

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 and etc., the paper offers a solution to develop smart home automation system (SHAS) using Internet of things (IoT). Smart Home systems, or smart home technologies, are systems and devices that can control elements of your home environment - lighting, appliances, telephones, as well as home security, mechanical, entry and safety systems. They can be used to improve safety, expand usability and make life easier for people of all abilities. SHAS can be operated by electricity or a computer chip using a range of different types of switches. Smart Home is the residential extension of building automation. Smart Home is a central system that can control and create communication between nearly all aspects of your house. This Includes: Lighting, Heating and Air Conditioning, Fire control systems, and Security System include (doors). the paper describes a design of SHAS that capable of monitoring sensors and remotely controlling actuators to flexibly construct security and safety services.

Keywords:

Smart Home Automation System (SHAS) , IoT, wireless network, Cloud Computing, wireless Sensors

1. Introduction

A network of internet-connected objects able to collect and exchange data using embedded sensors called internet of things (IoT) [1], [2]. The IoT refers to the connection of devices (other than typical fare such as computers and smartphones) to the Internet. Cars, kitchen appliances, and even heart monitors can all be connected through the IoT [3], [4]. And as the Internet of Things grows in the next few years, more devices will join that list.

Smart Home is today's one of the most important applications of IoT [5], [6]. Smart Home Automation System refers to automation of home appliances which can be viewed from safety, 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. Examples include programming your DVD to record your private

videos, setting the AC unit to turn on when the temperature reaches 160 degrees Fahrenheit, and installing alarm system that contacts the police in case of a break-in [7-10]. Smart Home gives you access to control devices in your home from a mobile device anytime anywhere in the house using IoT technology. The term may be used for isolated programmable devices, like regulators and irrigator systems, but Smart Home more accurately describes homes in which nearly everything -- lights, appliances, electrical outlets, heating and cooling systems -- are hooked up to a remotely controlled by Bluetooth[11-13]. From a home security perspective, this also includes your alarm system, and all of the doors, smoke detectors, surveillance cameras and any other sensors that are linked to it.

The other main characteristic of cutting-edge Smart Home is remote monitoring and access. While a limited amount of one-way remote monitoring has been possible for some time, it's only since the rise in smartphones that we've had the ability to truly connect to our home networks while we're away. With the right SHAS, you can use any Bluetooth-connected device to view and control the system itself and any attached devices. The choice for a particular smart-home system is depending on several factors:

1. Financial cost.
2. Ease of use.
3. Security
4. Safe energy

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 appliances. There are several devices for such monitoring and controlling. We are focused on monitoring and controlling the home appliances with Arduino. As these devices are cheaper and simpler to use and handle, they are used in co-

operation to widen the work and service functionality and comparatively [14-21].

This paper is organized as follows. Related work is described in Section 2. Hardware and Software used for Building SHAS is explained in section 3. System Setup and Configuration is given in section 4. results and analysis are shown in section 5. Finally, the conclusions are drawn section 6.

2. Related Work

Ventylees [22] combines many communication protocols such as ZigBee, GSM and Wi-Fi into wireless network through a standard home gateway. This home gateway works as a central control unit that manages the overall communication. S. Onofre et al [23] proposes a cooperation method between georeferenced sensors to coordinate the response to events depending of its location.

Dong et al. [24] 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 CO₂, air relative humidity, sound sensors, and air temperature.

[1] Ventylees Raj.S, "Implementation of Pervasive Computing based Highsecure Smart Home System," Proc. of the IEEE International Conference on Computational Intelligence & Computing Research (ICCIC2012), pp. 1 - 8, Dec. 2012.

[2] S. Onofre, P. Sousa, J. P. Pimentão "Geo-referenced Multi-agent Architecture for Surveillance" Proc. of the 16th International Power Electronics and Motion Control Conference and Exposition (PEMC2014), pp. 455 - 460, Sept. 2014.

3. Hardware and Software used for Building SHAS

The process of building SHAS consists of many Hardware devices and Software [14-18]. The hardware that will be implemented will enable the remote monitoring (Switching on or off) of electric

devices in the home, it will have a fire and sound alarm systems [14-20]. Theses hardware such as

- a) *Arduino*
- b) *Temperature sensors*
- c) *Smoke sensors*
- d) *PIR Motion sensors*
- e) *Light Sensors*
- f) *Bluetooth*
- g) *Relay Coil*
- h) *Servo Motor*
- i) *Web Cam*
- j) *ATX power supply*

Software Such as

- o *Arduino programming:*
- o *Android*

a) Arduino

Arduino is an open source, computer hardware and software, and user community that designs, and manufactures microcontroller kits for building and interactive objects that can sense and control objects in the real world. Arduino board designs use a variety of microprocessors and controllers. The microcontrollers are programmed using the programming languages C and C++.

b) 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 4.7K resistor for all of them. Although the LM35DZ just looks like a regular transistor, there is actually quite a lot going on inside.

