# HOME AUTOMATION USING ANDROID APPLICATION

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## ABSTRACT

*There has been a significant development in the field of an individual's routine tasks. Automation of the surrounding environment allows a modern era human being to increase his work efficiency and the comfort. Nowadays, we find most of the people clinging to their smart phones and other such devices throughout the day. Hence, with the help of this companion- a smart phone, some routine tasks can be accomplished automatically with comfort. Home Automation Using Android Application is a system that controls various home appliances such as a fan, bulb, AC, TV etc with an android application. 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 system makes use of the most famous and efficient short range wireless device –Bluetooth to create a link between a smart phone and home appliances. The Bluetooth devices and the android application is interfaced with an 8-bit micro-controller which drives the relay (ON/OFF switches) connected to home appliances.*

*Keywords: Automation, Android, Bluetooth device, Micro-controller, Relays*

## 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. 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

The system architecture of Home Automation Using Android Application has been developed over an android phone application called Blue term, implemented on a blue tooth enabled mobile phone, and an 8-bit micro-controller based relay driver circuit with a serial Bluetooth module, which is able to communicate with the home appliances over a wireless Bluetooth link. This link enables the secured exchange of data between the devices.

An ATMEL89S52 8-bit micro-controller has been used as an embedded micro-controller, Link Matik 2.0 as a Bluetooth module. Keil mvision IDE [10] for compiling C Language Code and µCflash+ programmer [11] for burning HEX file into microcontroller were used for the development. The system architecture is illustrated with the help of a block diagram shown in Fig.1.
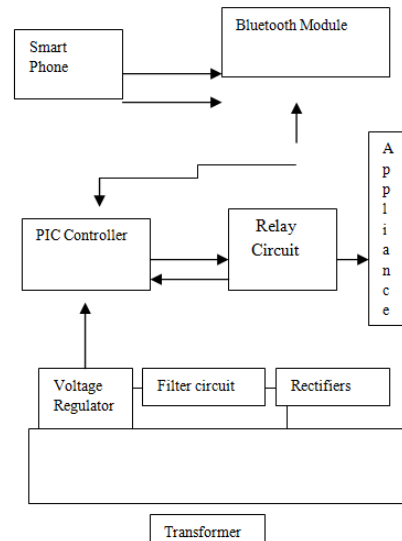


**Figure1. Block Diagram**

## III. DEVELOPMENT PLATFORM

This section describes the technologies used for developing the model of the Home Automation System Using Android Application. 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 [14].

### 3.1 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. Android was originally created by Andy Rubin as an operating system for mobile phones twenty-first century. In 2005, Google acquired Android Inc., and made Andy Rubin the Director of Mobile Platforms for Google [13].

Android's releases prior to 2.0 (1.0, 1.5, 16) 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), KitKat(4.4), Lollipop (5.0.0- 5.0.2), Lollipop MR1 (5.1.X) being the recent one.

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 [16].

Using the Bluetooth APIs, an Android application can carry out the following functions:

1. Scrutinize for other Bluetooth devices.

2. Enquire about the local Bluetooth adapter for paired Bluetooth devices.

3.  Establish the RFCOMM channels.

4. Connect to other devices through service discovery.

5. Exchange data to and from other devices.

6. Administer multiple connections.

### 3.2 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 [16]. Different types of Bluetooth applications can be developed using Android platform architecture using the bluetooth profiles.

The Bluetooth profile used in Home Automation Using  Android Application is of Link Matik 2.0. Link Matik 2.0 is a serial receiver /transmitter Bluetooth data link. It can be controlled from a host controller using simple commands. Link Matik 2.0 can also operate without a host controller for point-to-point serial connections. Auto-Slave and Auto Master modes allow LinkMatik 2.0 to operate a slave, master or wedded pair. Link Matik is shipped in Auto-Slave mode.The module can be interfaced to many standard Bluetooth devices, *e.g.* Laptop, Smart phones etc. Link Matik 2.0 replaces our earlier Link Matik and Blue Matik products providing an enhanced feature set, faster data rates and substantially lower power.

### 3.3 Keil µVision 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 mVision IDE [10].

### 3.4 µcFlash+ Programmer

The uc Flash+ Programmer [11] is an affordable, reliable, and fast programmer for MCS52/AVR Microcontrollers and 24Cxx I2C EEPROMs. The programme 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. µcFlash+ Programmer is used here for programming AT89S52 microcontroller for Home Automation Using Android Application system.

