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ECA Based Home Automation System

T.Haripriya¹, J.Rajanikanth²

M.Tech Student, Dept of ECE, SIETK, Puttur, Chittoor District, AP, India

Associate Professor, Dept of ECE, SIETK, Puttur, Chittoor District, AP, India

ABSTRACT: Automation of the surrounding environment of a modern human being allows increasing his work efficiency and comfort. There has been a significant development in the area of an individual's routine tasks and those can be automated. In the present times, we can find most of the people clinging to their mobile phones and smart devices throughout the day. Hence with the help of his companion a mobile phone, some daily household tasks can be accomplished by personifying the use of the mobile phone. Analyzing the current smart phone market, novice mobile users are opting for Android based phones. It has become a second name for a mobile phone in layman terms. Home Automation System (HAS) has been designed for mobile phones having Android platform to automate an 8 bit Bluetooth interfaced microcontroller which controls a number of home appliances like lights, fans, bulbs and many more using on/off relay. This paper presents the automated approach of controlling the devices in a household that could ease the tasks of using the traditional method of the switch. The most famous and efficient technology for short range wireless communication- Bluetooth is used here to automate the system. The HAS system for Android users is a step towards the ease of the tasks by controlling one to twenty four different appliances in any home environment.

KEYWORDS: Home Automation System, Android, Microcontroller, Bluetooth, Mobile Phone, Appliance

I. INTRODUCTION

Today's homes require sophistication control in its different gadgets which are basically electronic appliances [1]. This has revolutionized the area of home automation with respect to an increased level of affordability and simplicity through the integration of home appliances with smart phone and tablet connectivity. Smart phones are already feature-perfect and can be made to communicate to any other devices in an ad hoc network with a connectivity options like Bluetooth [2].

With the advent of mobile phones, Mobile applications development has seen a major outbreak. Utilizing the opportunity of automating tasks for a smart home, mobile phone commonly found in normal household can be joined in a temporary network inside a home with the electronic equipments. Android, by Google Inc. provides the platform for the development of the mobile applications for the Android devices [3].

Home automation system is a mobile application developed using Android targeting its vast market which will be beneficial for the masses. According to the International Data Corporation (IDC) Worldwide Quarterly Mobile Phone Tracker, Android maintained its leadership position in global market share [4].

Bluetooth is a short-range wireless communication technology that comes in handy as the solution while communicating over an ad hoc network environment like the home environment for connecting the home appliances with the mobile phones [5]. Bluetooth works over 2.4 GHz frequency range up to the range of 100 m with 1 Mbps speed, providing a safe and efficient solution for controlling home automation [2].

II. SYSTEM ARCHITECTURE

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The Home Automation System (HAS) was developed using Java Me [6] and MoSync [7] during the course of research and now a User Interfaced (UI) Android Application program implemented on an Android based Bluetooth enabled mobile phone, and an 8 bit microcontroller based relay driver circuit with Serial Bluetooth Module, which is able to communicate with the Home Appliances over Bluetooth link. The system is based on serial data transmission using Bluetooth wireless communication in order to facilitate the appliances control in a HAS. It also supports conventional ON/OFF system of appliances.

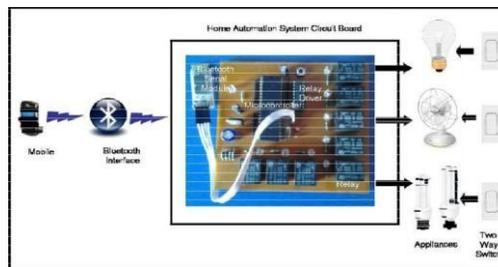


Fig 1. System Architecture

III. DEVELOPMENT PLATFORM

This section describes the technologies used for developing the mobile phone application of the Home Automation System. The mobile phone application development presented in this paper is based on the following technologies: Android [3], Bluetooth [2]. Android is a platform developing and deploying android based applications on mobile devices supporting it. Bluetooth has its own benchmark as a wireless communication technology for permanent and itinerant devices. Combining the power of Bluetooth, the best known and used wireless technology for short range communication provide a facility to create Android based mobile applications using the Bluetooth Wireless Technology. The Android Bluetooth specification [13], added in API level 5 of Android APIs.

A. Android

Android is everywhere. Present days Phones, Tablets, TVs and set-top boxes powered by Google TV. Soon, Android will be in cars, in in-flight entertainment systems on planes, and even in robots [13]!

Android was originally created by Andy Rubin as an operating system for mobile phones, around the dawn of this twenty-first century. In 2005, Google acquired Android Inc., and made Andy Rubin the Director of Mobile Platforms for Google. Many think the acquisition was largely in response to the emergence of the Apple iPhone around that time; however, there were enough other large players, such as RIM Blackberry, Nokia Symbian, and Microsoft Windows Mobile, that it seemed a salient business decision for Google to purchase the talent and intellectual property necessary to assert the company into this emerging space, which has become known as Internet 2.0 [13].

