

Controlling Home Automation Using Android Platform

Dafer Rzok Saker¹, Surah Adel Mahmod²

¹Law College, University of Al Muthanna, Al Muthanna, Iraq

²Chemical Engineering Department, Engineering College, University of Al Muthanna, Al Muthanna, Iraq

ABSTRACT

Smart Home is the residential extension of building automation and concerns the control and monitor of lighting, heating, ventilation, air conditioning (HVAC), appliances, and security. Smart systems usually consist of switches and sensors connected to a central hub often called a "gateway" where the system is controlled by a user interface that is communicate either with a wall-mounted terminal, mobile phone software, tablet computer or a web platform. However, smart home field is still heavily fragmented due to the very few world-wide standards that have been accepted in industry. In many competing operators common protocols of products include X10, Ethernet, Wi-Fi, ZigBee and Z-Wave, or other proprietary standards all of which are incompatible with each other. In this paper, we will make a comparison between these standards in order to choose the best protocol or standard in designing and deploying a Smart Home with remarkable features such as remote control, energy-efficient, and high scalability which provide both comfort and security to the consumers. This system will assist and give support to families, individuals, and elderly with disability or physical limitation or health issues in order to fulfill their needs of and in home. In this paper, we will analyze which standard makes the best fit for our proposed module and android based home controlling system for security, safety and healthcare for users. The existing system using protocols that provides either security and safety system or healthcare system but this project will give combination of these two systems. This system has more flexibility and can be deployed in many research areas. This paper illustrates a smart home system which could monitor and control household appliances remotely and realize real-time monitoring of home security status through mobile smartphone.

Keywords: Smart Homes, android phone, Bluetooth, SDK, Wireless communications, ZigBee technology.

I. INTRODUCTION

The "Home Automation" concept is a brand new approach of wirelessly controlling the home appliances. The terms "Smart Home", "Intelligent Home" is associated with this kind of system and has been used to introduce the concept of networking appliances and devices in the house. Smart homes and home control systems idea have developed along with the development of technology and the continuous improvement of people's living standard. Home automation Systems (HASs) represents a great research opportunity in developing new studies in the fields of engineering, architecture and computing. People with Disability are could be facing more problems in their daily life than other healthy people. Moreover, people with hearing issues cannot hear the doorbell; people with

Alzheimer illness can forget the gas open in the stove. For that kind of people, smart home technology has helped them to overcome their life difficulties. Automated homes can provide assistance, comfort, and safe, as well as securing and empowering environments around disabled people. The users can manipulate appliances anytime, anywhere, letting our houses become more and more automated and intelligent. The Smart Energy initiative serves these needs by providing an adoptable and sustainable experience by linking new and useful digital technologies to the needs of consumers. By empowering consumers with near real-time information of their energy usage through an array of products and services, the intent is to help consumers use energy more efficiently and also to minimize their personal impact on the environment.

Neng-Shiang Ling has presented architecture for home automation [1] where the system is based on a dedicated network. This system depicted how to solve home automation problems at the software level and no hardware aspects were included. Yavuz and Hasan [2] presented a telephone and PIC based remote control system. Other studies such as those presented in [3] [4] give examples of web based home automation system. Another PC based home automation system for appliances control was proposed by Sriskanthan [5]. However, the system cannot be controlled by a mobile/cell phone. R. Piyare proposed a Bluetooth based home automation system using cell phone [6]. Due to the advancement of wireless technology, there are several different protocol connections are introduced such as GSM, WIFI, ZIGBEE, ETHERNET, and Bluetooth. Each of the technology has their own special characteristics and deployment. In this paper we will review each protocol features trying to choose the one with the suitable capability features.