## IV. AUTOMATED SYSTEM HARDWARE

Automated system hardware is the actual circuit for a Home Automation Using Android Application system, which is shown in Fig.2.The home automation circuit comprises of micro-controller AT89S52, voltage regulator IC 7805, JQF-3FC relays, 1N4007 rectifiers, an Electrolytic capacitor as a filter, miniature transformer and other discrete components. Here in this circuit, microcontroller AT89S52 is worked as main programmable switching unit which receives data from Bluetooth serial module and controls the relay driver circuit for operating relay ON and OFF. The AT89S52 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The Atmel AT89S52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 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.
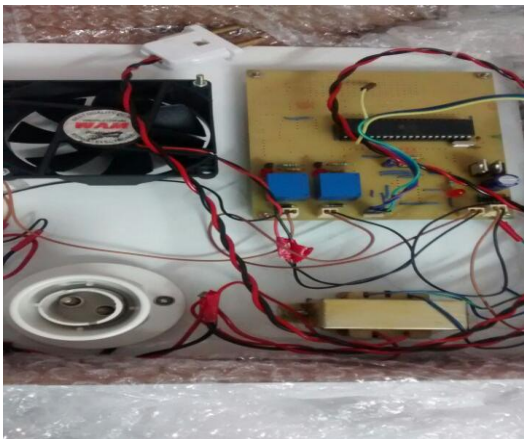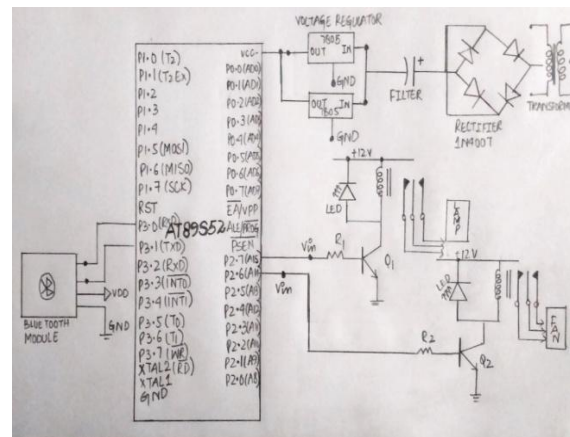


**Figure.2 Automated System Hardware**          **Figure. 3 Circuit Diagram**

## V. ANDROID APPLICATION PROGRAM

Home Automation Using Android Application system is developed using the android platform. Android is at boom in the market right now, therefore an android phone compatible application called Blue term is being used. Home appliances can be controlled using this interactive application within home environment. An Application is based on the expandable list view of the ON/OFF appliances as shown in Fig.4. This application is available on the Google Play Store, and hence can be installed on any version of an android operating system phone.
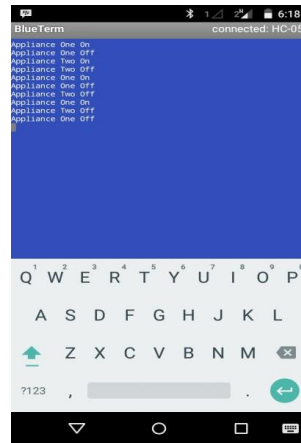
**Figure. 4 List View of the ON/OFF Appliances**

## VI. BLUETOOTH CONNECTIVITY

Home Automation System Application has the capability of expandable data with Home Automation Using Android Application circuit through Bluetooth facility of mobile phone when user touches the application. The Android platform comprises with other Bluetooth devices. The application frame work help of the Android Bluetooth APIs. These APIs make the application to connect wirelessly to other Bluetooth devices [16]. Link Matik 2.0 is the Bluetooth module used for the connectivity. The device operates here in the auto-slave mode.

### 6.1 Operating Modes

 There are three operating modes for LinkMatik2.0:

1. Auto-Slave Mode, where LinkMatik 2.0 allows other devices to connect to it.
2. Auto-Master Mode, where LinkMatik 2.0 tries to connect to devices it is paired with.
3. Command Mode, where LinkMatik accepts instructions from the host. Command mode is also used for:

   a) Configuring Auto-Slave and Auto-Master settings such as baud rates.

   b) Audio modes.

    c) Connections to multiple devices

### 6.2 Auto-Slave Mode

In Auto-Slave mode, LinkMatik 2.0 waits for a remote device to discover and connect to it. No commands are required, and, unless configuration commands are sent, no responses are generated except data from the remote device. The ESC input would normally be tied low in Auto-Slave mode unless configuration commands were to be sent to LinkMatik 2.0. The ATN output indicates whether the module is in a connected state. The ATN output will be set high when a connection is complete and low when there is no connection. If data is sent while the ATN is low, it will be interpreted as a command.

## VII. MICRO-CONTROLLER AT89S52 PROGRAM

The program (HAS.c) for the microcontroller is written in C and compiled using Keil mVision IDE to generate hex code. The generated hex code is burnt into the microcontroller using a mC Flash+ programmer. The

program coding starts with '#include<reg51.h>' header files. The microcontroller port pins are defined using 'sbit' function for interfacing with the surrounding peripherals. By selecting device from list menu of Home Automation Application program which is developed using Android installed on mobile device, will transmit ASCII characters serially through Bluetooth and on the receiving side microcontroller receives data through serial Bluetooth module on serial port of microcontroller AT89S52. 'SBUF register' will read this ASCII characters as equivalent HEX value which will be ported to Port 0, 1, and 2's pins of AT89S52.