Home Automation System (HAS) using Android for Mobile Phone

Android's releases prior to 2.0 (1.0, 1.5, 1.6) were used exclusively on mobile phones. Most Android phones and some Android tablets now use a 2.x release and Android 3.0 was a tablet-oriented release but does not officially run on mobile phones. The current Android version is 4.3. Android's releases are nicknamed after sweets or dessert items like Cupcake (1.5), Frozen Yogurt ("Froyo") (2.2), Ginger Bread (2.3), Honeycomb (3.0), Ice Cream Sandwich (4.0), Jelly Bean (4.1) and KitKat (4.4) being the recent one.[14].

Android applications are written in the Java programming language. The Android SDK provides tools for code compilation and packaging data and resource files into an archive file with `_.apk'`extension called as an *Android package*.



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Android devices used the `_.apk` file to install the application. Android's application framework allows for the creation of extremely feature rich and novel applications by using a set of reusable components.

The amalgamation of the Android development environment with the Bluetooth wireless technology is known by Android's support for the Bluetooth network stack, which permits a device to wirelessly exchange data with another Bluetooth device. The application framework enables access to the Bluetooth functionality using the Android Bluetooth APIs. These APIs allow wireless applications to connect to other Bluetooth devices for point-to-point and multipoint wireless features.

Using the Bluetooth APIs, an Android application can carry out the following functions:
Scrutinize for other Bluetooth devices

- Enquire about the local Bluetooth adapter for paired Bluetooth devices
- Establish the RFCOMM channels
- Connect to other devices through service discovery
- Exchange data to and from other devices
- Administer multiple connections
- Android had unique support for Bluetooth in Android-powered devices including: Classic Bluetooth for more battery-intensive operations such as streaming and communicating and with low power requirements, Android 4.3 (API Level 18) introduces API support for Bluetooth Low Energy [15].
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B. Bluetooth

Wireless networks for short range communications have a wide spread usage of Bluetooth radio transmissions between 2400–2480 MHz by Telecom vendor Ericsson since 1994 [2]. Bluetooth technology forms small ad hoc networks termed as Personal Area Networks (PANs) also provides a mechanism to emulate the RS-232 data cables, supervised by the Bluetooth Special Interest Group, since 1998. Modern mobile devices embed small, low-powered and cheap integrated chips functioning as short-range radio transceivers for Bluetooth radio communications. Device pairing, authentication, encryption and authorization techniques have given recognition to Bluetooth technology due to its vital security mechanisms.

Different types of Bluetooth applications can be developed using Android platform architecture using the Bluetooth profiles. The device manufacturers provide the services using the support of these profiles in their devices to maintain compatibility for the Bluetooth technology.

The Bluetooth profile used in Home Automation System (HAS) Android mobile phone application is the Bluetooth Serial Port Profile (btsp) [15]. RFCOMM is a connection-oriented protocol. It provides streaming communication between the devices. The tap profile and RFCOMM protocol are used in the application to access the serial port and communicate using streaming data. All of the Bluetooth APIs is available in the android Bluetooth package

C. Keil Vision IDE

Keil development tools for the 8051 Microcontroller Architecture support every level of embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, Single-board Computers, and Emulators support all 8051 derivatives. `_.C Language Program code` for AT89c51 microcontroller is developed, compiled and debugged using Keil Vision IDE [10]

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D. ucFlash+ Programmer

The ucFlash+ Programmer [11] is an affordable, reliable, and fast programmer for MCS51/AVR Microcontrollers and 24Cxx I2C EEPROMs. The programmer is designed to operate with the Intel Pentium- based IBM-compatible desktop computers and notebook computers. No interface card is necessary to plug the module into a PC (this feature is especially handy for notebook computer users). The menu-driven software interface makes it easy to operate. UcFlash+ Programmer is used here for programming AT89C51 microcontroller for HAS.

IV. HOME AUTOMATION HARDWARE

Home Automation Hardware is work as client part in Home Automation System and it is formulated in two ways like: (A) Automated and (B) Conventional

A. Automated

Home Automation Circuit comprises microcontroller AT89C51, Serial Bluetooth Module, octal peripheral driver array ULN2803, regulator IC 7812, IC7805 and a few discrete components. Here in this circuit, microcontroller AT89C51 is worked as main programmable switching unit which receives data from Bluetooth serial module and transferred appropriate program data to ULN2803 for operating relay ON and OFF. The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C51 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, five vector two-level interrupt architecture, a full duplex serial port, and on-chip oscillator and clock circuitry. [12]

B. Conventional

Conventional way means traditionally all the devices are controlled using switches through switch board. Any user wants to make device _ON/OFF_ without using HA S then he/she can use particular switch attached to device. To incorporate this, relays are connected through.