The chip includes the special 1-wire serial interface as well as control logic and the temperature sensor itself.

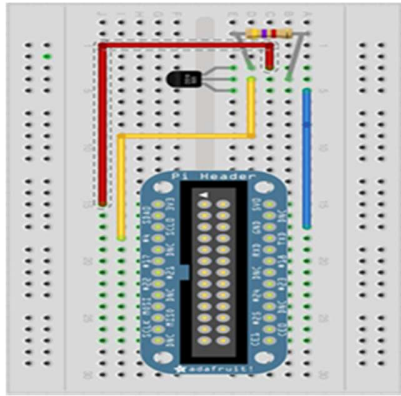


Figure 1: LM35DZ sensor

c) 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

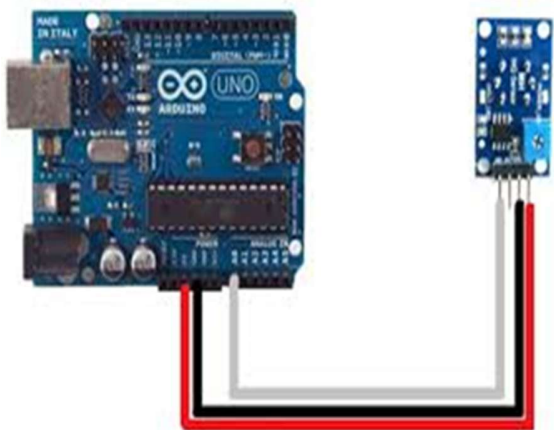


Figure 2: Smoke sensor

d) 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.

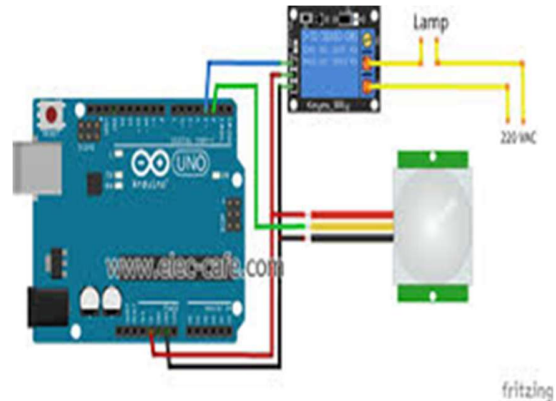


Figure 3: PIR Motion Sensor with LED Light

e) Light Sensors

A light sensor is an electronic device used to detect light. There are several types of light sensors. A photocell or photo resistor is a small sensor which changes its resistance when light shines on it. A CCD (charged coupled device) transports electrically charged signals and can be found in digital cameras and night-vision devices. Photomultipliers detect light and multiply it.

f) Bluetooth

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

g) 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)

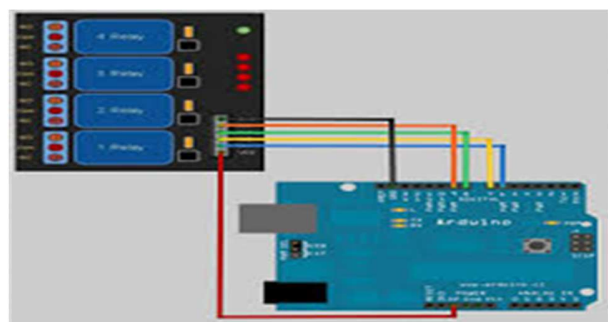


Figure 4: Relay Coil

h) Servo Motor

Used to secure the door and opened. the shaft typically does not rotate freely round as stepper motor but rotate

only 200 degrees or so back and forth .It is used in our system to help us with Surveillance Camera

i) *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

j) *ATX power supply*

Used for Supply Arduino with power

4. System Setup and Configuration

SHAS-IoT gives you access to control devices in your home from a mobile device anytime anywhere in the world. From a home security perspective, this system also includes your alarm system, and all of the doors, windows, locks, smoke detectors, surveillance cameras and any other sensors that are linked to it. The following figure shows all objects of the systems.

