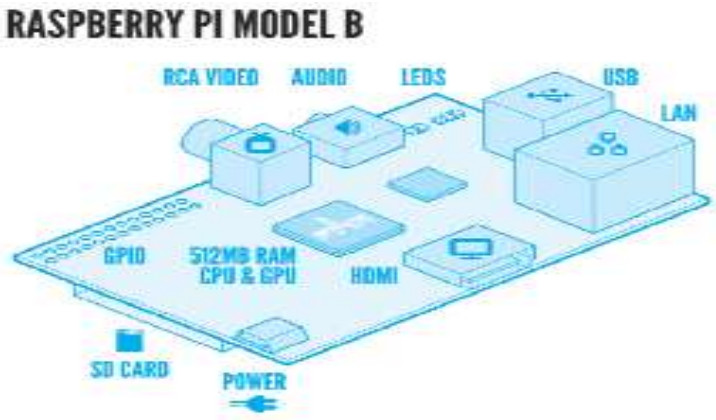

Figure 1.2: Raspberry PI Model (Source: Karia,2013)

2. LITERATURE SURVEY

When a individual leaves their homes, the safety of their property always concerns the growing amount of robbery, theft and other incidents. A number of automated systems were created, informing the owner of any intrusion or attempt to enter the house in a distant place. However this paper explores the creation of an ANDROID application which identifies the text a mobile device gets about the possible intrusion and then provides an SMS response that causes a distant house alarm / buzzer (Sharma, 2014). They can provide many helpful services including assistance for older and individuals with disabilities, access control, environmental monitoring and home automation. In addition, the need to regulate and handle smart home using these devices is growing with the widening dissemination of mobile apps and their inclusion with new auto identification techniques. Hence the primary purpose of the job is to create and validate hardware and software architecture, capable of monitoring and managing a home automation system based on KNX in an effective and secure way, through an Android mobile device. De Luca, (2013) As mobile devices and Internet services develop rapidly, the management of home security using these phones and services is becoming increasingly popular.

We are proposing a UPnP Surveillance Camera System (USCS) that uses UPnP technology to search, monitor and handle IP-based cameras to increase the usability of standard house monitoring cameras. For data sharing, communications and entertainment, UPnP allows interconnected devices and the control network within the home. The present UPnP, however, was initially intended for local networks. Therefore, in order to reach UPnP services over the remote system, UPnP control module has been incorporated into the Open Service Gateway Initiative (OSGi) context. The control point is an internal network that allows access to the UPnP device that is hosted via USCS on a home network. Compared with a standard scheme, our system has demonstrated enhanced search, management, foundation and manipulation of IP-based cameras on our home network. A remote access feature supplied by OSGi enables users to use a mobile device to monitor the home safety status in real time. Thus, consumers can more effectively and immediately track their homes and ensure the security of house members and property (Gu, Yi, 2013). The next paper is to introduce a fresh concept to control and regulate household appliances with GPRS via the FPGA Platform with the Micro-Blaze micro nutrition operating system and to use the PIR sensor to monitor break-in. The following document is online. Given the rigid time limit criteria, resource usage and planning significance, real time operating system (TRTOS) is played a very significant role in embedded system growth (Trung van Thanh, Bui, and Van Cuong, 2013).

Due to various advantages, including cost reduction, simple positioning and installation, simple expansion, convenience benefits and mobile device consecutiveness, the use of wireless techniques in domestic and industrial devices is increasing. This paper gives a report on the choice of appropriate technology for load control, from various wireless protocols such as ZigBee and Bluetooth. The project model also defines how different loads / appliances are remotely controlled and implies that power can be efficiently utilized by means of a Real-Time power level indicator using a PC-based GUI implementation. The evaluation of the system implemented is further examined for the assessment of different performance parameter such as latency, RSSI value, RSSD time, ZigBee's network coexistence technology (Karia, Deepak, 2013). The photovoltaic system is considered a significant alternative to the renewable energy industry. There has recently been a trend towards an improvement in the application of Ubiquitous computing in photovoltaic systems because of the spread of Ubiquitous computing and smart phones. Owing of the advent of Cloud technology in the house, the personal and domestic computer resources have been saved. When required, the public cloud mergers and shares the resource. Hybrid Cloud has been placed to practical use using an internal server Private-Cloud technique combining public cloud.

