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Raspberry Pi Home Automation System Using Mobile App to Control Devices

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ABSTRACT: In modern era of advanced technology, many people have come to appreciate the efficiency, effectiveness, convenience and relatively inexpensiveness of using devices such as phones and computers to perform day-to-day activities. Every day, new innovations are made in technological world. The ultimate goal of these endeavours is to make life easier, ensure that there is maximum output and also to assist human in performing duties which are essential difficult or highly demanding. This project was conducted with the major being to find a most effective and cheaper way of detecting and reporting intrusion within home. Fundamentally, this will be the best way of solving insecurity problem which is rampant within the country. The owner of this device can easily monitor the state of his home without necessary having to be physically present. Compared to other devices available in the market, this device has been designed in a manner which makes it cheaper and convenient; therefore, most people will be able to afford. The fact that the app uses smartphone makes it easy to manage, primary on basis that many people own smart phones. Some of the most outstanding features of this device is that it is able to generate other related data such as usage per hour, number of times the device was used, the time of the day when the device was used and many more. In addition, the user can switch off and on the device from the smartphone using the app.

KEYWORDS: Home Automation, Mobile App, Raspberry Pi, Smartphone

I. INTRODUCTION

In modern era of advanced technology, home automation has become one of the most practical applications; and has enhanced the living standards and made life easier. There are many ways in which home automation has been manifested or applied. Some of the basic forms of applications range from controlling the heating system within the house, managing the lighting systems, to switching on and off Television, radio and Wi-Fi. There are valid reasons behind wide application of home automation devices. For instance, people living with disability can manage their day to day activities within their homes with the assistance of these devices. With the introduction of smartphones, a major conundrum to be answered has been how they could be integrated with various devices within home in order to enhance their performance output and efficiency of the latter. Smartphones have capacity of managing many different forms of apps. These apps can be designed to fit the context of home automation; therefore, producing sophisticated system of control. Through this, users of smartphone can manage devices at home regardless of their geographical locations at the time. Mobile app designed to integrate various computational aspects, if interlinked with home devices, and with application of artificial intelligence, produces sophisticated, efficient and convenient form of home automation. Various mobile based home automation have been innovated and designed, however, we endeavoured to come up with the most inclusive app, which is multidimensional in terms of service provision. With the help of raspberry Pi, we designed an app which could detect the intrusion of home compound through sending information regarding the same and the time of such intrusion. The fundamental aim of this is to protect the property at home. The

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owner can easily monitor the security of his home, from the comfort of his bed or outside parameters of his compound. There are other features which enable the user switch on and off home devices such as TV, Radio, Wi-Fi, Lights and air conditioning system [1][2][14].

II. PROPERTIES

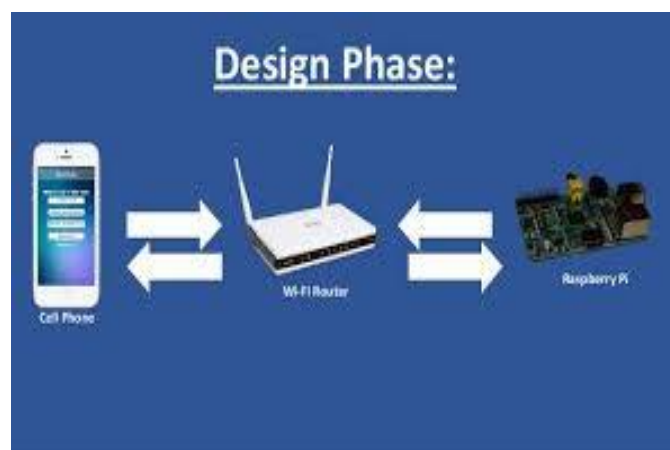
This mobile app is integrated with the smartphone of the user. Wi-Fi router is also required in order for the app to operate. In addition, Raspberry Pi will link the home devices with the app and its major function is to send data to and from the two ends.

III. SMARTPHONE

Smartphone is the most important component of the whole system. This is where the app will operate from. Most phones such as Androids, Windows and iPhone will accommodate the app. This app has been designed to showcase the information received from the Raspberry Pi, regarding the intrusion or control of home devices. Essentially, the app has various properties which showcase data. The app has the ability to switch on and off devices such as television, air conditioning system and even lights. This is majorly through the assistance of Raspberry Pi. The Home screen appearance of the app; shown in the smartphone has features such as: *Home now or Moved Out, Switch on/off devices, Check intrusion History, Power Analytics and Exit.*

IV. RASPBERRY Pi

Raspberry board is a very important component in devising and operating this system. Any model can be used. Major function of this component is to provide an intermediate channel of transmitting information from the devices and mobile phone; which is fundamentally incorporated with the app.



