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Home Automation System Using Bluetooth Technology

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Abstract—Implementation of home automation using the latest technology gives us more convenience, security and safety. Smartphone affordability increases every year and they have begun to play important roles in our day to day life due to its size and portability. Controlling home appliances using an Android phone gives user the ability to control the home appliances anywhere, anytime in their home and saves the time spent searching for the remote control unit of home automation systems since the user's phone is usually kept close at hand. This project presents the design and implementation of a low cost prototype of Bluetooth based home automation system using Android phone. Android application is developed to provide user an Interface through which user can be able to send signals easily for controlling home appliances remotely.

Keywords— Home Automation and Security; Arduino; Embedded Systems; Android ADK; Android Phone

I. INTRODUCTION

The "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. This paper presents the overall design of Home Automation System (HAS) with low cost and wireless remote control. This system is designed to assist and provide support in order to fulfil the need of elderly and disabled person in home. The main control system implements wireless Bluetooth technology to provide remote access from the smart phone. The switches status is synchronized in all the control system whereby every user interface indicates the real time existing switches status. The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation.

II. TECHNOLOGY USED

1. Arduino Board:

Arduino is an open source computing platform based on simple input/output board and a development environment that implements the Processing Language. The Arduino board we use in our project is the popular Arduino Uno having an ATMega328P Microcontroller on board that comes with 32KB flash memory and 2KB SRAM. We needed a microcontroller with atleast 1KB SRAM as we have to integrate scmRTOS that requires a minimum of 512 bytes of SRAM. 2KB of the flash memory is consumed by the Arduino Bootloader. The ATMega328P microcontroller has 8-bit CPU and 14 Digital I/O pins and 6 Analog I/O pins.

Fig 1. Arduino Board

2. Bluetooth Module and Relay Board:

The Bluetooth module allows us to wirelessly transmit and receive data. The Bluetooth module that we are using for our project is HC-05. The module that we are using is based on the bluetooth V2.0 protocol and is having a range of 10 meters operating at frequency of 2.4GHz radio transceiver and baseband with a maximum data exchange rate of 2.1Mbps. It has the footprint as small as 12.7mm*27mm. The relay board that we are using comes with 4 relays that can each handle a load upto 6A.

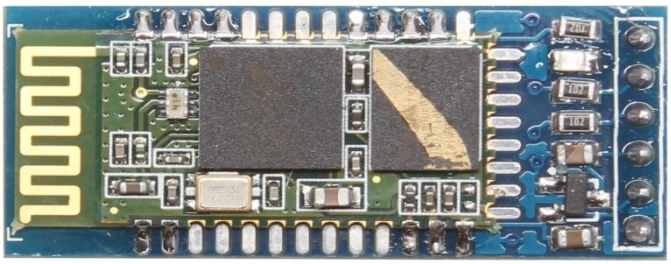


Fig 2. HC-05 Bluetooth Module

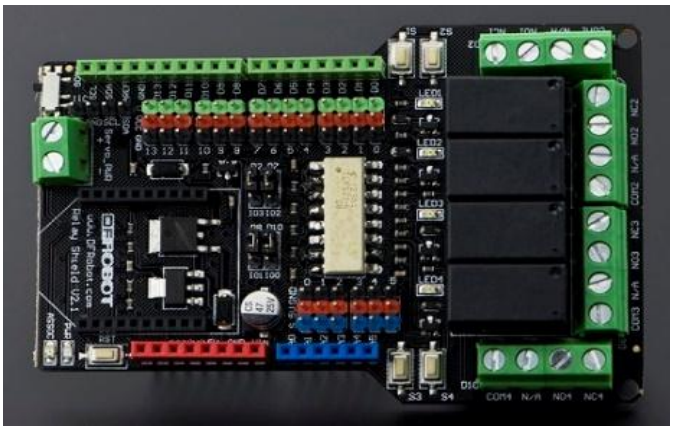


Fig 3. Relay Board

III. SOFTWARE

1. Android Application:

Android is a software stack for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools on the Android platform using the Java programming language. By providing an open development framework, Android offers developers the ability to build extremely rich and innovative applications. Developers have full access to the same framework APIs used by the core applications. Android includes a set of C/C++ libraries used

by various components of the Android system. The Android SDK compiles the code along with any data and resource file into an Android package, an archive file with **.apk** file extension. All the code in a single .apk file is considered to be one application and is the file that Android powered devices use to install the application.

Once installed on a device, each Android application lives in its own security sandbox. Some important application fundamentals are:

- The Android operating system is a multi-user Linux System where each application is a different user.
- By default, the system assigns application a unique user ID. The system sets permissions for all the files in an application so that only the user ID assigned to that application can access them.
- Each process has its own virtual machine, so an application's code run in isolation from other applications.
- Every application runs its own Linux process.

