SHAS-IoT: Smart Home Automation System (SHAS) using Internet of Things (IoT) to Improve Safety and Security

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Abstract: In these days, there are a problem to control our home remotely in case of outside such as turn on or off lights, electrical devices as TV, air condition, open or close the doors, etc., the study offers a solution to develop Smart Home Automation System (SHAS) using Internet of Things (IoT). The proposed model of Smart Home Automation (SHAS-IOT) control elements of your home environment such as lighting, heating and air conditioning, fire control systems and security system include (doors) using any smart phone through particular android application. The main objective of the study is to improve safety, security, expand usability and make life easier for people of all abilities. SHAS-IOT provides high degree of security and safety and energy saving. This includes a description of SHAS-IoT that enable of monitoring sensors and remotely controlling actuators to flexibly construct security and safety services.

Key words: Smart Home Automation System (SHAS), IoT, wireless network, cloud computing, wireless sensors, security

INTRODUCTION

Internet of Things (IoT) plays a one of the most important technologies in these days. It used for connecting everything to the network and made easy to access those things anytime anywhere remotely (Chiang and Zhang, 2016; Gubbi *et al.*, 2013). IoT technology raises in many fields of smart applications. It has not yet found boundary constraints for increasing of this technology. They can be connected through the IoT (Rani *et al.*, 2017; Gubbia *et al.*, 2013). To achieve this goal, we can use IPV6 as the internet of things grows in the next few years, more devices will join that list.

Smart home automation has been gaining importance in recent years. It plays an important application of IoT (Bisio *et al.*, 2017). SHAS-IoT refers to automation of home appliances which can be viewed from security, automatic monitoring and controlling view. Smart home is more than just a remote control for your TV but it means full control in evert thing in the home remotely (Minoli *et al.*, 2017; Yang and Zhang, 2012; Zanella *et al.*, 2014).

By mobile application, you can full control on smart home anytime anywhere using IoT technology. Smart home more exactly describes homes in which closely everything-lights, employments and cooling systems and others are a remotely controlled by mobile application. The major element of home automation based IoT is sensors network, Arduino and mobile application (Mulligan and Olsson, 2013; Huang *et al.*, 2014; Kranenburg and Bassi, 2012). From a home security perspective, this also includes your alarm system, smoke detectors and all of the doors, lighting, cameras and others sensors (Fig. 1). The choice for a particular smart-home system is depending on several factors:

- Financial cost
- Ease of use
- Security
- Safe energy

Fig. 1: Smart home automation systems

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We are focused on monitoring and controlling the home appliances with Arduino. As these devices are cheaper and simpler to use and handle. So, our research solves many problems that we face in these days. We make a system for solving these problems and provide user with the ability to monitor and control of home applications.

Literature review: The literature on smart home automation systems show a variety of approaches. Previous researches such as the following researches.

Raj (2012) combines many communication protocols such as ZigBee, GSM and WiFi into wireless network through a standard home gateway. This home gateway works as a central control unit that manages the overall communication.

Onofre *et al.* (2014) proposes a cooperation method between georeferenced sensors to coordinate the response to events depending of its location.

Liu and Lu (2012) were the first to implement a mixture of environmental sensors. A hidden Markov Model predictable the number of occupants in two office cubicles which were equipped with PIR motion detectors, indoor and outdoor CO_2, air relative humidity, sound sensors and air temperature.

Ganesh and Khan (2015) proposed and developed smart home automation using raspberry pi to performed the five tasks such as records temperatures and changes in temperatures and switch off or on the light and opening and closing of the door for authenticated people.

Peng *et al.* (2015) proposed and developed smart home automation using agent based. They provide by many agents based sensors and actuators cooperate together to complete tasks managed by agents in the task management layer. They have two technical problems. Firstly, cooperation with heterogeneous IoT devices. Secondly, role allocation for security task. To solve these problems, they propose two solutions. Agent-based infrastructure for IHSS using IoT devices and role and task-based dynamic security service.

Many other researchers who are recognized in literature such as Kothandaraman and Chellappan (2016), Kowshalya and Valarmathi (2016), Velusamy *et al.* (2013), Chung *et al.* (2017) and Natasha *et al.* (2007).