Using the app, the operator of the smartphone will send information such as switching on and off of devices like Television, Radios, Wi-Fi and Lights through the Raspberry Pi. Artificial Intelligence is formulated at this juncture, and any data transferred from the mobile app is interpreted, synthesized and decoded by the Raspberry Pi before being transferred to the devices. This component is also important in streaming the updates of the home devices to the smartphone's app. Raspberry must be connected to a source of energy; precisely electricity in order to function [3][1].

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V. WEB SERVER

The mobile app, through the smartphone is connected to the web server which rely data from the devices such as television, bulbs, air conditioners and intrusion alert system through Raspberry Pi and Wi-Fi router. A user with smartphone can easily control the devices through the existing internet relayed by the Wi-Fi router. This however, does not mean that the user should be near home in order to operate the devices; in contrary, devices can be operated from geographical locations which are far from home, as long as the smartphone has its own internet connection [4][8][13].



VI. SIMULATION & RESULTS

Experimental results show functioning features of app and how it operates in conjunction with other supporting components such as raspberry Pi, Wi-Fi router, and smartphone. Figure 3, 4 and 5 shows the images of the app when viewed smartphone. Some of them are:

Home Screen

This feature is on the Home Screen. User can switch on and off devices at home. The data regarding what the user wishes will be transmitted through the phone and raspberry component to such devices. Basically, this part has specification such as TV, Air Condition, Wi-Fi, Lights (depending on the number existing) and intrusion system. Apart from the intrusion system, other features are simple. They have either on or off component. On the other hand, intrusion system feature is more sophisticated. It has been designed to provide additional information such as the time of intrusion and number of such intrusions. Switching on and off of TV, Wi-Fi, Lights, and other such devices can be delayed depending on the interest of the interest of the smart phone user.

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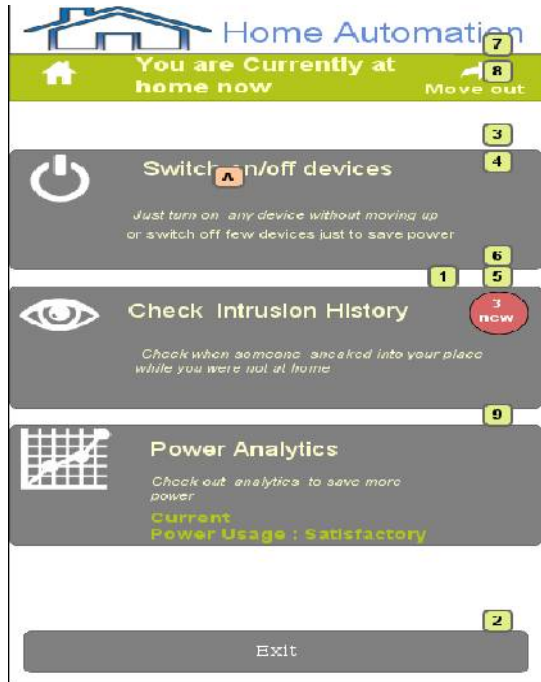


Figure 3

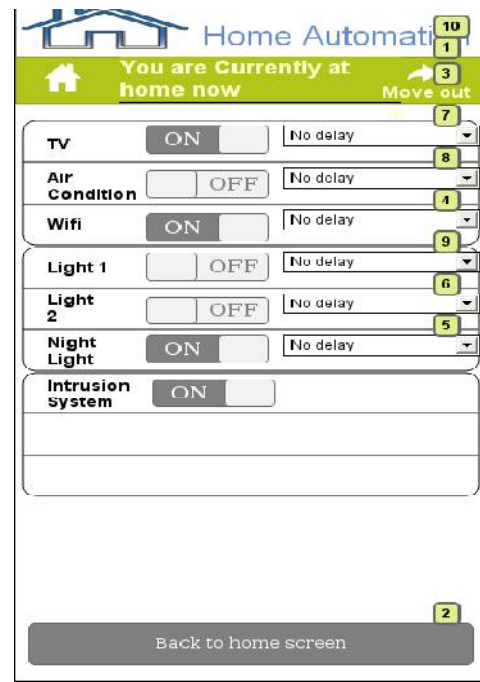


Figure 4

Intrusion History

User of the smart phone can check the intrusion history of his home. The home screen of the mobile app has a feature where it shows the number of times when intrusions happened. This is besides the availability of information regarding the specific time of intrusion. Every time intrusion occurs, the app updates itself. By accessing this feature, user can easily see the number of times when someone intruded his or her home. *Figure 3* shows intrusion history.