II. METHODS AND MATERIAL

1. System Architecture

A. System overview

In this paper we will illustrate a smart home environment which will be remotely controlled and monitored via using a low cost smart home system. An overview of the proposed system architecture is illustrated in Figure 1. The system mainly composed of a mobile smartphone; an app developed using the Android platform, a wireless connection, and based micro web-server. The microcontroller is the main controller that connects the micro web-server and carried out all the necessary operations that needs to be. The sensors and actuators/relays are directly connected to the main controller. The smart home app enables the smart home environment to be controlled and monitored from different remote areas. Finally, on the consumer device any internet connection such as Wi-Fi, 3G/4G network, ZigBee, Bluetooth, or X10 can be used. The features that the proposed design offers are the control of energy

management systems such as lightings, power plugs and HVAC (heating, ventilation and air conditioning) systems; security and surveillance system such as fire detection and intrusion detection with siren and email notifications; automatic smart home environment control such as maintaining a certain room temperature; voice activation for switching functions and has user authentication to access the smart home system [8].

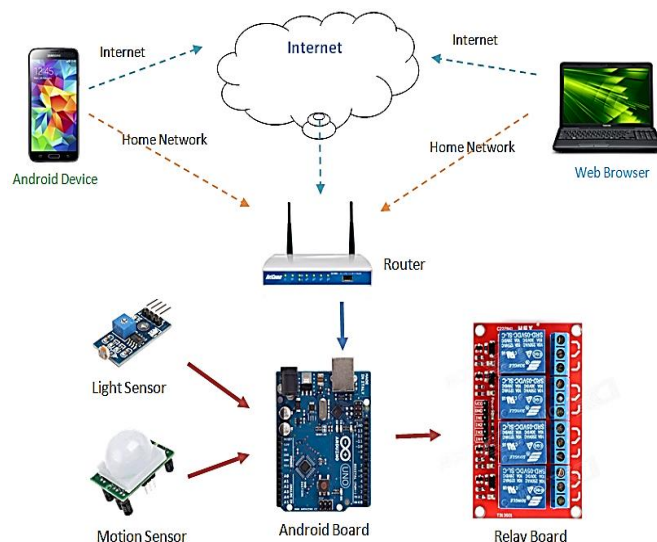


Figure 1. Smart Home System Architecture

B. Hardware design

This section will focus on the hardware construction of main control board. Fig 2 demonstrates the hardware block diagram in the main control board. In the home automation system the main hardware components are the Smart Phone, the Microcontroller Board, the Bluetooth module connected to the Microcontroller board and relay switches that delivers the electricity to the appliances. PIC Microcontroller, PIC18F2550 is deployed because of its ability to perform both serial and USB features in order to achieve the wireless and USB connection to the GUIs. A HSM-20G Sensor Module is deployed due to its low cost 2-in-1 combination of humidity and temperature modules. The other components that are also present include LCD display, Real Time Clock (DS1307), Temperature sensor (LM35), and Light Dependent Resistor (LDR).(9).

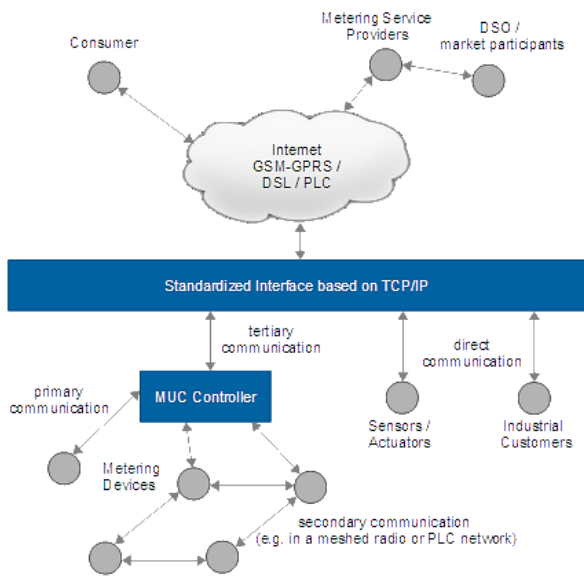


Figure 2. Hardware block diagram.