This paper implements the Web service based photovoltaic surveillance system for Mobile. The Sencha-Touch-based web application framework has been introduced in latest years. And it is feasible to have a user-orientated surveillance system on smart phones or tablet PC that offers the singular advantages of the Sencha Touch system through the notion of ubiquitous computing. Moreover, Reports have been introduced on distinct device or operating systems without restriction, as the mounting charts have been written in pure JavaScript. Lastly, the use of Cloud middleware-based Web services is helpful in the new development of the monitoring technology because the future will be easier to scale photovoltaic systems, and when Bluetooth is combined the wireless network and 4 G LTE device (Ryu, Yeonghyeon, Young Kim and JeakyuYoo, 2012).

2.1 Hardware Tool - Raspberry Pi

Raspberry Pi handles the camera (RECORD / STOP) and regulates it in actual time. You can play video recordings in the order of your timestamps, switch on / off insignificant devices. Raspberry Pi also has PIR sensor capability to detect movement. When the movement is found, it automatically starts to record and then sends a warning to the mobile device of the user. A live video feed can be viewed from your cameras and any device built into the Raspberry pi remotely controlled. For example, if an intruder is detected, a user can choose to record several minutes of video from the camera for intruder identification and so turn the light and the stereo on to detect the intruder. It utilizes movement sensors, remote monitoring and recording cameras, an information storage server and an interface. The Web Application from a mobile device directly or through the Control Protocol is linked to the server by all internal devices, like cameras, lights, PIR sensors.

