Home Automation Through Remote Monitoring And Mobile Applications

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Abstract— Home automation refers to the use of computer and information technology to control home appliances and features. Systems can range from simple remote control of lighting through to complex computer/micro-controller based networks with varying degrees of intelligence and automation. Home automation is adopted for reasons of ease, security and energy efficiency. One or more human-machine and/or machine-to-machine, interface devices are required, so that the residents of the home can interact with the system for monitoring and control; this may be a specialized terminal or, increasingly, may be an application running on a smart phone or tablet computer. The home automation system uses Zigbee and Wi-Fi network that are integrated through a common gateway. The dedicated gateway provides network interoperability, a simple and flexible user interface, and remote access to the system. The system is scalable and allows multi-vendor appliances to be added with no major changes to its core.

Key words—Home Automation, Cubie tech, Zigbee, Android, WiLan

I. INTRODUCTION

The home automation is the introduction of technology within home to enhance quality of life of its occupants, through the provision of different services such as telehealth, multimedia entertainment and energy conservation. In recent years, the quantity of network enabled digital devices at homes has been increasing quick. In this paper, associate automaton primarily based home automation system that enables multiple users to regulate the appliances by associate automaton application or through an internet web site is conferred. The system has an area device to transfer signals to home appliances, and a mobile good device running automaton application. The example implementation of the planned system is evaluated supported the factors thought-about when the need associate ana lysis for an adequate home automation system.In other words, home automation aims the orchestration of digital devices to provide users with real comfort together with security and ability to monitor multiple dwellings . Traditional home automation systems involve the control of digital devices which provide the functions such as heating, lighting and shading. But due to the rapid growth of information technology and modern entertainment systems in recent years, these

primary functions are expected to be enriched with additional services (i.e., the stereo reducing volume when the telephone rings).

The benefits of home automation systems (the smart house systems) are listed as safety, comfort, power saving and communications. As the systems provide these benefits, some technical requirements must be also respected such as low cost, plug and play, flexibility, easiness of use and reliability.

In this study, a home automation system, which provides two alternative user friendly interfaces, an Android application and a gateway application, is presented. The system is built to serve multiple users, using up-to-date and emerging technologies, in order to support the communication between the main hardware components of the system. In the following sections, the pros/cons of the employed technologies in the literature are discussed first and then the details of the proposed system architecture are given. After listing the analysis and evaluation criteria for an adequate home automation system, the paper is concluded with the possible future work comments.

II. PREVIOUS works

There has been a significant research and numerous approaches for the home automation systems. In [4], X10 industry standard, developed in 1975 for communication between electronic devices, is identified as the oldest standard in home automation systems by providing limited control over household devices through the home's power lines.

Recently the home automation becomes a popular field of Research by the introduction of different technologies such as remote control systems, network enabled devices and internet technologies. In [5], a Bluetooth based home automation system is presented. The system involves a primary controller and a set of Bluetooth sub-controllers in which each controller is physically connected to an individual home device. The sub-controllers are responsible to send all messages to primary controller. Although the system reduces physical wiring through the

use of Bluetooth technology it has the disadvantage of incurring an access delay due to the sharing of a single Bluetooth module between numerous devices.

In a Java based home automation system, developed in [6], an embedded board which is integrated into a personal computer based web server is physically connected to all home devices. Java technology used in the system provides a built in security. However, the use of a high end computer and the wired installation per

In [4], after discussing the potential of ZigBee standards in home automation systems, a home automation system based on ZigBee and Wi-Fi network is presented and a virtual home is constructed. It is reported in the study that the ZigBee technology has advantages such as lowering the expense of the system and intrusiveness of the respective system installation compared to existing technologies over the virtual home.

In addition to aforementioned systems which offer different technologies in construction of home automation systems, in several other studies (i.e., [8]) different techniques are presented to improve the home automation. In [8] a data mining method is presented. In the proposed method, regularly occurring device usage patterns are discovered to improve the system performance.

Though the publicly available industrial research in the area of home automation systems is limited, there are several instances developed in different countries by different companies [9], [10].