C. Software design

For the software part, an Android platforms above API level 8 (Gingerbread or higher) is needed as the main application for Android Smart Phone in order to be coded in the environment of Eclipse Indigo IDE. The development kit used to program on Eclipse Indigo IDE is the ANDROID SDK which is developed by Google, Inc. The development environment for a visual programming language will be LabVIEW platform (short for Laboratory Virtual Instrumentation Engineering Workbench). The aim behind using such program is to monitor the usage of processing and measure the equipment in any laboratory design. LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of interface including Microsoft Windows, different versions of UNIX, Linux, and Mac OS X. We are using LabVIEW as key software which is installed in the controlling PC under the name "SERVER" and must be "ON" at all time. The LabVIEW starts to work when a message is been received. After that, LabVIEW will decode the message into code and compare that code with the other already saved passwords or codes. In case the comparison of that code is true LabVIEW transmit the signal through parallel port in order to switch the specific device into "ON" statue. The software LabVIEW is basically gives certain output on the basis of certain input conditions according to the programming.

D. Android Application

A smart home app, usually known as a house automation app or a smart home automation app, is an application used to remotely control and monitor connected non-computing devices in the house, practically from a smartphone mobile or tablet. Smart home apps might be used for a single-purpose, for instant adjusting smart light bulbs in order to automate and control a home's lighting system. Beside lighting, other appliances in a smart home that smart home apps able to automate and manage include heating and air conditioning, entertainment systems, doors and windows, window coverings, security systems, water sprinkling and more. Systems and environments around smart homes could be monitor as well with the use of the appropriate sensors. Moreover, multiple systems within the home are communicating with each other via a home automation hub in order to be controlled and managed by smart home apps. Smart home starter kits, could be found in many different vendors, including all the necessary components to monitor and control systems in the home: sensors, networking, the connections hub and the mobile smartphone app.

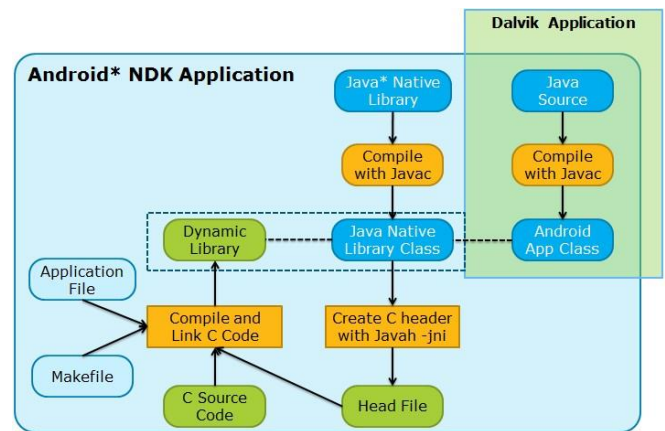


Figure 3. Android Application

Groups of actions are usually allowed to the costumer for particular situations Smart home apps can offer. For example, a saved scenario called "Leaving for work" might include locking the doors and setting the security system, as well as adjusting the heating/cooling, window coverings and lighting, while a scenario called "Coming home from work" might reverse those processes. Java language is used for writing Android applications language. All the necessary tools which used to develop Android applications (API) can be found in the Android

Software Development Kit (SDK). Examples on these tools include a compiler, debugger and a device emulator, as well as its own virtual machine (emulator) to operate Android programs. The purpose of these tools is code compilation and packaging data and resource files into an archive file with ".apk" extension called as an Android package. In installing an application the ".apk" file form is used in Android devices.

2. Home Automation Protocols

Smart home can be built with many different technology platforms, or protocols. Each one of these protocols has its own language. Each language signals to the various connected devices and order them to perform a function. Choosing a smart home platform sometimes can be tricky business. Consumers always desire in choosing a standard or protocol which is capable of supporting a large number of devices, offering the best possible device interoperability (the ability for devices to talk to each other), power consumption, bandwidth and cost. Following is an overview of some of the most common home technology protocols on the market.

1- X10

The granddaddy of home automation protocols, X10 protocol has been around since the mid 70's. At first it was used as a powerline-based system (meaning it's hard-wired into your walls), but lately went wireless. It's not known for great speed or communication between units and difficult to install.

2- UPB

Universal Powerline Bus has been used in powerline communication protocol after x10 protocol due to its higher voltage and stronger signal. However, it can be used as powerline only making this protocol rather expensive and hard to install as well.

3- INSTEON

Insteon is a new home automation protocol designed to transform the powerline-based standards into wireless protocols making it able to be used with both. It's also appropriate with x10 devices, so it's not a bad choice if you've already own a home installed with X10 protocol and are looking to transform to wireless.