2. Bluetooth Development:

The Android platform includes support for the Bluetooth network stack, which allows a device to wirelessly exchange data with other Bluetooth devices. The application framework provides access to the Bluetooth functionality through the Android Bluetooth APIs. These APIs let applications to wirelessly connect to other Bluetooth devices, enabling point-to-point and multi-point wireless features.

Using the Bluetooth APIs, an Android application can perform the following:

- Scan for the Bluetooth devices.
- Query the local Bluetooth adapter for paired Bluetooth devices.
- Establish Radio Frequency Communication channels.
- Connect to other devices through service discovery.
- Transfer data to and from devices.
- Manage multiple connections.

The program flowchart that scans, establishes a connection and then sends data to our Bluetooth enabled Arduino board is shown in the figure below. As shown in the flowchart, we first get hold of the local Bluetooth adapter present in the smartphone and establish a connection with our external Bluetooth module that is connected to the Arduino board. Once the connection is successfully established, we then send command from our smartphone to the Arduino that are then used by the microcontroller to decide which appliances to switch ON/OFF.

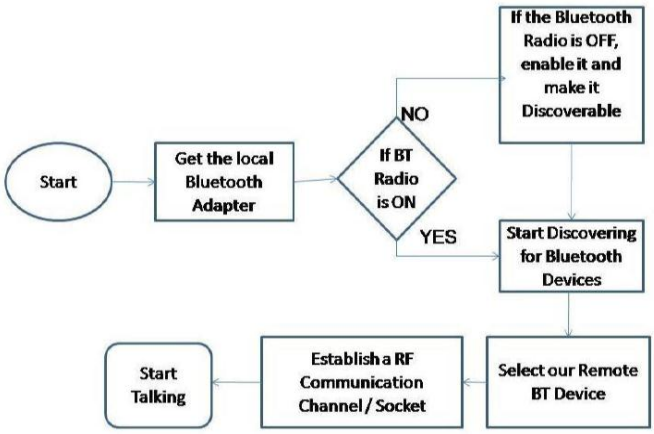


Fig 4. Program Flowchart for establishing Bluetooth Connection

IV. WORKING OF THE SYSTEM

We are developing an Android application which can be installed on Smart phones having Android version 2.1 (Eclair) and above. After installing the application on the smart phones the user will access the system in the following way:

- User logs in to the system with the authentication id and credentials that is being coded in the program.
- The system will search for the discoverable Bluetooth devices.
- The system will pair the discovered Bluetooth device with the control board.
- Once the pairing is done, the user will send signals for controlling the home appliances (ON/OFF).
- The system will receive signals from the user and forward them to the appliances in the form of electrical signals.
- The appliances will get either turn ON or turn OFF, and will provide a notification to the user.
- After completing the operations, the user can terminate the connections by logging out of the system.

The flowchart for the interaction between the user, system and appliances, is given below:

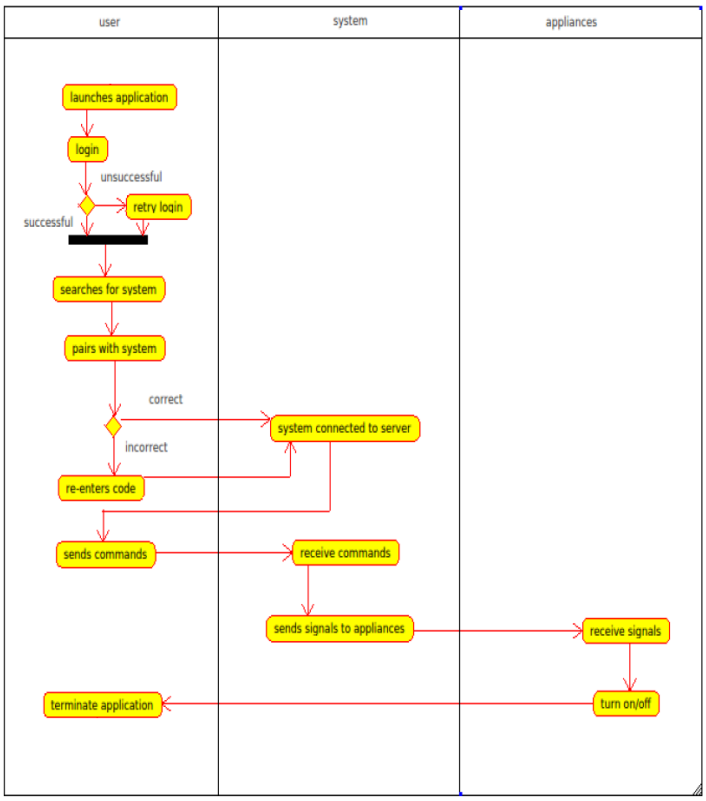


Fig 5. Flowchart for interaction between user and the system

The user interface of the application is designed in such a way that any people having basic English knowledge will be able to operate it very easily and efficiently. The user interface of our application will be somewhat like the figure given below:

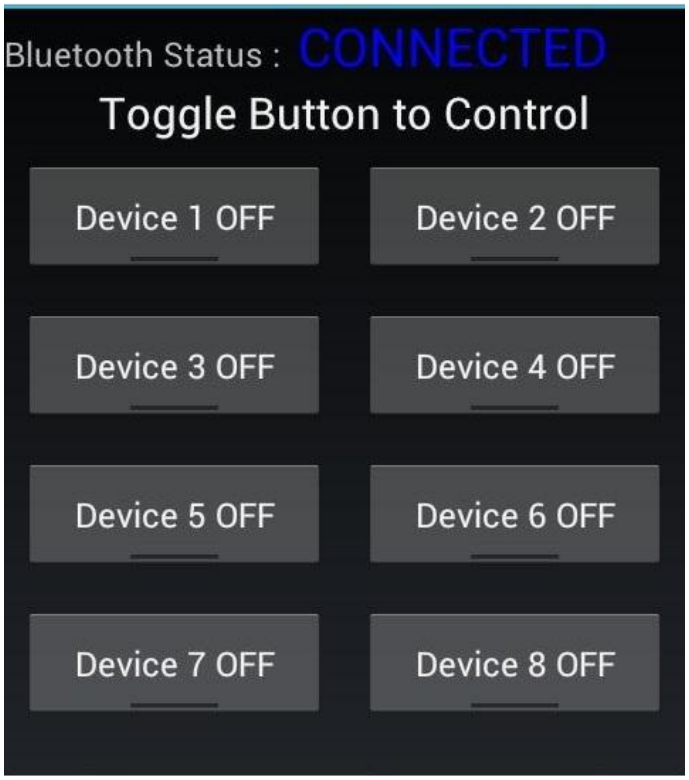
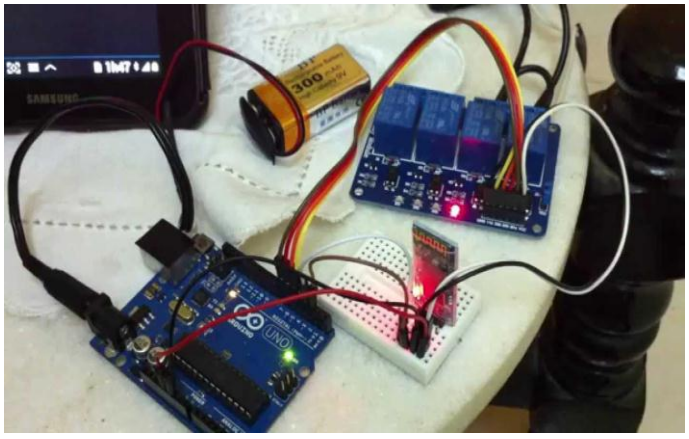


Fig 6. User interface of the system

The connection between the hardware's can be done in the following manner:

- The Bluetooth module will be installed in the Arduino board with the help of bread board and the controlling code for bluetooth module will be written in the Arduino IDE.
- The Relay board will also be installed in the Arduino with the help of bread board and will act like a switch for controlling the appliances.
- An android application is developed for the users to interact with the system to control the home appliances with the help of Smart phones.

The installation of the hardware's will be in the same manner as in the diagram below:



V. BENEFITS

- Home appliances can be controlled remotely.
- HAS is helpful for disabled persons.
- No need for internet connection.

VI. FURUTE WORK

Improvements can be made to improve this project. Some of the recommendation are:

- Voice commands can be implemented so that the persons without hands can also operate this system.
- Sophisticated electrical appliances can be controlled. For example: Microwaves, Air conditioning temperature, etc.

VII. CONCLUSION

This is an ongoing project. Our prime objective is to assist handicapped/old aged people. This paper gives basic idea of how to control various home appliances and provide a security using Smart phone. This project is based on Android and Arduino platform both of which are FOSS (Free Open Source Software). So the overall implementation cost is very cheap and it is affordable by a common person. Looking at the current scenario we have chosen Android platform so that most of the people can get benefit.

The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the Android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors. We have discussed a simple prototype in this paper but in future it can be expanded to many other areas.

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