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Iot-Home Automation System

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ABSTRACT

People use the technology to make their everyday lives easy. They may need to communicate with their homes from anywhere in the world and at any time of the day. The most popular way is using their smart mobile phones to communicate with their homes. The most important thing in smart homes is the protection from disasters such as fire and gas leaking. In this thesis a smart home automatic protection system has been developed that is controlled by an application running on a mobile device. The developed mobile application can control and monitor the smart home via the Internet and using the SMS to send commands. With the help of the developed mobile application, the user can open/ close the doors, open / close the windows, open/ close any pump in the house, open / close any fans, open/close lights in the home, and also open/close the air-conditioning system, for example before coming home. The user can monitor the ambient temperature, humidity and most importantly the gas level at home. Then ovelties of the developed system are that the system can automatically control the firefighting and gas leaking. Additionally, one of the most important novelties of the developed mobile application is that the user can get feedback from the control actions to ensure that the required control actions have been implemented successfully.

INTRODUCTION

This chapter provides the introduction, thesis problem, aims and significance of the study for IoTs, automation and control of a smart home.

The Internet of Things (IoT) is an area of technology that is in it speak of development which continuously improves people's living standards by digitalizing the physical world like homes, offices or vehicles, this digitalization is done by connecting different technologies and applications to the objects around (Li, 2011). IoT enables objects to be detected and controlled using various communication means, this makes physical world integration into computer world which provide proficiency and accuracy.(Bingol et al., 2014).In recent years, the mode of interaction with home appliances is fast changing, this is due to the development in IT and wide use of mobile devices and cloud-based services (Uhlemann, 2015).

Research in the IoT and smart homes resulted to several smart homes models, which includes setting a server that connect all the objects (Kumar, 2014).Other models included the connection of the objects with the cloud (Yang et al., 2010). There are several alternatives available for smart homes connections which includes Bluetooth, Wifi and sensors (Chew et al., 2016).

Home automation is becoming very popular due to its immense contribution in substituting human hand works, the connection is either remotely or by using local network (Jain et al., 2014). Automation minimizes human hard works, save time and power efficiency, where everyone can manage and control different objects within minimal time. (Gandhi et al., 2016). Smart Home afford comfort, power performance and safety (Adriansyah and Dani, 2014). Also, smart homes interact with the smart power network to have sustainable electricity (Li et al., 2016).

The recent developments in IT gave birth to a small open source micro controller called Arduino which serve as a mini computer used to build electronic projects. It has Bluetooth and Wi-Fi support features which enabled internet connectivity and data transfer from/ to different objects (Aru,Ihek weaba and Opara,2013).Now a days, Arduino is widely being used as a controller for different home appliances due to its high functionalities, in expensive, easy to use as well as its GSM and Ethernet supports (Zeebaree and Yasin, 2014).

Overview of the Study

This Thesis consists of six chapters which are Introduction, Related Research, Theoretical Framework, Systems

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Development, System Implantation, And Conclusions and Recommendations.

Chapter 1 give details about the general introduction of IoT, automation, the thesis problem, the aim of the study, the significance of the study and overview of this study.

Chapter 2 presents the related research work.

Chapter 3 introduces the theoretical framework.

Chapter 4 talks about the system development and architecture…etc.

Chapter 5 the system implantation was discussed in details.

Chapter 6 is about the conclusion of the study and recommendations of the thesis, suggestions, and for future studies.

LITERATURE REVIEW

Controlling a Smart Home

Fitriyah et al. (2016) designed a remote control based on a button which is outfitted with LCD screen. The LCD screen reduced the quantity of buttons as choices might be displayed in it. In addition, The LCD screen would return visual feedback of observability for users.

Kumar and Pati (2016) proposed a low-priced and flexible solution to the smart home. Home devices can be controlled by different technologies like GUIs and the internet. The house owner can monitor his family and the home devices from anywhere and at any time he wants. It improves home safety where the owner became alerted in case of any emergency to take the necessary action at appropriate time. The system minimizes frequent supervision and management of home devices as well as proper handling of guests in case if the owner is not around. The system also helps in saving electrical energy by proper scheduling and monitoring of devices.

Gandhi et al. (2016) developed smart industrial system where by all machineries and electronic devices in a company or industry can be controlled via an android application, a message is sent when a sensor is active or inactive.

Li et al. (2016) developed smartphone applications for an energy-efficient to control smart phone applications. Two versions of the application was developed; the first is iSHome1 which can interact with power plugs, and the second version is iSHome2 which communicate with the home management server. Both 2 versions uses Bluetooth as means of communication.

Khaled et al. (2016) designed a system for controlling and monitoring of submersible pumps using SMS with GSM modem. The system allows a user to control and monitor the pump remotely from anywhere, in which information about the state of the pump can be accessed or altered. This system works very fast and required minimal resources compared to other systems.