Switching on/Off Devices

The app has a page where the user can switch on and off the devices at his home. Delaying the switching off/on can be set on this page. *Figure 4* above shows it

Power Analytics

The App has ability to provide data regarding power usage. Through a diagraph, information such as the usage of power by each device connected to the app can be seen. This analytical data enables the user to switch on or off devices which are deemed to consume a lot of energy. Through this, power consumption can be regulated. A comparison between various periods can be derived from the app. The previous month's power consumption is juxtaposed with the prevailing month's power consumption data.

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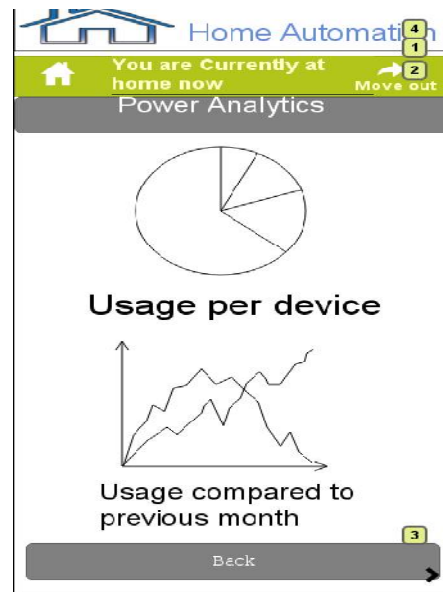


Figure 5

VII. ADVANTAGES OF USING THE MOBILE APP

There are numerous advantages of using this mobile phone app in home automation. This gives it an edge over other existing devices which have been innovated or are in existence. This app is comprehensive in its application and encompasses multiple features; yet still flexible and convenient to majority of users. Some of these advantages are:-

It is convenient to use.

Many people own smartphones. Rather than using other devices such as computers to monitor home intrusion, this device offers a convenient way of doing so. In addition, user can monitor and control home devices regardless of his geographic location. It is possible to switch on and off televisions, Wi-Fi or lights from places other than home.

Offers security and protection against intruders.

User of this app can easily monitor what is happening at home through the phone. Updates on the number of intrusions and specific time of the same provide an insight of how and when intrusion happened. Unlike other devices such as CCTV, user of this device can be updated regarding intrusion while the latter is still happening. He can therefore, call the police or raise alarm. This is a form of anti-burglary device, however, not limited to such function. There are other places in which this app can be used.

It is cheaper and affordable

This application can be used by those who cannot afford to use other devices such as electric fences, CCTVs etc. Any user can get the app through downloading from various media. To operate the app, all that is needed is a smartphone and other related home automations.

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It can be easily operated

The app is easy to operate; and any person can quickly learn the basics. It lacks the complexities which hinders quick application of the app. Small children can understand the app and use it to manage the devices at home.

It offers Other Services such as Monitoring of Energy Consumption by Devices

User of this mobile app can monitor consumption of electricity by various devices connected to the phone. In addition, it provides a comparison between the level of consumption of energy in the preceding and the prevailing month. This analytical data, in form of diagraph presentation, is useful when determining the amount of energy being consumed by devices.

It Provides Data on Specific time of intrusion

This app provides specific time data and the same can be easily accessed by the user. It also update the user on the occurrence of intrusion; therefore, enables him, to take necessary actions accordingly.

VIII. LIMITATIONS

There are several limitations to usage of this app. Some of these limitations, however, can be fixed. Like in most applications used today, some of the limitations are:-

It Requires a Smartphone to operate it

This app, while managing home automation systems, will need a smartphone. Inasmuch as many people have smartphones today, that number does not represent the whole population. This limitation makes the app less applicable in most areas.

It only has a Feature of Switching On/Off

User of this app can only switch on/off devices. It lacks specific features such as increasing the volume of Television, changing the rate of functioning etc.

IX. CONCLUSION

In conclusion, it can be stated that the mobile app is revolutionary in enhancing the home automation systems. It is a hybrid of smartphone, computer and devices technology. The ultimate purpose of this app is to provide high quality services, enhance convenience and also an alternative to other devices which are mostly expensive. The fact that this app enables a person operate home devices regardless of his geographical location makes it the most convenient application for day-to-day activities.

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First, I would like to appreciate the efforts made by every person who; in one way or another, assisted me while devising this application. I am so grateful to all my colleagues who shared their ideas with me on how to perfect or improve this application. I cannot forget my friend, Mr.Sandeep Mukherjee, who gave us both moral and financial support. Thank you so much.

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