3. SYSTEM MODEL

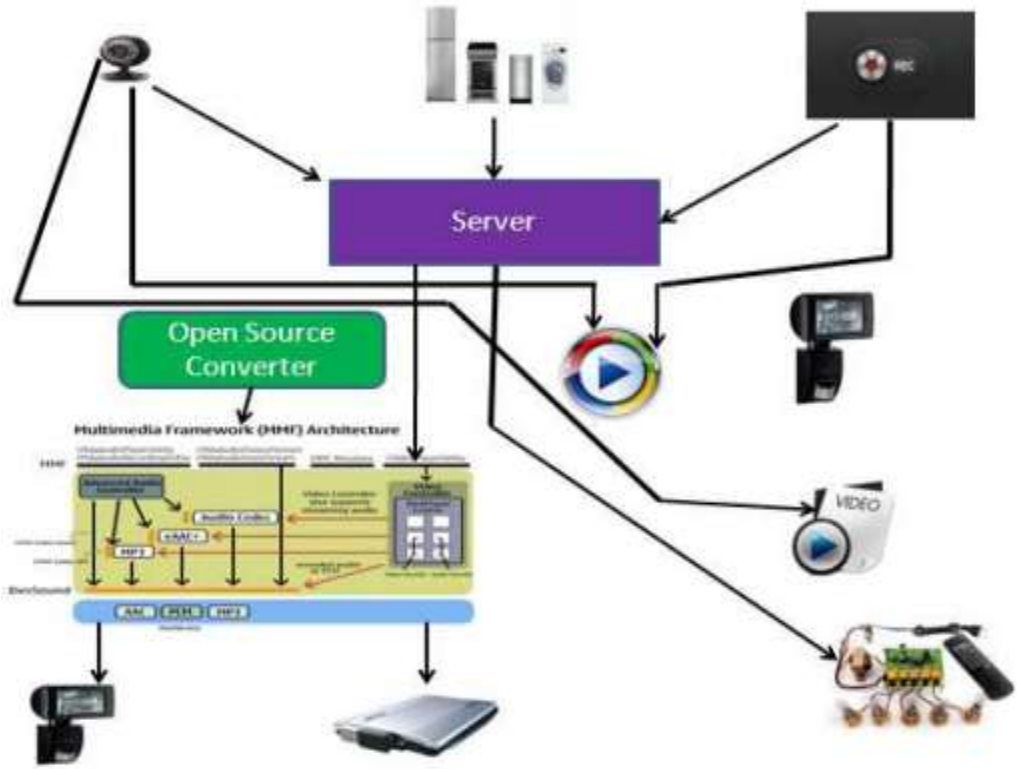

Figure .3.1: System Model

The Raspberry Architecture design (figure 3.1) while showing the hardware and execution parts, including communication between server and client. The architecture is divided into 4 layers: application, internet server, programs, and data storage. They are each further broken up by unidirectional or bidirectional communication connections into smaller entities. On our web application, we are creating an Apache HTTP server with a PHP internet server package open source. Raspberry is using the architecture model of the client-server. Displays video from server to client as well as from client to server orders and controls are shown on the screen. Alerts will be sent from the server to the client if needed.

3.1 Experimental Setup

Complete user control, such as the personalization of home electrical devices, surveillance rooms, home safety with cameras, as well as a media centre. Users at home receive a intelligent interface in which they are able to connect to the browser / app to regulate and customize activities, if the user dashboard also has the' this' type of instructions.

3.2 Control of Camera

Since Raspberry Pi allows you to choose any sort of video capture device (e.g., webcams lined either inside or outside the server, or cloud IP cameras), we had to take account of each of their different design information and adapt a solution that could fit them seamlessly into one cohesive implementation, Of the two types, generic webcams were more difficult to implement since they presented a unique challenge to allow the user to simultaneously view and record live video. We encoded and capture the video program with C++ which meets the API instructions RECROD / STOP. It saves video in an AVI file which is then converted to an open source MP4 converter for FFmpeg.

3.3 Data Storage And Retrieval

Recorded videos with timestamps as filenames are stored on the internet server. The PHP record script reads and places the contents of the MP4 file names in a hyperlinked list and displays a list of records in our implementation. Storage also takes place on an external hard disk that allows time stamps to be retrieved even without the network.