ROY and WILLIAMS. (2016) proposed a wireless control system for greenhouse which depends on Zigbee to minimize human hard work, the system was designed using Visual Basic then hosted to a Web server for easy communication with devices. A mobile phone was synchronized with the software using (TEAM VIEWER) to keep the devices in synchronization with the server, also a wireless camera was attached to monitor the real time activities. This system is mainly used for monitoring the three basic parameters for plant growth; humidity, temperature and light intensity. The results were truly consistent and accurate. The system successfully overcome several weaknesses of the current systems by decreasing the power loss, support and complexity, at the same time implementing a flexible and specific form of saving the environment.

Das et al. (2014) also developed a home appliances monitoring system using GSM phones, where one can easily send an SMS command to control and receive the operation status of each device.

Zeebaree and Yasin. (2014) implemented an electrical devices control system in which home used electronic are remotely being controlled and monitored using a microcontroller via a GSM network.

A message command can be sent to the system via a mobile phone from anywhere without internet connection. This system is very flexible in which electronic devices can be added or removed to the system.

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The Summary of the Related Research
The below table summarises the related research papers based on the authors, methodologies used which will directly show the missing gaps, and then based on the table I Chose my criteria.

THEORITICAL FRAMEWORK

Internet of Things
In the literature, many researchers have defined Internet of Things as a system that is interconnected with sensors and actuators which are in devices and used to leverage data that is obtained through sensors (Arpita et al., 2015; Chase, 2015). Arpita et al. (2015) refers to the Internet of Things as the Internet of Objects implying the use of objects being connected to a wireless network and self-configuring system for example a household. Cisco Systems, Inc. describes the Internet of Things as:

"The Internet of Things (IoT) is a computing concept that describes a future where every day physical objects will be connected to the Internet and be able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it also may include other sensor technologies, wireless technologies or QR codes."

The three main components of Internet of Things that enable ubiquitous computing between interconnected devices are explained below:

- ***Hardware:*** These include a group of embedded communication tools, sensors as well as actuators.
- ***Middleware:*** These refer to data analytical tools that are used and on demand storage services.
- ***Presentation:*** The output should be presented in an easy way that is easy to visualize, understand and interpret.

History of internet of things
The origin of having networked devices began as early as 1982, with the first internet connected machine being a Coke machine at Carnegie Mellon University. The machine had the ability to detect whether loaded drinks were cold or not. In 1999, IoT started being well known through the Auto ID Centre at MIT as well as through market analysis publications. The convergence of multiple technologies in 2015 resulted in the vision of the Internet of Things being evolved starting from wireless communications to embedded systems (Arpita et al., 2015).

Smart air conditioning systems are able to predict house occupancy times based on the saved history and by so doing the air conditioner can automatically switch on to achieve the desired results the time the house occupants arrive (Arpita et al., 2015). Furthermore, the researchers explained that, enhanced comfort can be achieved through the use of smart homes assisting the elderly people with technology interconnected to do daily chores such as cleaning, cooking, shopping and laundry. In addition, reminders can be set to remind patients of their daily medicine dose through the use of intelligent home systems. These systems have the ability to monitor patients and send signals to the caregivers so that they can respond in a timely manner before extra costs such as hospitalization costs are incurred. It is crucial before implementing such systems to ensure that the smart home system is secure and trusted.

Automation of smart homes
Automation of Smart homes is an emerging technology that is designed to provide a more convenient, comfortable, energy saving and secure system to its occupants. Marius et al. (2016) described that by adding intelligent systems to house environments it has the ability of increasing the quality of life.

Automation ways of smart homes
In order to fully understand how automation of smart homes work, Kodali et al. (2016) gave an example of a house owner expecting a visitor at his house, however the visitor arrives when the owner is not there. The moment the visitor arrives, the owner receives a video call and the owner now has the option of pressing different options besides 1, 3 will turn on lights, 4 will switch on the fan and 5 will turn on the air conditioner or the owner can disable the security system remotely.

The camera that is connected to a microcontroller is helpful in assisting the owner to make well informed decisions based on whether the person is a guest or the person is an intruder. The system is solely dependent on the owner's discretion on the actions he/she chooses to take. The following actions can be done based on the user's discretion:

- The surveillance camera outside captures the image of the guest or intruder and emails it to the user.
- The user checks the received image to see if the face of the person is familiar or not.
- If the person is a visitor, the owner can disable the security system and welcome the guest into the house.

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- If the face is not familiar and the owner suspects that the person outside is an intruder, he or she can remotely forward the captured image to the police station.
- The police investigating team can then make well informed decisions on how to get to the house and arrest the intruder.