V. HOME AUTOMATION SYSTEM APPLICATION PROGRAM

Home Automation System Application is developed using Android platform for mobile phones and tablets with Android support having the Bluetooth connectivity option. Android devices have almost covered a larger pie in the market, hence keeping in mind its popularity; this application can prove to be a boon for those users longing to make their house – an automated home. Home appliances can be controlled using this interactive application within their home environment easily. Expandable list view is used to group list data by categories like Living room, Bed room, Kitchen, Guest room, Store and Porch. It has the capability of expanding and collapsing the groups when user touches header as shown in Figure 3 (a).

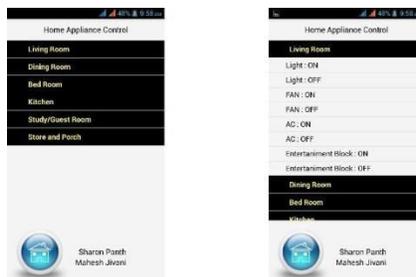


Fig 2. Screenshot of Home Automation System Application: (a) List View (b) Expanded List view

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VI.PROGRAM FLOW CHART

Power up the Circuit and scan the Bluetooth devices on your Mobile Device. If everything's done correctly you will be able to find a Bluetooth device named 'Tiny OS' or name of Bluetooth Module. You will be asked for a pairing code in case of the above model (Tiny OS) it is **1234** but it might be different if you are using a Bluetooth module from another vendor. Figure 6 shows the real implementation of HAS. As shown in figure 6, follow the steps for operating devices listed in program.

- Start Bluetooth connection of your mobile phone.
- Open the 'HAS' application on your Android mobile phone.
- Select connect device from option menu using scan for new devices.
- Bluetooth Serial Module will be available under 'select a device to connect' list.
- Pair 'Bluetooth Serial Module' by providing pair code '1234'.

Start selecting particular device for making 'ON/OFF' from List Menu as shown in figure 6, you will see relay ON and OFF according to combination.

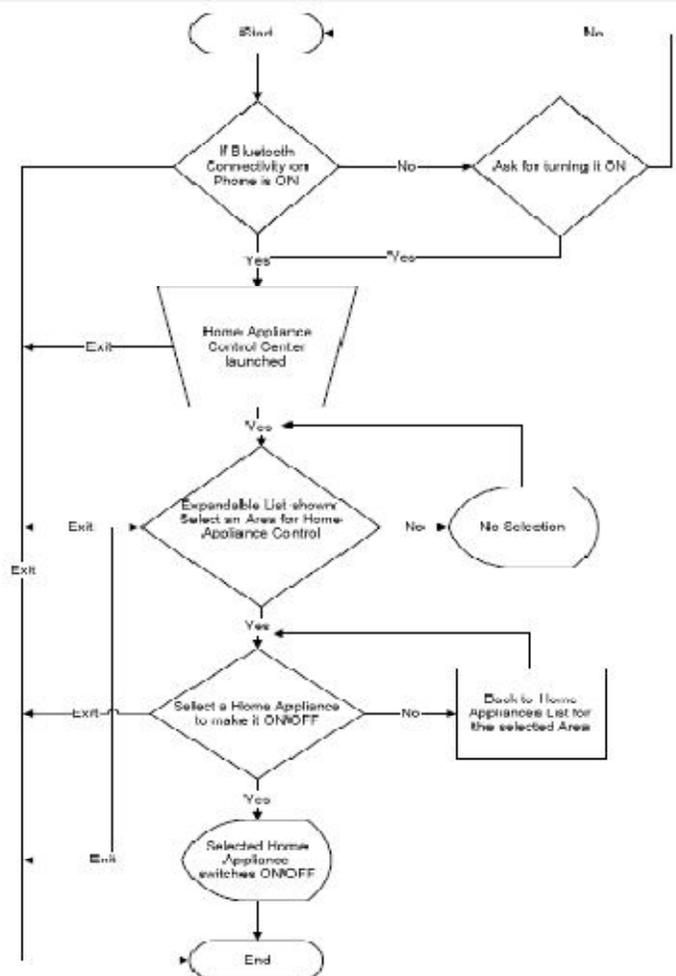


Fig 3. Flow Chart: Android Mobile Application Program



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VII.CONCLUSION

Design and implementation of a Home Automation System using Android for mobile phone has been discussed. The purpose of the system is to use mobile phone's inbuilt Bluetooth facility for automation without using Air Time. Different hardware and software unit of the system are described. The complete application software has been designed using Android, Bluetooth API and C Language. The HAS application program is tested on various Android mobile phones and the results are presented in table 2, which are quite satisfactory and response received from the community in general is encouraging. The HAS furnishes a good paradigm for any Automation System based on Android Mobile Phone and Bluetooth.

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