Figure 3.2: Light Switch ON/OFF Mode

3.4 **Electricity Efficiency**

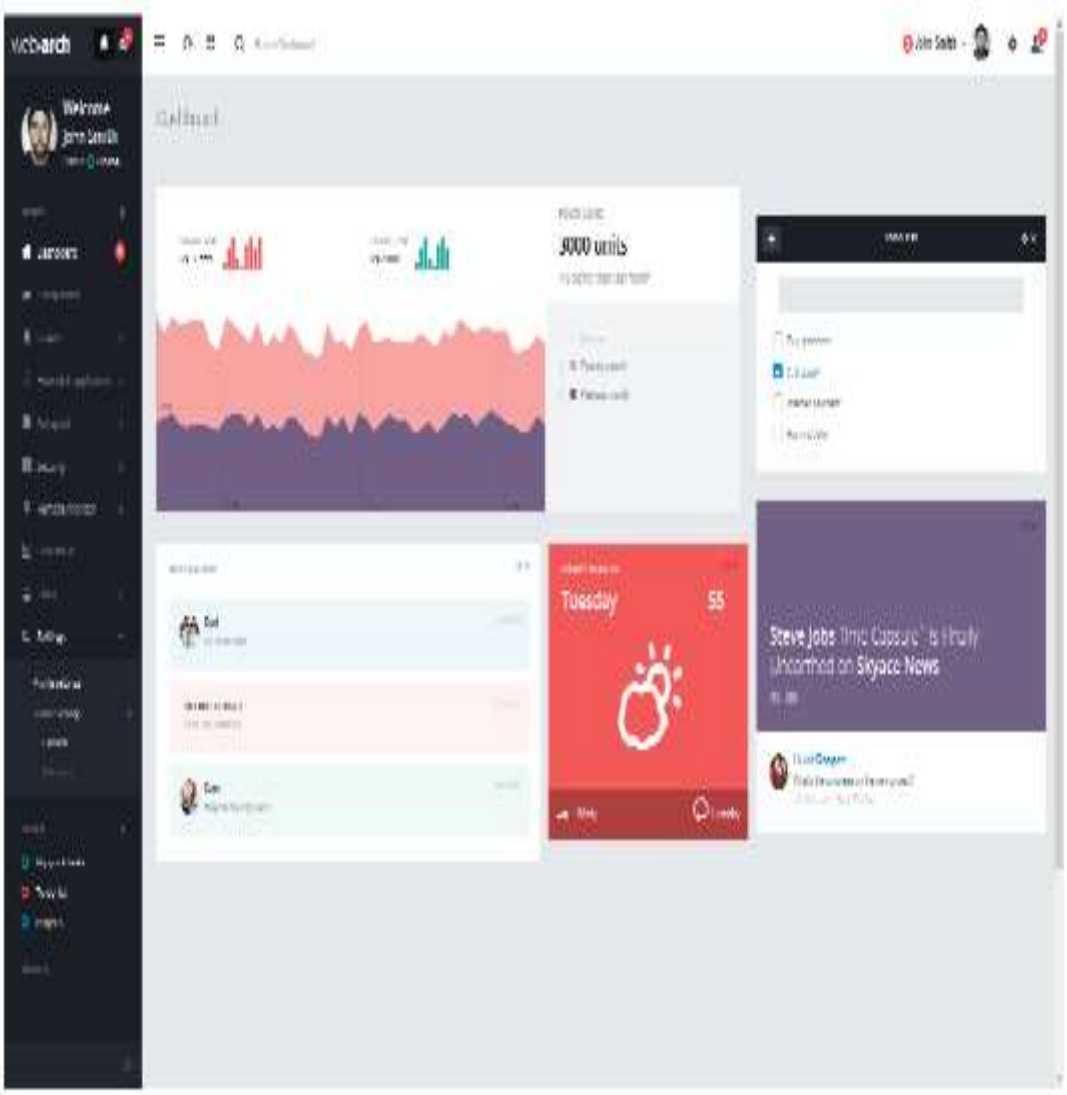

Figure 3.3: Efficiency Graph Details

Auto switch the ON / OFF lamps automatically when the user enters the space and the luminaries length (figure 3.2). If no move can be detected more than for a specific amount of time-which can also be controlled by the user-all electric devices in the room can be put to power by saving power. A separate code set can be added, which can modify the automation process when required in order to avoid the power consumption of devices during sleep. For example, during sleep, even if there is no movement, appliances like AC and fans should be ON. At certain occasions the operator can set the AC to turn on and off and maintain the temperature. In order to decrease energy consumption, the AC is turned off and the ventilators can be turned on until the temperature reaches the top threshold, as when the required temperature has reached. An IR transmitter installed on the board shall operate the AC. During the initialization phase, this transmitter must be programmed remotely from the AC using an on-board IR receiver.

There are endless opportunities. Options to monitor power can be set up, which means that the webpage shows the power used on the basis of the scores of the device. The average daily and monthly energy and graphs are shown in figure 3.3. Since a server controls the process, a dedicated email can be created to forward all energy accounts and telephone bills. The customer will receive a notification for the same one. The Raspberry Pi system can also be given voice control choices and therefore obtain the effectiveness information.