The system can also be synchronised by integrating the system with a voice call feature that allows smart phone applications to control devices and appliances within the house by making use of voice and directing devices to do certain actions (Marius et al., 2016).

SYSTEM DEVELOPMENT

System Architecture

The proposed system has hardware and software parts. There are an online part and GSM-based part of the system. Therefore, the application needs the internet and mobile network to perform the tasks such as open/close door, window, light, air-condition and perform protection part such as open/close water pump, running alarm and fan. The system connects to the internet via LAN cable and mobile network via SIM card.

System Technology

In this project some technologies are used to offer many tasks to build the smart home application which control by a mobile application.

Mobile technology: The system based on a mobile device because the attributes as send and receive SMS and internet access are easy to use.

Arduino technology: Arduino is an open-source electronics platform designed at the Ivrea Interaction Design Institute in 2005 as a simple apparatus for quick prototyping, the design depends on simple hardware and software that can easily be understood by students (Abdullah et al., 2016). Arduino technology started from programs that reads inputs, light on a sensor, activating a motor, turning on an LED (Caldo et al., 2015). Instructions are sent to the microcontroller to determine the action to be taken. In the later years, Arduino board began changing to adjust to new challenges and difficulties, it offers from basic 8-bit board to IoT applications, 3D printing, and embedded environments (Fatehnia at al., 2016). It is been used in communition and controlling, and also became a backbone for many large number of complex projects.

Windows Operating System

Windows are sets of Operating systems created by Microsoft which started back in 1985 with Windows 1.0 as the first release. Several versions have been released in the later years (Sharma et al., 2017). Windows has been the most widely used operating system for PCs. They later releases CE versions used for handheld devices, and Windows mobile which is an OS for smartphones and Pocket PCs. In 2007, window mobile turned to be the most prominent smartphone software in the U.S. But later, this fame and popularity blurred and other software took over (Dinesh et al., 2015). In February 2010, when windows is in competition with its rivals i.e. iOS and android OS, they release a windows phone to succeed the windows mobile.

C Programming Language for Arduino

C is a procedural programming language developed in 1973 for writing operating systems and compiler designs. C language has a low level memory access and it has an easy set of keywords (Kanetkar, 2016). Most of the newer programming languages have copied the programming syntax from the C language. E.g. Java, PHP, JavaScript and many other languages is mainly based on C language. C language can be used on different platforms from PCs, microcontrollers and supercomputers. Arduino can be also be used for programming microcontrollers using C language.

SYSTEM IMPLEMENTATION

A mobile device is used by people for interacting with technology. So, applications can help them to communicate with the environment to know the weather conditions and smart home situation. This application is a smart home system with automatic protection that controls via a mobile application and web based. This application can control and monitor smart home through the internet and SMS. This chapter described all functions of the system.

Hardware Parts

The system has hardware part which is consists of Arduino, Ethernet shield, sim900 shield, two servo motor to control door and window, tow LEDs, four sensors (Temperature sensor, Gas sensor, Humidity sensor and motion sensor) and four relays to control outputs (water pump, fan, alarm and air-condition).

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Software Parts
The system has two types of programing:
 The first: Arduino programming which uses C language to control input and output devices.
 The second: Android programming, which uses Java language to make a mobile application that, enables controlling hardware part.

System user: The system has one user who is controls and monitors the smart home system.

User: System user.

Features: Main screen, control by internet screen, control by SMS screen, setting screen and about screen.

Main screen this screen consists of a page that shows values as temperature, humidity and gas level.

Control by internet screen: This screen consists of buttons, which uses to control hardware via internet.

Control by SMS screen: This screen consists of buttons, which uses to control hardware via SMS.

Setting screen: This screen consists of two fields. The first one used to enter IP address and port number as a link. The second one used to enter the telephone number.

About screen: this screen consists of the information page.

CONCLUSION

In this thesis a smart home automatic protection application has been developed for the users so they have an ability to control a smart home by a mobile device. The system gets the commands through a mobile application and then executes these commands into Arduino that are used to control the hardware. With the developed system a user can control and monitor a smart home system. The user can open or close the doors, or the windows, or control a pump, activate or deactivate a fan, control the lights or start or stop the air-conditioning system. The user can monitor the ambient temperature, humidity and gas level. The user can know the door is open or close, the window is open or close, the pump is open or close, the fan is open or close, the light is open or close, the air-condition is open or close and there is motion or not.

The system can run the alarm, open door and window when there is a fire and then activate the water pump automatically for firefighting. The system can run the alarm, open fan and window when there is gas leaking. The user can control system by mobile application through the internet and SMS. The system gives feedback to show the situations via a mobile application and web-based page.

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