A System Architecture

The whole infrastructure design as a top-view communication diagram of the home automation system is given in Fig. 1

III. SYSTEM ANALYSIS AND DESIGN

This section presents the architecture of the proposed home automation system implemented through the project research period and describes the approach and the systematic design of the project phases. At first, related to the system architecture part, the main components of the proposed system are pointed out with diagrams depicting the communication infrastructures where those parts are in-use. Each different part is briefly explained in different subsections. At second, the analysis and design criteria of the system delivered at the output of the analysis phase of the project and taken into consideration at the beginning of the implementation phase are listed as the viewpoint of the system designers. he proposed system uses an ARM controller to physically manage the home appliances. The prototype implementation of the proposed system uses an alarm triggered by smoke sensor, a lamp triggered by automatic switches controlled by home automation system application, and an air-conditioner representing the changes in home climate. More physical appliances could be integrated to system on demand.

home increases the expense of the system.

An interesting system, phone based remote control system, is proposed in [7]. Unlike the numerous systems using the internet, the communication in the system is all performed over a fixed telephone line. The advantage of the system is that it can be accessed via any telephone. On the other hand, the lack of graphical user interface, the necessity to remember the user access code and the device codes   can   be   listed   as   the

A. *System Architecture*

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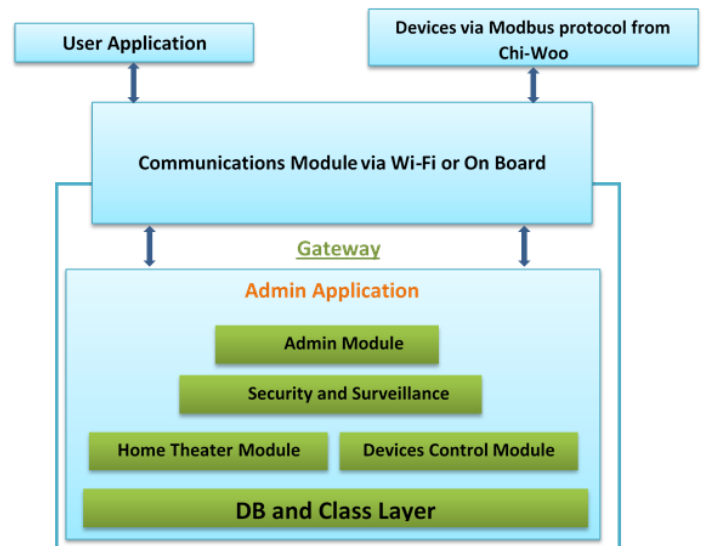

Figure 1: System Architecture

B. Local Hardware

1) Cubietruck (Cubieboard3)

The third version has a new and larger PCB layout and features the following hardware:

SoC: Allwinner A20

CPU: ARM Cortex-A7 @ 1 GHz dual-core

GPU: Mali-400 MP2

display controller: unknown, supports HDMI 1080p, no LVDS support

2 GiB DDR3 @ 480 MHz

8 GB NAND flash built-in, 1x microSD slot, 1x SATA 2.0 port (Hard Disk of 2,5").

10/100/1000 RTL8211E Gigabit Ethernet

2x USB Host, 1x USB OTG, 1x CIR.

S/PDIF, headphone and HDMI audio out, mic and line-in via extended pins

Wi-Fi and Bluetooth on board with PCB antenna (Broadcom BCM4329/BCM40181)

54 extended pins including I²C, SPI
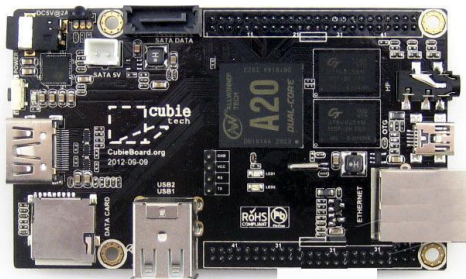
Dimensions: 11 cm × 8 cm

Figure 2: CubieTruck ARM 2 GHZ

There is no LVDS support any longer. The RTL8211E NIC allows transfer rates up to 630–638 Mbit/s (sending while 5–10% idle) and 850–860 Mbit/s (receiving while 0–2% idle) when simultaneous TCP connections are established (testing was done utilising iperf with three clients against Cubietruck running Lubuntu)

To connect a 3.5" HDD the necessary 12 V power can be delivered by a 3.5 inch HDD addon package which can be used to power the Cubietruck itself as well.[14] Also new is the option to power the Cubietruck from LiPo batteries.

2) Zigbee Co-ordinator

The most capable device, the Coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee Coordinator in each network since it is the device that started the network originally (the ZigBee LightLink specification also allows operation without a ZigBee Coordinator, making it more usable for over-the-shelf home products). It stores information about the network, including acting as the Trust Center & repository for security keys. ZC hardware acts as the main mediator between the gateway and the switch node's transponder to communicate the signal.