4. RESULT AND DISCUSSION

We first performed experiments to assess the streaming video latency from a distant place for two instances and then broadened the range of our assessment to include additional trials. For 6 consecutive latency readings, the outcomes were registered 20 seconds apart and then averaged. Each experiment has been repeated ten times. We tested on a webcam and the results for individual streams as expected (around 1-2 seconds) at high resolution 640x480 pixels i.e. 7.5 frames per sequence (fps) for the first scenario on Figure 4.1, even the video is high-quality.

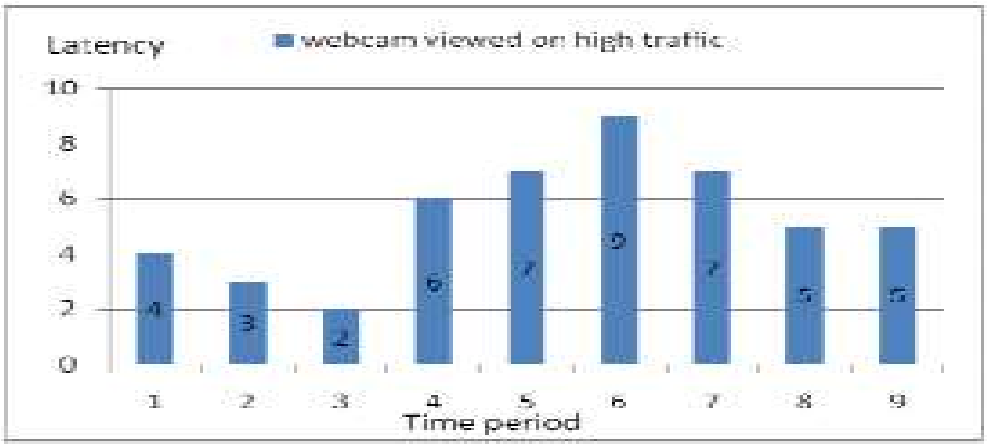

Figure 4.1: Latency of streaming video

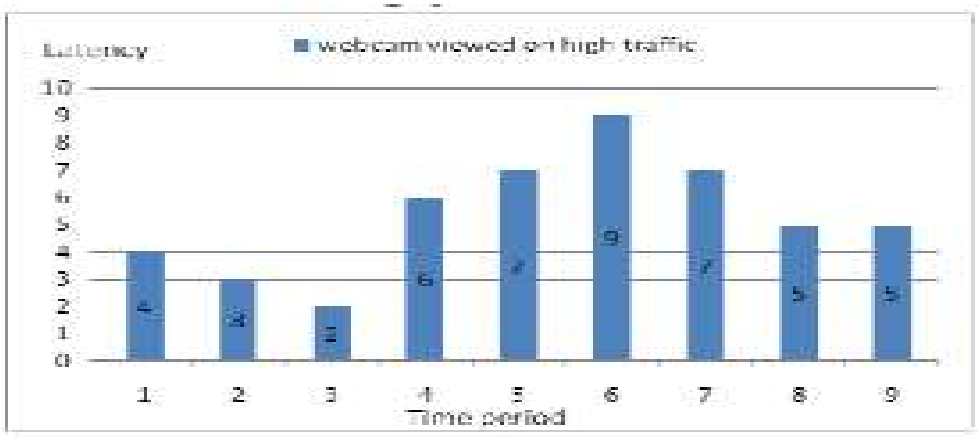

Figure 4.2: Latency of streaming video

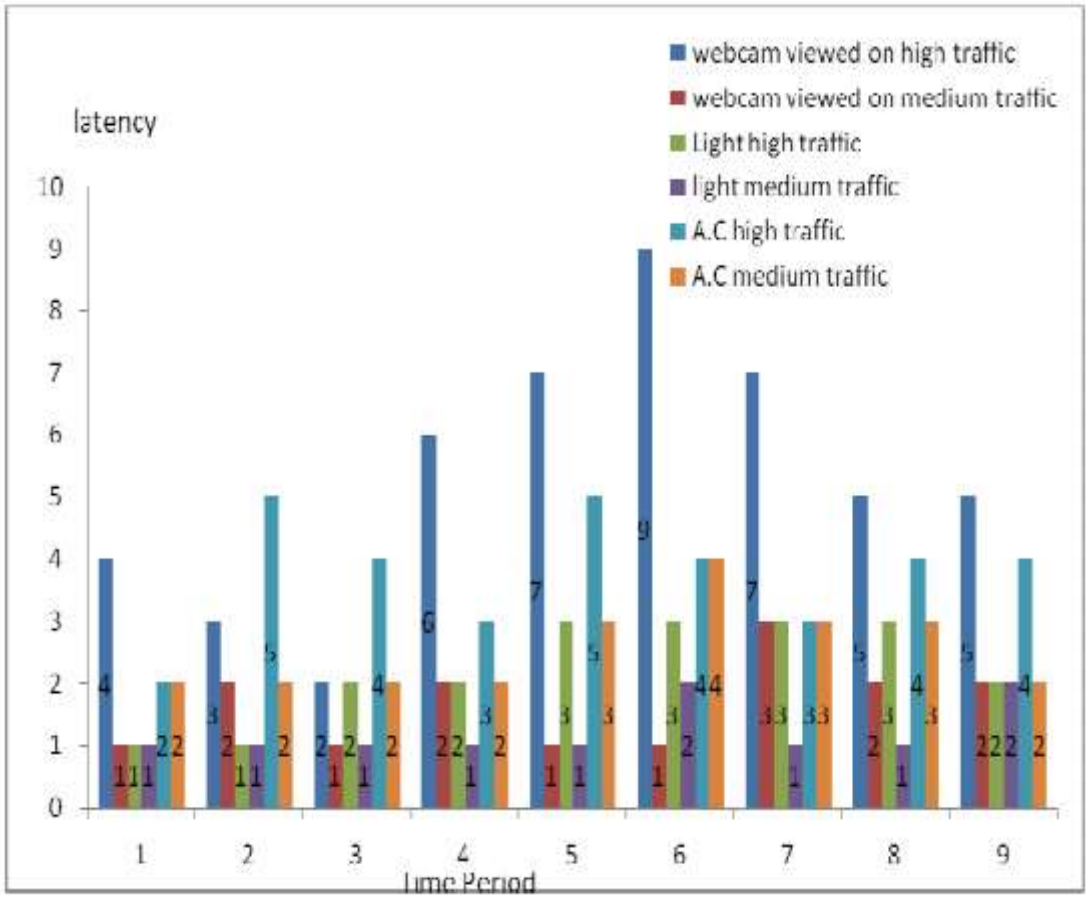

Figure 4.3: Latency of streaming video with different traffic

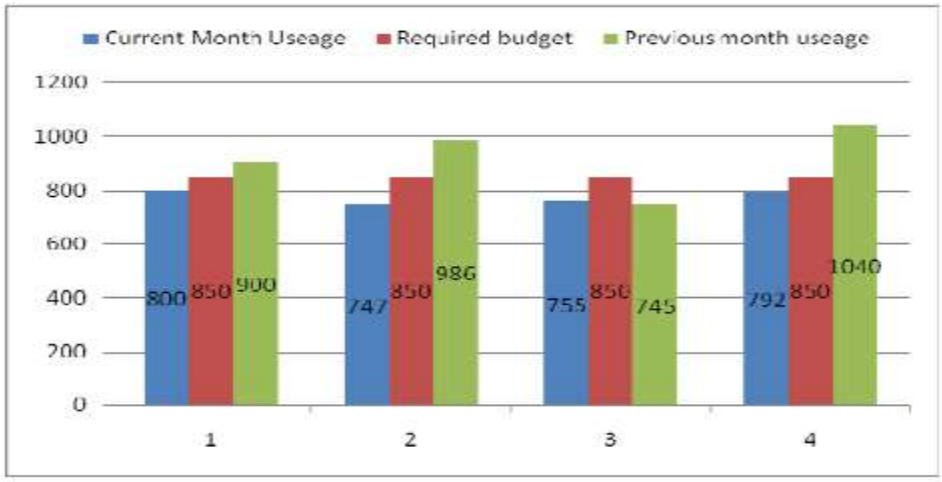

Figure 4.4: Weekly usage: Current Efficiency

Table 1: Comparison between Proposed System And Existing System With Reference To Functionality