4- Z-WAVE

Z-Wave is a wireless home automation protocol which operates under frequency band of 908.42MHz. The Z-Wave Alliance group now boasts more than 1,000 various compatible devices, giving you a wide range of options when it comes to automating your home. This protocol main feature is the ability to utilize a type of network called a "mesh network," which essentially means that one Z-Wave product will transmit the signal along to another one until it arrive its planned destination. Another advantage is its extremely low power, which is excellent for devices that run on battery power.

5- ZIGBEE

IEEE has built an 802 wireless communication protocol called "ZigBee". Like Z-WAVE protocol, it has the ability on consuming a very small amount of power and using a mesh network structure. Moreover, ZIGBEE offers an excellent range and speedy communication between devices.

6- WI-FI

It's not surprising that a wide range of manufacturers have begun making smart home devices that work with WI-FI protocol. A hub/access point is not essential when you already have a wireless router in order to connect the devices together. Otherwise, WI-FI protocol comes with one key drawback: interference and bandwidth issues. For example, if your home is already full of Wi-Fi-connected devices such as (TVs, game consoles, speaker docks, laptops, phones, and tablets) then your smart devices will have to compete for bandwidth resulting slower ability to respond. Wi-Fi consumes a lot of power as well, so it's not ideal for battery-based smart devices such as doorbells and locks.

7- BLE

BLE is short for Bluetooth Low Energy technology. Almost every device comes with Bluetooth technology backed with it such as locks to light bulbs to speaker docks. Bluetooth technology protocol is sometimes used in home automation, but not as the main protocol. Its features a low power consumption but also has a limited

range compared to other networking protocols, so it's not great for devices that need to stay connected all the time like security systems and motion sensors.

III. RESULTS AND DISCUSSION

The question here is which protocol should you go with in designing your smart home? In smart homes, high-bandwidth is not required due to the signals that are sent by home control devices are very simple such as simple on/off and state-change signals. System networking with such signals kind, Wi-Fi protocol or Bluetooth would be overkill. Regarding the low power consumption and bandwidth requirements, both ZigBee and Z-Wave protocols make a remarkable fit for our system. This makes for much more efficient devices, and reduces the amount of "background noise" in a residential or light commercial structure that is already awash with signals on virtually every part of the radio spectrum. In addition to the lower power, ZigBee networking system has the ability on covering large areas due to its mesh topology. As a result, ZigBee is the best global, standards-based wireless approach that can conveniently and affordably control and manage the widest range of devices providing comfort, security and convenience for users. It is the technology of choice for world-leading service providers, installers and retailers who bring the benefits of the Internet of Things into the Smart Home.

IV. CONCLUSION

Smart Home concept has become reality at last, enabling home owners to monitor and control a different type of helpful applications such as energy efficiency, access control, security, home monitoring and home care. In any Smart Home all appliances will be controlled and integrated via smart sensors. For instant, the security system can be integrated along with the lights control system by using one motion sensor for both. This sensor will switch off the lights when a room is empty and has no motion in it. The same motion sensor, when the home security system is on, can be used to send an alarm if someone breaks in and is moving throughout the house. In the near future, in the "Really Smart Home", ZigBee communication standard is the one that has been used for that purpose. Every appliance will run under the same open, and the different sensor applications will be integrated, connecting their intelligence resulting in

building the real Smart Home that does not require human interaction. ZigBee is the language for a wide variety of smart home devices so companies can deliver an integrated ecosystem of home monitoring, energy management, heating and cooling, security and convenience devices.

Today, ZigBee is used by a variety of cable and telecommunication companies including Comcast, Time Warner Cable, EchoStar, DirecTV, Charter, Rogers, Deutsche Telekom, and Videocon. These companies are using ZigBee in their set-top boxes, satellite transceivers and home gateways to deliver home monitoring and energy management solutions to their customers. This system can be developed for future purposes to include any type of home appliances such as refrigerator, oven, washing machine, temperature of room, doors, lights, and other. This will definitely help people with disability, elderly, people with health issues with their needs.

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