Figure 3: Zigbee Coordinator with Antenna

3) Mobile smart device

The mobile device, either a smart phone or a tablet, needs to run Android operating system since the user system involves an Android application. The mobile device application simply receives the users' requests, stores them in the session manager of the application by shared preferences. The sessions are useful when it is necessary to store user data globally throughout the application. The issue of storing the data can be handled in two manners. The first way is to store the data in a global structure variable in the program and the second alternative is to store the data in shared preferences. The problem with storing the data in a global variable is that the data will be never be lost even after the user closes the application. The end-user may feel the communication is directly happening between the Mobile application and the switches because of the speed of response but the actual way how it works is the command is triggered in the mobile application and then passed on to the Gateway application then the request is processed and based on the request a new signal is generated by the gateway application and then alerted to the switch nodes(group of switches connected in a single circuit) and then the respective switch behavior is altered it could be a simple on/off or some complex behavior. Even if the switches are manually altered then the mobile application synchronizes with the updating of the behavior of the appliances under monitoring.

B. System Analysis and Evaluation

At the initial phases of the whole project, within the analysis and design stages, the main criteria of an appropriate home automation system have been delivered. Though these criteria may be relative to different designers based on different analysis of the system, this section first explains briefly how the analysis of the system has been done. Then, the section gives the list of measurement criteria to decide whether

an office/home automation system is good or not good as the point of view of the system designers. The implemented system is also evaluated regarding that list of criteria.

Within the analysis stage of the project, the four main designers of the system among the all authors have pretended to be the users of an office or home automation system and have discussed what they would desire in such a system. Then the six co-authors of this paper involving those designers have discussed about the functionalities of the system with respect to its software and hardware tasks. Based on the discussions among those six experts, all considered properties or attributes for a convenient home automation system are taken into account and the final list of criteria that makes the home automation system adequate and qualified regarding the state- of-the-art technologies is picked up. It would be worth to emphasize here again that the list of final criteria as the deliverable output of the analysis phase of the proposed system is relative to the opinions of the project group members of the proposed system. Nevertheless, the decided criteria are based on the abovementioned requirement analysis mechanism.

The running implementation of the prototype system is also briefly evaluated based on those criteria. After testing the system with different users and sub-users for several times, the evaluation results are summarized and simply classified as "adequate" or "inadequate" for each criterion in the list. The mentioned criteria together with their explanations and evaluation results are listed in Table I.

TABLE I

LIST OF CRITERIA FOR AN ADEQUATE HOME AUTOMATION SYSTEM

Criterion	Evaluation Result	Explanation
Hardware safety	Adequate(+)	The hard lines are off direct access and highly insulated
Application data	Adequate(+)	The actual data is transferred in a encoded format
Security	Adequate	The communication between gateway is vulnerable but MAC level authentication restricts the intruders
Power saving	Adequate(+)	The user has the choice to optimize his entire appliance usage based on his level of usage
Energy awareness	Adequate(+)	Lightweight application with few data communication is used.
Cost	Adequate(+)	Flexible packages to all types of consumers
Plug and play	Adequate(+)	Android application is ready to add/remove appliances.
Scalability	Adequate(+)	Number of homes, appliances, users may be increased with some extra configurations without changing the structures of server, local hardware, and Android application.
Ease of use	Adequate(+)	Friendly and appealing GUI is used in both local hardware and mobile device.
Reliability	Adequate(+)	Firmware protocols are well designed to handle the exception scenarios
Response delay	Inadequate(+)	As the trigger is from the hardware side updating is a bit slow.(duplicates need to be sorted out)
Availability	Adequate(+)	Anytime the end-user initiates the session, within seconds services are rendered

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IV. CONCLUSION

The paper proposes an intelligent automation system using Android operating system as the emerging technologies used in home automation area. The system has three hardware components: a local device to transfer signals to home appliances, a coordinator to communicate among the switch nodes and gateway, and a mobile smart device running Android application. The paper proposes an intelligent automation system using Android operating system as the emerging technology used in home automation area. The functionalities of each different component of the system are dissected and the communication infrastructures of the parts are explained. Such a design of service and data distribution makes the system cost-effective. The prototype implementation of the proposed system is evaluated based on the criteria considered after the requirement analysis for an adequate home automation system. According to the evaluation results, the proposed system is completely feasible to meet the requirements of the end-user's expected requirements.

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