Functionality	Proposed System	Existing Systems		
	SSHEMS	Revolv	Vivint	Smart Things
Ease of Use	√	X	X	X
Energy Efficient	√	X	X	X
Remote Access	√	√	√	√
Programmable	√	√	√	√
Randomized Programs	√	X	√	√
Wireless System	√	√	√	√
Wired System	√	√	X	X
Security Monitoring Service	√	X	√	X

Tests were carried out on a distinct network representing a home user in the third case on figure 4.2 and the user was watching the stream from a medium traffic network outside the home and a stream from a heavy traffic external network. For that third situation on figure 4.3 compared with the others, the high-speed traffic network suffered considerable delays. We have also evaluated home automation latencies such as ON / OFF devices. Actions in 1-2.5 second range were performed. Table 1 shows the comparison between the scheme proposed and the current system in terms of functionality.

5. CONCLUSION

We have created a extensive solution for home automation and safety applications that are user-friendly. This has been achieved by integrating inexpensive, stand-alone equipment, interfaces and software with a user-friendly interface. This work allows users to access remotely and control their home devices and safety via an easy to use mobile application. In the future we plan to provide a wireless relay connector and wireless sensors that can be moved and used and installed in a single system for the safety of the entire building. This offers complete home safety assistance. The system is created to monitor and control the electrical appliance in an elderly home efficiently over time. Electrical devices can thus be viewed via a website in real-time. For tracking the entire intelligent building, the system can be expanded. We strive to determine the regions of daily peak hours of energy use and provide a solution for reducing consumption and improving the use during peak hours of already restricted funds. The networks of sensors are programmed with different user interfaces that are appropriate for diverse customers and experts such that can keep the system smoothly and interact with in an easy way.

6. RECOMMENDATION

This research also seeks to evaluate the reaction of customers to their perception, benefits and disadvantages, potential issues and general perceived utility of smart grid technologies. The system that has been created is robust and flexible. A novice customer can easily manage local and remote user interfaces and is effective in operational management. The scheme will be incorporated with co-systems in future, such as intelligent home resident behavior recognition systems, which determine the resident's welfare with respect to energy use. Therefore, intelligent energy management and real-time information monitoring is feasible from anywhere.

REFERENCES

1. De Luca and Gabriele, E. (2013) Using NFC and Android technologies to allow a smart home based on KNX, Software, Telecommunications and Computer Networks (SoftCOM), 21st International Conference, IEEE.
2. Gu, Yi (2013) Design and Implementation of UPnP-based Home Security Surveillance Camera System, International Conference on Information Science and Applications (ICISA), IEEE.
3. Karia, Deepak, et al. (2013) ZigBee-based Load Control and Power Monitoring System Performance Analysis, Advances in Computing, Communications and Computer Science (ICACCI) International Conference, IEEE.
4. Ryu, Yeonghyeon, Young Kim and JeakyuYoo. (2012) Mobile Photovoltaic Systems Cloud Services, Cloud Computing Technology and Science (CloudCom), 2012 IEEE 4th International Conference on. IEEE.
5. Sharma, Rupam Kumar, (2014) GSM home safety scheme based on Android interface, Issues and challenges in the International Conference on Intelligent Computing Techniques (ICICT), IEEE.
6. Trung van Thanh, Bui, and Van Cuong, (2013) GPRS monitoring and control of systems on the FPGA platform, Advanced Communications Technologies (ATC), International Conference, IEEE.