MATERIALS AND METHODS

Building SHAS-IoT: The process of building SHAS consists of many hardware devices and software. The hardware enable the remote monitoring (Switching on or off) of electric devices in the home, it will have a fire and
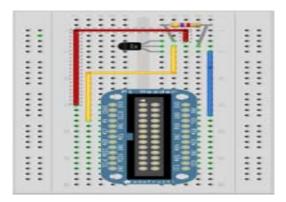

Fig. 2: LM35DZ sensor

sound alarm systems (Minoli *et al.*, 2017; Yang and Zhang, 2012; Zanella *et al.*, 2014; Raj, 2012; Onofre *et al.*, 2014; Liu and Lu, 2012; Ganesh and Khan, 2015). These hardware such as:

- Arduino
- Temperature sensors
- Smoke sensors
- PIR motion sensors
- Light sensors
- Bluetooth
- Relay coil
- Servo motor
- Web cam
- ATX power supply

Software such as:

- Arduino programming
- Android

Arduino: Arduino is an open source, computer hardware and software. Arduino used for construction and interactive objects that can sense and control objects in the real world. The microcontrollers are programmed using the programming languages C and C++.

Temperature sensors: Temperature sensors (LM35DZ) used to detect the room temperature. The LM35DZ "1-wire" sensors can be connected in parallel. All sensors should share the same pins but you only need one 4.7 K resistor for all of them. The chip includes the special 1-wire serial crossing point as well as control logic and the temperature sensor itself (Fig. 2).

Smoke sensors: This sensor used to detect smoke in case of fire. If there is any fire in the home

the smoke sensor will read the amount of smoke and alarm will be turned on and the door will be opened (Fig. 3).

PIR motion sensors: This sensor used to open light in case of there is motion. When any one move in the room it will read the motion and the light in this room will be turned on and the camera will be focused to the room in where the motion.

Light sensors: A light sensor is an electronic device used to detect light. There are several types of light sensors. Photomultipliers detect light and multiply it.

Bluetooth: It is a wireless technology standard for exchanging data over short distance.
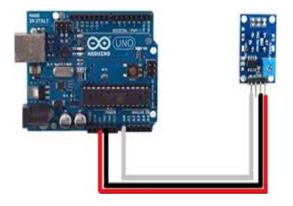

Fig. 3: Smoke sensor

Relay coil: A relay is an electromagnetic switch operated by a small electric current that can turn on or off a much larger electric current. The relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones). Relay coil used to connect between the inputs and the controller (Arduino) (Fig. 4).

Servo motor: Used to secure the door and opened. The shaft typically does not rotate freely round as stepper motor but rotate only 200° or so back and forth. It is used in our system to help us with surveillance camera (Fig. 5).

Web cam: Used to live stream video as a surveillance cam. The biggest and the most obvious benefits of installing security cameras are deter crime, monitor scenarios and activities and gather evidence.

ATX power supply: Used for supply arduino with power.

Approach: SHAS-IoT gives you access to control devices in your home from a mobile device anytime anywhere in the world. Figure 6 shows all objects of the systems. The main objectives of the system as the follows:

- Develop a smart home remote system
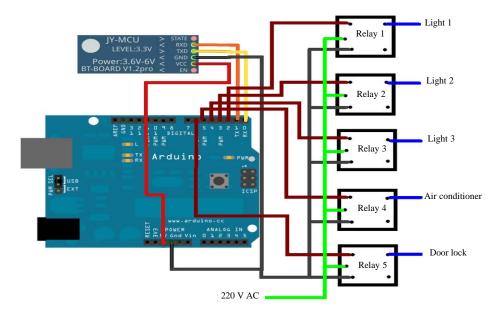- Develop mobile applications for control all component in the smart home

Fig. 4: Relay coil
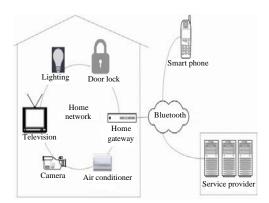
Fig. 5: Servo motor

Fig. 6: SHAS-IoT systems diagram

- Use Bluetooth technologies for communication between mobile application and prototype for the home
- Use devices that are easy to install
- Use low prize material and devices
- Control home doors
- Control home lights
- Fire sensor and alarm
- Temperature and air conditioning

Scenarios for building SHAS-IoT: There are two scenarios for full control on smart home remotely. The first scenario in case of we need full control in everything in the home remotely by mobile application. The second scenario, all sensors works in case there are a person in the home.

First scenario; Smart home remote system: For this scenario, the Bluetooth module will have turned on and begin sending and receiving from the mobile. First you must sign up in the mobile application by personal data then you can sign in now If you chose room one you can control every device in the room by clicking turn in or turn

off. Following figure shows the smart home remote system. In the first scenario the user can do the following tasks and services:

Close door: This service includes the process of closing the door.

Open door: This service includes the process of opening the door.

Open or close lights: This service includes the process of opening or closing the lights.