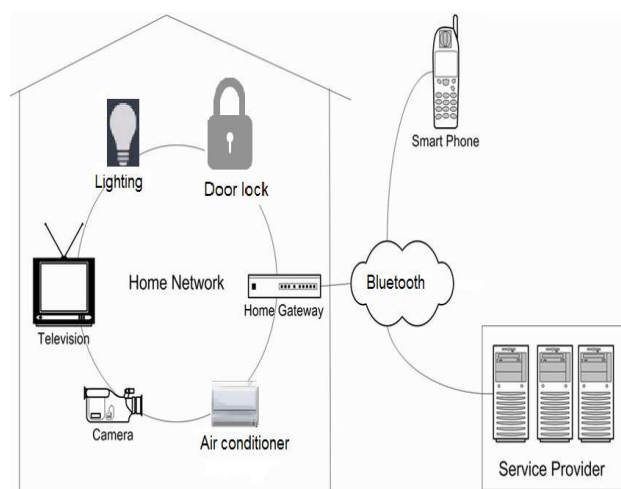


Figure 5: SHAS-IoT systems diagram

The main objectives of the system as the follows

1. Develop a Smart Home remote system
2. Develop mobile applications for control all component in the smart home
3. Use Bluetooth technologies for communication between mobile application and prototype for the home
4. Use devices that are easy to install
5. Use low prize material and devices
6. Control home doors

7. Control home lights
8. Fire sensor and alarm
9. Temperature and air conditioning

4.1 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

4.1.1 First Scenario: - Smart Home Remote system

When we use first scenario the Bluetooth module will 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 devices in the room by clicking turn in or turn off. Following figure shows the Smart Home Remote system



Figure 6: Smart Home Remote System

In the first scenario the user can do the following tasks and services

1. *Close door*

This service includes the process of closing the door

2. *Open door:*

This service includes the process of opening the door

3. *Open or close lights:*

This service includes the process of opening or closing the lights.

4. Launch alarm:

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

5. Detect temperature and open fan:

This service includes the process of detecting temperature then opening fan.

6. Light / motion sensor:

This service includes the process of open lights when it is a move in the room

7. Sign up

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

8. Login

This service includes the process of login by the mobile application

4.1.2 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

1. Open or Close door automatic:

the process of closing or opening the door automatically after entering the home

2. Open or close lights:

This task describes the process of opening or closing the lights.

3. Launch alarm:

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

4. Detect temperature and open fan

This task describes the process of detecting temperature then opening fan.

5. Light / motion sensor:

This task describes the process of open lights when it is a move in the room

6. Detecting fire Scenario (smoke sensor and alarm)

The smoke sensor and alarm **initiates** the scenario by Smoke sensor detect fire and Launch alarm

5. Results and Analysis

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

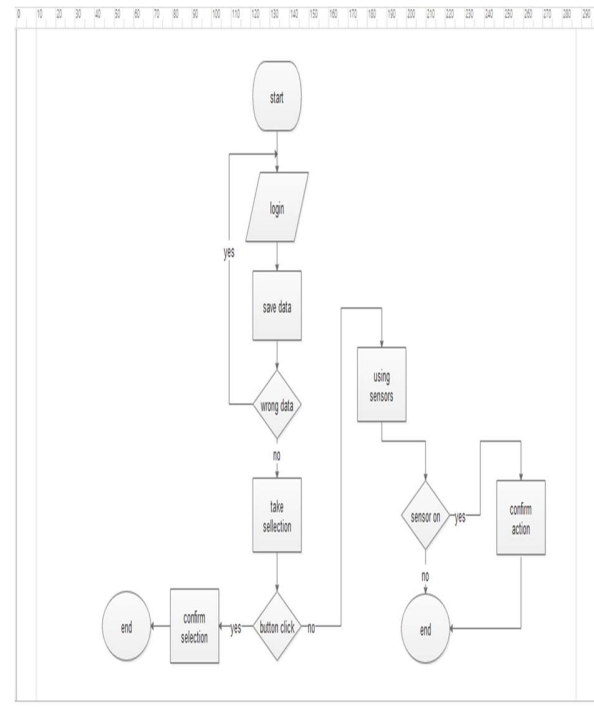


Figure 7 : Flow chart diagram for the systems

Opening the 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.

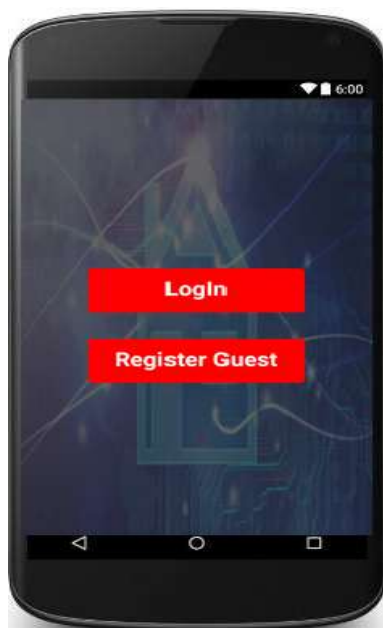


Figure 8 : The main screen of the mobile application

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.

