Internet of Things (IOT) Based "Smart Homes System"

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Abstract— The Internet of Things is an emerging technology. The technology that has made our world smarter. With the help of the same "Internet of Things" we can transform our daily use home into a "smart home" and use it extensively to make our daily life easier and more comfortable. This paper describes the concept of "smart home". There are many appliances in your home but this paper gives an overview of how you can make your home smart by incorporating those smart initiatives. In a "smart home" a person can handle devices from a certain distance, control them, and this is what the Patient, elderly, and other humans in the home take advantage. Homes in some areas have been transformed into "smart homes" using the Internet of Things, and "smart cities" are emerging. And the country is developing. Similarly, all the type of function, application, security and privacy challenges in this regard are proposed in this paper.

Keywords: Smart Home function, Implementation

I. INTRODUCTION

Nowadays, the home is the safest place in a person's life where a person keeps the highest amount of privacy and personal information. Valuable items like money, jewellery and person's personal information are in that house. Therefore, the future needs to improve the theme of smart home and create new ideas in action. Because the idea of such a smart home in the next human life is not an idea but it will be a relief for all humans. For example (1) Changing the room temperature. (2) Turn the light on and off. (3) To increase or decrease the volume of multimedia entertainment device. Replacing the old locking method with a new digital code locker. wifi, smoke alarm, locker alarm etc. Humans are making many new discoveries in human life. Because our life is trying to find new ways to be comfortable and in the shortest possible time. In addition to making daily tasks easier, it also includes some new ideas to overcome some of the works. In today's world of "smart home" ideas, people control their devices by installing smart devices at home. And for that they incorporate smart devices into the home. There are many types of smart devices. Remote control is widely used in that device. So, man can control that device from some distance from that remote device. Man does not have to go near that device. One of the most active experiments in the "Internet of Things" is the "smart home" experiment. People are often imagining something to convert a normal home into a "smart Home". Peoples also seek information on the internet for smart homes. And companies and start-ups are also investing heavily in this area.

II. MOTIVATION

As a result of the "smart home" initiative, Every home in India should be transformed into a "smart home" soon. A "smart home" depends on the infrastructure of communication and the Internet, from which a variety of new services are created. Thus, IOT is an important factor in creating a "smart home". The purpose of this paper is to propose smart home and to make human life comfortable and convenient.

III. SMART HOME FUNCTIONS

Humans are doing new and small experiments at home. From there, he makes some applications and uses them at home. Its main function is presented in the following application and by making proper use of it, it facilitates many types of functions in human life.

A. Alert

Smart home systems are able to be aware of your environment. And it also sends an alert to the account as it uses it. That alert provides information on environmental data. That information includes different types of environmental factors. For example, the level of the atmosphere, temperature, humidity, light intensity, etc. are included. Regular alerts are also sent in premonition time. And serves to alert the user. Alerts can be obtained through any social media set by the user. for example via email, Twitter.

B. Monitor

This is one of the most important functions of a "smart home". A "smart-home" is able to monitor it. with the help of sensors from various devices and monitoring the home with a camera feed is an important task. Because it keeps an eye on every action in the smart home. Sensors can alert users and take further action or make decisions. For example monitoring room temperature And sending a warning to the user to turn on the air conditioner if the temperature exceeds the threshold.

C. Control

This is one of the many functions of a smart home for the user Allows control over different activities. The following activities can be done through this activity. For example - (1) turning on or off the lights, (2) cooling or humidifying the indoor environment, and many other similar tasks that the user can do at his convenience. For this he can control all these actions from a fixed distance in one place or through remote. At times, some of these tasks are based on user-defined rules automatically performs actions automatically. For example (1) Cooling the temperature by turning on the air conditioning when the room temperature is humid. (2) Humidity if cold. Or shutting down if under control.

D. Intelligence

One of the most important functions of a smart home is home intelligence and refers to the intelligent behaviour of the smart-home Environment. This function is relevant Deciding automatically when an incident occurs Various programs. Home intelligence depends on artificial intelligence (AI) system built into Smart Home environment. Home intelligence doesn't just give the brain but it is also very significant to make a smart home and home security approach. Home intelligence creates an integrated

environment in the smart home in which the artificial intelligence mechanism can identify and suitably react according to changing conditions and events. By identifying abnormal or unexpected events home intelligence can alert user and provide an immediate automatic response if desired.

IV. APPLICATIONS OF SMART HOMES

Although the application area of a smart home is only limited by human imagination, this paper illustrates some of them which are described below.

A. Smart Lighting

Lighting is employed for energy saving that can be achieved by adapting lighting to the ambient conditions and by change on/off or dimming of lights in line with user desires so reducing the supernumerary use of energy. Saving energy conjointly helps in reducing price. The smart lighting may be enforced with Solid State lighting (LEDs) or IP-enabled lights (Internet or wireless controlled). The sensible lighting works by sensing the occupancy, temperature/ humidity and LUX level within the surroundings.