Launch alarm: This service includes the process of detecting fire then launch alarm.

Detect temperature and open fan: This service includes the process of detecting temperature then opening fan.

Light/motion sensor: This service includes the process of open lights when it is a move in the room.

Sign up: This service includes the process of sign up (adding new user) on the mobile application.

Login: This service includes the process of login by the mobile application.

Second scenario; Smart home (full control automatic within the home): In second scenario, all sensors work in case there are a person in the home. If you enter the home or any room you can see the action happened by sensor for every part in the home such as the following:

Open or close door automatic: The process of closing or opening the door automatically after entering the home.

Open or close lights: This task describes the process of opening or closing the lights.

Launch alarm: This task describes the process of detecting fire then launch alarm.

Detect temperature and open fan: This task describes the process of detecting temperature then opening fan.

Light/motion sensor: This task describes the process of open lights when it is a move in the room.

Detecting fire scenario (smoke sensor and alarm): The smoke sensor and alarm initiates the scenario by smoke sensor detect fire and launch alarm.

RESULTS AND DISCUSSION

We use Bluetooth chip in our application to deal directly with all sensors and control what we want.

Using mobile application: When you open the mobile application, the Bluetooth will be opened and connect it with the Bluetooth chip of the smart home. Firstly, the login page will be appeared.

This page has two buttons the sign in and sign up if you are already a user in the system you should only sign in by entering the username and the password.

After logging in you can control doors, lights, air conditions, fans, sleeping lights and so on. The application makes it easy to work with and control the house easily and remotely (Fig. 7).

After signing up you will be back to main page to sign in with your new account and you will be able to access all of the things inside the application (Fig. 8):

- There are two forms for login the first one is for the admins will be opened
- First the login page will be appeared
- This page has two fields the username and password, if you are already a user in the system you should only sign in by entering the username and the password
- The second page contains 5 activates (select Bluetooth device, room 1-3 and hall)

After choosing the room you wish to control then you are able to perform which order you want to you can control what you want in the system (Doors, windows, light, camera, weather, …).

According to the user who signed in with his username and password the system will recognize if the user is an admin or a member or a guest from his username and password (Fig. 9 and 10). Each one of them (admin, member) has different permissions.

The admin can control anything in the system. Here, is what the rooms will look like from inside (Fig. 11).

Fig. 8: Screenshot of registration for admin

Fig. 7: The main screen of the mobile application

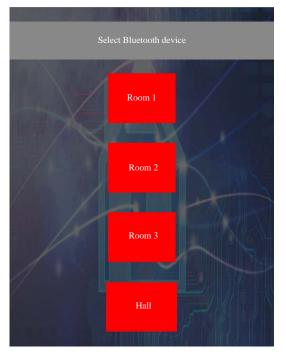

Fig. 9: Screenshot of login form

Fig. 10: Screenshot of the home rooms

Fig. 11: Screenshot for the room in SHAS-IoT

If you aren't an admin of the house you can only manage the first room and the hall. Here what appears to you if you are guest (Fig. 12).
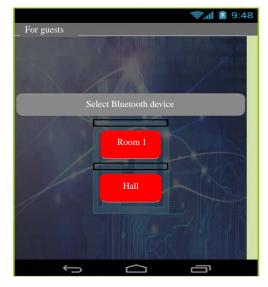

Fig. 12: Screenshot for the guest form

CONCLUSION

SHAS-IoT means combination of all electrical device like smart mobile phone and everything in the home to monitor, control and alert in a smart way. The primary focus is to make safe and secure the home we live in and have information on status of electronic devices we have managed to control our home through a detected system which I can control the lights and know the status and time of each individual light bulb, outlet, air conditioner, temperature, motion, doors, windows and live stream surveillance camera in each room of our home. This proposed system provides many advantages including protection, security, improved ease, energy and cost savings. In order to achieve this goal of flexibility and functionality, a novel, standalone, flexible and low-cost home controlling and monitoring system using mobile application for control remotely present user and the home devices. Performed research have shown that by using the Arduino and android it is possible to control all devices in a home in such a way that user can create his/her own solution customized to meet his/her individual needs. Thus, the proposed system is well from the elasticity, flexibility and security point of view than any other home automation systems.

RECOMMENDATIONS

In future research, controlling manually from webpage can be made, so that, user can have more option in controlling device. Central server system could be developed and through lab view based dashboard,

information can be monitored through gadgets like iPhone, iPad, etc. These features can be added and improved in future research. The future research is to design the detail of task description and to perform a comprehensive evaluation of our SHAS-IoT.

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