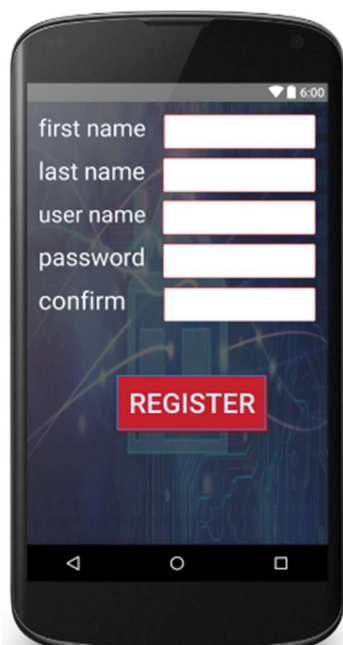


Figure 9 : Screenshot of registration for admin

- 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.

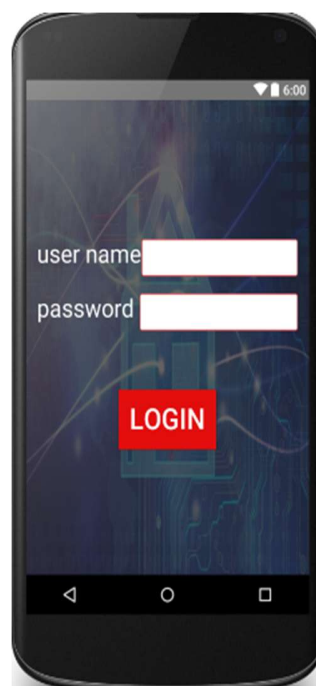


Figure 10 : Screenshot of login form

- The Second Page contains 5 Activates:-
(Select Bluetooth Device, Room1 ,Room2, Room3, and Hall)

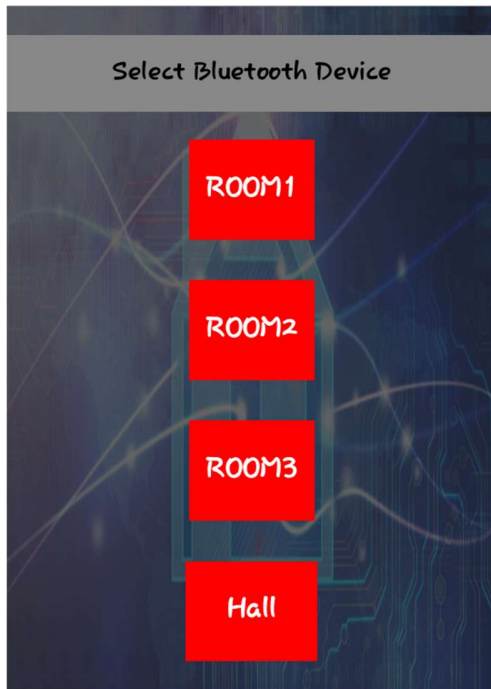


Figure 11 : Screenshot of the home rooms

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. 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:



Figure 12 : 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 :

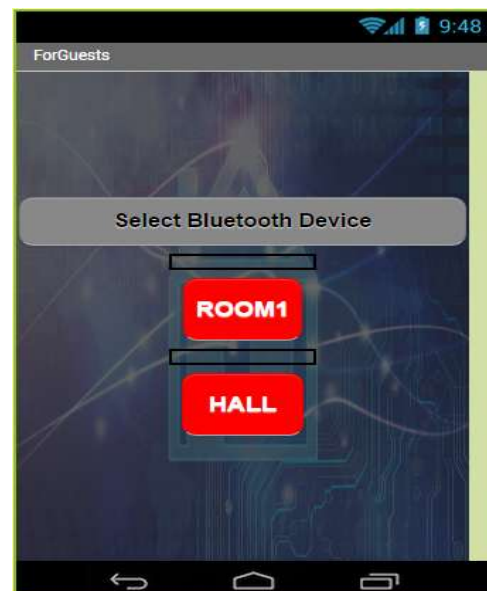


Figure 13: Screenshot for the guest form

6. Conclusions and Future Work

We proposed an SHAS using IoT devices, and showed some results using the experimental system with aim of monitoring, logging and controlling home appliances. 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. As prime target of system, some sensors were monitored and then used the information for controlling devices. in future work. 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 work. The future work is to design the detail of task description and to perform a comprehensive evaluation of our SHAS-IoT.

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