B. Smart Appliances

Smart appliances area unit used for gathering standing information of appliances and to simply management appliances from among the space or remotely. It is also used for programming tasks at predefined time and for runtime integration between appliances. good appliances save energy and time.

C. Intrusion Detection

Intrusion detection is employed for alerting user through email and text message. The intrusion detection application also can send elaborate report with pictures or audio/video clip to the user. The main goal of this application is to observe suspected activity in good home and alert user and take necessary actions for security purpose.

D. Smoke/Gas Detection

This application is employed for sensing the good home atmosphere for healthy living and might also be used for security. This application is employed for optical detection, ionization, and air sampling technique. it's capable of raising tuned in to close to by fire station just in case of fireplace and smoke and to user via email/SMS informing them concerning health risks.

V. SMART HOME ARCHITECTURE FOR SECURITY

The security of the Internet of Things system is becoming a major issue due to the growing number of services and users in the Internet of Things network. The integration of internet of things system and smart environment makes smart things more effective and powerful. However, the consequences of security insecurity of the internet of things are very dangerous in critical smart environments used in areas such as medicine and industry. If Internet of Things-based smart environments do not have strong security systems, those applications and those services could be compromised. The privacy, integrity and availability of applications and services in a smart environment based on the Internet of Things are three key security concepts; Thus, to address this concern, more information security is needed in the Internet of Things systems. requires greater research focus [2]. For example, IoT-based smart homes face security and privacy challenges that span all layers of the IoT architecture. The creation of smart environments in the real world faces two notable barriers: the security of IoT systems and the complexity and compatibility of IoT environments. Attacks such as DoS or DDoS attacks on IoT networks affect IoT services and thus affect the services provided by smart environments. Researchers study the security challenges of the Internet of Things from many different points of view, one of which is the security vulnerability of Internet of Things communication protocols. This survey focuses on IDSs for the Internet of Things paradigm, independent of any specific protocol; thus, this study focuses on the security challenges facing Internet of Things systems on the basis of the IEEE definition and the general IoT architecture.

The security challenges in Internet of Things systems are related to security issues arising in the different IoT layers. Physical damage, hardware failure, and power limitations are challenges faced in the physical layer. DoS attacks, sniffing, gateway attacks, and unauthorized access are challenges relevant to the network layer. Malicious code attacks, application vulnerabilities, and software bugs are challenges faced in the application layer.

VI. SMART HOME SYSTEM IMPLEMENTATION

The application running on Brillo is composed from five services written in C++ that interact with each other in order to achieve the desired security mechanisms. Sensors Services The Light Service is the one responsible for detecting changes in light.

A. Sensor service.

These are definitions from the HAL. The libraries upm and libmraa are used by the HAL to contact the hardware elements. Upm provides software drivers of commonly used sensors. These drivers interact with the hardware elements through libmraa API. This way, sensors usage in application development is very simple. Programmers need to include the corresponding header file, instantiate the sensor class they need and then manipulate the object. The next step is to activate and open the chosen sensor. Then, it starts retrieving data. When it detects changes greater than the default threshold, it means that an unexpected activity is happening. So, it triggers the buzzer from the alarm service.

B. Alarm Service

There is a separate service which implements the alarm mechanism. This Alarm Service is used for controlling the buzzer of this project. It has methods for instantiating the Buzzer object from the upm library which sends information to the hardware device from the Grove Starter Kit. When the other sensor services decide they need to trigger an alarm, they call a StartAlarm() public method from this service which opens the buzzer. It can play either for a certain amount of time or indefinitely, depending on the arguments passed to the buzzer.

C. Lock Service.

For implementing the lock system, this service also uses objects from the upm library. It needs Stepper Motor and GroveRelay in order to trigger a motor movement. The two objects control the stepper motor and relay hardware from Grove Starter Kit. This locking service initializes the objects from HAL, sets the speed and specifies the direction in which the motor move: either forward or backward. This is the basic idea for how it could lock and unlock a real door or window. As it has been presented in this section, each service contains the implementation necessary for controlling their specific hardware component or smart device. All services have their own .rc configuration file which mention their name, where they are located and when they should start. In this manner it is ensured that the operating system has finished all the necessary initializations before staring the smart home services. The smart home application running on Brillo does not have access to any resource from the system like storage or the sensors' drivers. Every required access with a hook in the kernel has to be explicitly allowed through policies [24]. These are specified for each service and are placed in .te files under sepolicy directory from the application. Using this method, the services have access to only the resources they need.

