

# Intelligent and Secured Software Application for IoT Based Smart Home

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**Abstract**—As saving the energy inside a house is an important issue to address, more home appliances are now implementing IoT technology. Here, we propose an IoT based smart home software application that are able to intelligently control the home appliances automatically based on our instruction set or behavior. The smart home uses the software to receive input from the user and forward the input to the server or host. In addition to receiving input from the user, the smart home software is also used to display all information about the house condition to the user. The smart home system uses AMQP as the communication protocol between software, server, and host. To ensure the security, all of the communication data is encrypted by the system using either RSA or AES algorithm.

**Keywords**—smart home; IoT; AES; RabbitMQ; RSA

## I. INTRODUCTION

Nowadays, a secure and comfort house are hard to get. Another problem is the energy. Inside the house, there is often a waste of energy by letting the appliances turned on without being used. By using smart home systems, users can easily monitor and control the device inside the home, improve home security by enabling home locking systems based on user location, and monitor the energy usage of each devices.

The smart home system uses Internet of Things (IoT) technology. IoT technology utilizes the internet to be able to exchange data and communicate. The use of IoT on smart house systems is based on the ease of every user in accessing the internet. By using IoT technology, users can access all devices in the home anytime and anywhere through mobile devices as long as the mobile device is connected to the internet [1]. Therefore, by using a smart home system, users can enjoy the ease in monitoring and controlling the house in real time.

## II. SOFTWARE DESIGN

Smart home system software is designed based on Android operating system. Android has been chosen to be the smart home application operating system with the consideration that Android is now the operating system that is largely used for mobile devices as well. With this consideration, the smart home system is expected to attract more users to use the system. By using Android operating system, software is made of two main files, java and XML file. Java file is used to

manage whole applications, while XML file is only used to set the display of each activity on the Android application. The software consists of many activities. Each activity can access another activity by using an Intent function as activity changer in their own java file. The software structure is shown in Fig. 1.

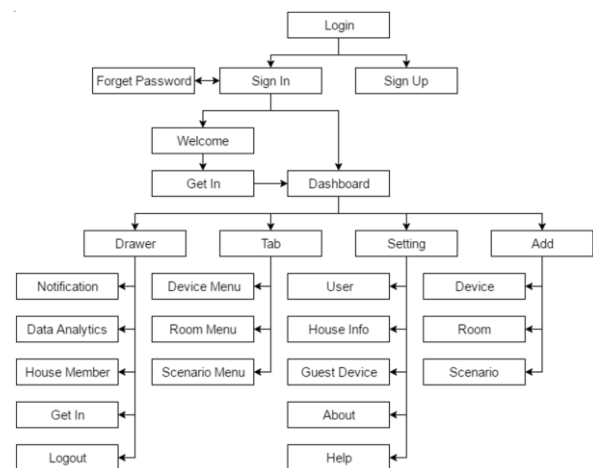


Fig. 1. Smart home software structure.

Smart home system has eight features to help users to increase the security and convenience level, while reducing the house energy usage. Followings are the description of each features.

### A. Device Category Feature

By using device category feature, each device can be categorized by device type and location of the room of each device. This feature eases every user to control or monitor devices at home. There are six different type of devices, lamp, curtain, door, switch, temperature, and fan. Room category can be created by user manually.

### B. Scenarios and Scheduling Feature

This feature allows user to activate multiple devices in one time. Scenarios can be added by a user by inputting the name and status of a device. When the scenario is registered, the user can activate the scenario by pressing the power button on the scenario list. Scenarios can also be activated automatically each day if the user input the activation time of the scenario in the input column.

Automatically activated scenarios are also called scheduling. Scheduling feature can be used to set scenario automatically as a daily routine. By using this feature, users can also save the energy usage in the house by turning off devices such as lights or Air Conditioner automatically in the morning.

### C. Notification Feature

There are two types of notification: normal and warning notification. Normal notification is a notification about adding, changing or deleting device, room, scenario or member. Meanwhile, warning notification occurs when the house is in a locked state and the system detects a command to change the status of a device without opening the home status first. Users can lock and open the house anytime and anywhere through this application. To lock the house, the user can activate the lock scenario. To open the house, the user can use unlock scenario. When a warning notification is sent, the system indicates someone else is trying to hack the user's smart home system.

### D. Member Privilege Feature

Member privilege is used to distinguish the user's authority status in controlling the device inside the house. Thus, only trusted users can control every device in the home so this feature can increase the security in the home. The smart home system has two types of privileges: admin and guest. Admin can control all devices in the house, while guest can only control the devices permitted by admin.

### E. Usage Data Monitoring Feature

Usage monitoring data will display the duration of device usage data in the house. The device duration data is displayed on a curvature graph with a vertical axis, the duration of device use and the horizontal axis is the date of device use. With this feature, users are expected to be more efficient in using the device in the house. Therefore, this feature can be utilized in order to save energy.

### F. Network Security Feature

The encryption uses two algorithms: RSA and AES. AES is more secure than RSA [2], but to do the communication, system needs RSA because RSA has a pair of static keys known to both parties [3], while the key for AES encryption is a dynamic key that always changes when the user signs in and when the user logs in within 24 hours. Dynamic key on AES encryption aim to improve security so that hackers are more difficult at hacking home network security systems.

### G. QR Code Scanning Feature

To add new devices to the smart home system, users only need to scan the QR code listed on the device using the QR code scanning feature. Once successfully scanned, the smartphone gets the code of the device. The system will send the device protocol data and device type in encrypted form to user's smartphone.

### H. Auto-Lock Feature

Auto-Lock is a feature that can be used to activate the lock scenario automatically based on the user's smartphone location. Scenario lock is like an ordinary scenario so it can be modified,

but it is the only scenario that can be automatically activated based on location. It is automatically activated when all users are outside the home radius. The specified home radius is 100 m with the consideration that the common house area is smaller than 16.180 m<sup>2</sup>.

## III. SOFTWARE IMPLEMENTATION

The software is tested using Asus Zenfone 2 ze551ml, Xiaomi Mi4i, Samsung Note 4, Samsung Note 5, Samsung Galaxy S7, LG Stylus 2, and also an emulator on Android Studio (Nexus 5). Testing is conducted by accessing each activity and testing the function of each component on the page as well as testing every feature that has been designed. Fig. 2 shows the software user interface comparison on Asus Zenfone 2 ze551ml and Nexus 5.

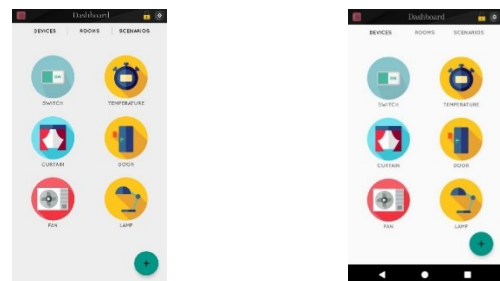


Fig. 2. Dashboard menu on a) Asus Zenfone 2 ze551ml and b) Nexus 5.

After testing, Xiaomi Mi4i shows slower access time in opening the dashboard page compare to Asus Zenfone 2. This result is due to lack of RAM remains on Xiaomi Mi4i when running smart home software. However, moving pages and feature testing runs smoothly as expected [4].

## IV. CONCLUSIONS

Smart home software that can monitor and control all devices in the house in distance and real time has been designed. Users can use every smart home system feature and monitor the device through the smart home system software operated on Android. By using the software, user can control the devices automatically based on our setting or behavior. Thus, it can efficiently save the energy usage in the house and increase the user convenience.

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