The flow chart for the program is shown in Fig.5.

## VIII. IMPLEMENTATION

Power up the circuit by applying a suitable current to the transformer circuit as the voltage reaches the circuit the Bluetooth module is activated via controller. Search for the nearby Bluetooth devices using the android supported mobile phone. As the android application used works in the auto- slave mode, therefore, pairing of the devices is not needed. Start up the application on your android phone, as shown in Fig6.and click on the nearby device with which the connection is to be established. The Blue term application will save the device name. And, hence, the connection between the two devices is established.
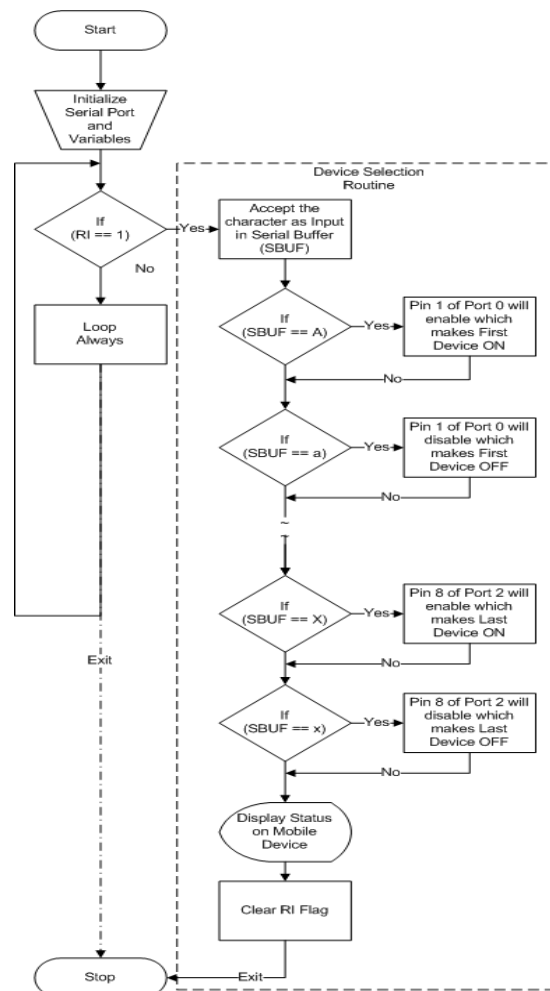


**Figure.5 Flow Chart for Program**

**Figure.6 Connection Establishment**

In the circuit the power supply is given to the controller by 7805 three way voltage regulator, the supply to which is a filtered signal output of the electrolytic capacitor. The input to the electrolytic capacitor is provided by the rectifier 1N4007 which rectifies the AC signal amplified by the transformer. As the controller receives the +5V supply on its VDD pin, it activates the bluetooth module through its RXD and TXD pins. The blueterm application installed in the android phone interacts with the micro-controller with the same Bluetooth device. The controller is programmed in a way that whenever the command is given to the controller through the application for driving the appliances on and off, it communicates with the relay circuit. The use of the LEDS on the circuit board has been made in order ensure that the power supply is reaching the relay circuit. The relay circuit is the single pole double throw type, connected to the appliances through the connecting wires. The relays work as the conventional switches, for switching ON/OFF the appliances, the only difference is that the circuit is driven by a micro-controller and not mechanically.

## IX. RESULTS AND DISCUSSION

The Home Automation Using Android Application system has been implemented successfully. Home appliances were switched ON/OFF using the Blueterm android application. The application was tested on various phones and the results were encouraging. The picture of the model while operating, is shown in Fig7.a) and Fig7.b)



**Figure.7a) Working Model**          **Figure.7 b) Working Model**

The list of the phones on which the application was tested is given in Table1.

**Table1. List of Various Android Phones on Which the Application Has Been Tested**

| Serial no. | Mobile Phone | Android OS version and name | Screen Size in Inch |
|---|---|---|---|
| 1 | Moto G2 | 5.0.2, Lollipop | 5 |
| 2 | Sony Xperia E3 | 4.4.4, Kit Kat | 5 |
| 3 | Samsung Galaxy Duos | 2.3,GingerBread | 4.3 |
| 4 | Lava Iris 504q | 4.2, Jelly Bean | 5 |

## X. CONCLUSION

The design and the implementation of the Home Automation Using Android Application system has been discussed. The complete review of the technologies used for developing the system has been given in the paper. The main motive of the paper is to demonstrate the system that can use the inbuilt bluetooth capability of the android based mobile phones to control the various home appliances. This system was designed mainly to benefit the physically challenged and differently abled people, who won't now require an extra helping hand for switching ON/OFF various home environment appliances. The response from the community in general is encouraging and satisfactory.

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