VII. RESULTS AND EVALUATION

Throughout this paper it has been described how to obtain a smart home project which integrates the functionalities of two intelligent appliances, Philips Hue light bulb and Nest Thermostat, and also several types of sensors, buzzers and motors. This system can be controlled from a mobile device with Internet access.

The resulting miniature smart home system is represented by a concept house with small walls made out of cardboard. All the mentioned elements are combined inside the cardboard walls in order to reproduce the smart home features. This is the proof of concept which presents how more types of functionalities from a house can be integrated into a single gateway, the Edison board. It exposes all the available commands in the cloud.

Since it is an open source project, any individual can integrate this system inside their house without having to pay for it. The motors can be attached to doors and windows in order to lock or unlock them and the sensors can be placed in sensitive places inside the house where they could detect unusual events.

Using this project, the user must configure only a single application for setting up the smart home environment. Although some of the appliances used have separate configuration applications on the market, the usage is simplified with the solution presented in this paper. In addition, it offers the possibility of remote home control.

The board application runs on a fast and light operating system designed especially for embedded products. It starts in a few seconds so the user can immediately use its features by connecting the smart appliances and then controlling them. The configuration steps include Internet communication and obtaining the secure parameters for the gadgets registration. Then, users can start exploring the smart home application features.

This solution offers security as well by using Weave protocol for all exchanged data between the board and the web client application. Users must register and then authenticate before accessing the smart home product that is associated with their account. Such a product must be assigned to only one user and then it can be shared with others if this is desired by the main account.

The outcome of the proposed home solution has been analyzed based on the interaction between the user and the end elements: sensors, buzzers, motors and smart appliances. The chosen components behaved as expected during tests. This is a proof of concept implementation of a miniature smart home system which can be integrated inside a real house.

The light sensor is able to detect whether the lights have been opened or closed at any time of the day. Besides this, the value received from this sensor can also inform the owner of the house if they forgot to close the lights.

Detection of other presences inside a room is achieved through the motion sensor. It has an area of impact for up to 6 meters, which is more than enough for a standard room if it is placed appropriately.

Regarding the Philips Hue light bulb usage, there are four parameters which can be changed. One is related to the on and off states of the light and the others reflect the ambient colour: saturation, brightness and hue.

On the Nest Thermostat side, the user can set target temperature. As a result, they can remotely specify to what value the temperature should be at the time they get home. This adds more comfort to the home environment.

With the help of this smart home project, the user has a single application for monitoring light, temperature or other presences inside the house and controlling their door and windows locks. In addition, this solution triggers an alarm when unusual activities are detected.

The application which integrates all functionalities starts in a few seconds after the Edison board gets powered on. This is the result of using Brillo, a lightweight operating system that was developed for IoT products.

On the client side, any type of operating system can be used. The requirement is to support an Internet browser and to have access in the cloud. After the user authenticates in the Weave Developer Console, it can immediately start to control the home security application.

Therefore, using the smart home product described in this paper improves daily home activities without raising security concerns. Users' home experience gets better with minimal configuration steps. It includes different functions meant to cover many aspects present at home which could be remotely controlled.

VIII. Conclusions and Further Improvements

The paper proposes a proof of concept for a smart home system that can be easily adapted to a real house. The miniature house presented in this paper gives a solution for implementing a security mechanism that can be remotely controlled. Besides this, it integrates the functionalities of two intelligent devices for changing light parameters and room temperature through a single interface.

The application can be accessible from any kind of mobile device with an Internet browser access and the correct access rights. This adds flexibility and eases the interaction with the presented application. Since the interface of the application is easy to understand, this project can be used by both system engineers and people with little knowledge in technology.

This paper explains how the smart home mechanism is implemented. Here it is described what physical components it needs, the communication between them, the architecture of the application and details of implementing the mentioned functionalities.

There are other house security systems on the market that also incorporate doors and windows locks, sensors for detecting presence and devices that activate alarms. An advantage that this proof of concept gives is the fact that it is an open source project which can be easily adapted to control elements in a real house.

Regarding the smart devices it uses, this system has another advantage. It creates a single interface for the management of both devices, the thermostat and the light bulb. Therefore, the user needs to access a single application in order to configure their home.

As a conclusion, this paper shows how to connect smart devices into a single entity using Brillo operating system on an Edison board. The presented idea has a flexible and extendable configuration which can easily be adapted to new appliances and features.

Future development of this smart home solution can be concentrated on more areas. On the one hand it could integrate more types of intelligent appliances in order to incorporate various kinds of home activities. In addition to this, on the board device can be developed more features for the currently added devices. These include setting default scenes and themes that automate the smart appliances duties from home based on user's configurations.

The security solution can be integrated into actual products with other functions besides the available ones from the sensors. Users could control their home security without having to install specialized devices from security companies.

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