# Bluetooth Based Home Automation System Using Android and Arduino

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## Abstract

*Electronic devices and appliances have become very common in this recent year of technology especially with fast development in smartphones. In this paper, the design of Home Automation System compatibly with Local housing and good features for home automation via remote access are presented. Bluetooth Based Home Automation System Using Android and Arduino is design and implemented. In this research work a part of smart home technology which using Bluetooth in a mobile device is used, so it will cheap and efficient to use. This paper describes about home automation system which would use to enable home lighting, garage door motor, water pumping motor and smoke detection using a smart phone application with Bluetooth wireless technology. The system included three main components: an Arduino microcontroller for connecting the appliances, a Bluetooth module for signal transfer, and a smartphone with the Android application to control home appliances. Bluetooth communication technology and controlled system is that the operating range is low, but it can control from anywhere inside of home, by using smart phone application we can control household appliances and provide security to decrepit peoples. The idea of paper is to control home appliances to avoid the dangerous of electric shock and convenience of decrepit and physically disable people, who can easily access and control the home appliances by staying at particular place and access them remotely without the help of other people. By using this system, our home automation works smartly by providing increased quality of life, and comforts to users.*

## 1. Introduction

Since Myanmar's telecoms revolution began in 2014, the number of internet users has risen from 2 million to more than 39 million, while the number of SIM cards in circulation has risen by almost 400 percent, according to government figures. Myanmar now has at least 33 million active mobile subscriptions in a country with an official population of 53 million. Today, most mobile phones using in Myanmar are 'smart phone', which offers more advanced capabilities in connectivity issues than regular cell phones. Smart phone usage rate is reported at 80% in Myanmar. Smart phone usually support one or more short range wireless technologies such as Bluetooth and infrared, making it possible to transfer data via these wireless connections. Smart phone can provide computer mobility, ubiquitous data access, and pervasive intelligence for almost every aspect of business processes and people's daily lives [1]. One of the smart phone applications that have been developed is smart homes technology [2]. The fundamental of building an automation system for an office or home is increasing day-by-day with numerous benefits. Industrialist and researchers are working to build efficient and

affordability automatic systems to monitor and control different machines like lights, fans, garage door motors, smoke detection and other requirements [3]. The use of Bluetooth technology in a smart phone today is not just for the transfer of data and files only. In recent years, Bluetooth technology is used one of the applications of home automation System. Bluetooth technology operate over unlicensed, its available at 2.4GHz frequency, it also can link digital devices within a range of 10m to 100m at the speed of up to 3Mbps but it depending on the Bluetooth device class [4]. By using home automation System, we can control household appliances. So, many manual actions are replaced by reducing human efforts and time saving. The design of Home Automation System which remains the existing electrical switches which status is synchronized in all the control system with low voltage activating method and that provides more safety for danger of electric shock and provide security to decrepit peoples. In this paper, Bluetooth based home automation system using android smart phones and Arduino UNO microcontroller board is used. Such a system will enable users to have control over home lighting, water pump and garage motors and smoke detection in their home with Bluetooth. The main requirement for user is an Android smart phone, which is present in almost every person hand nowadays, and a control circuit. The control circuit consists of an Arduino Uno microcontroller, which processes the user controls switching of devices and detect the alarm. The microcontroller and the smart phone are connected with Bluetooth wireless technology because Bluetooth technology is low cost to use and secure wireless network. This application also focuses on smoke detection with secure application against unauthorized user. Remote operation is achieved by any smart phone/Tablet etc., with Android OS, upon a GUI (Graphical User Interface) based touch screen operation.

## 2. Literature Review

In these recent years, smart home automation system has become very common of technology and especially with fast development in internet WebPages. Various smart home systems with improved technologies have been implemented. Most of the technologies are based on controlling home automation systems in android application which gives user interface for monitoring and controlling their home electronic appliances from local network or internet.

### 2.1. Arduino Board

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on LED, publishing something online. We use the Arduino programming language and the Arduino Software (IDE) by sending a set of instructions to the microcontroller on the board to control the Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers such as students, hobbyists, artists, programmers, and professionals has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software is

also open-source, and it is growing through the contributions of users worldwide [5].

## 2.2. Arduino UNO

The Arduino UNO is the best board to get started with electronics and coding. The UNO is the most used and documented board of the whole Arduino family. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform [6].
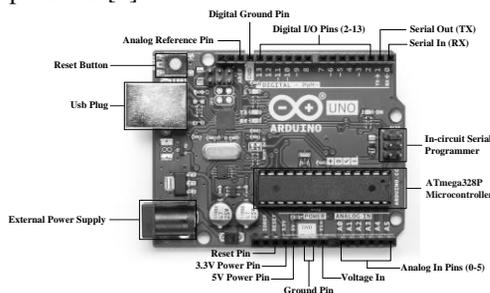


**Figure 1. Arduino UNO REV3 board**

## 2.3. Arduino Software

Arduino IDE (Integrated Development Environment) is open-source software and that enables better and assisted code editing, compiling and debugging. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. So, this Arduino IDE basically has inbuilt functions and commands that though work on Java platform, are customized to run on the Arduino board. Thus Arduino IDE serves for code editing, its compilation, debugging and then burning the code into the Arduino board.



**Figure 2. Arduino IDE**

## 2.4. Bluetooth Module (HC-06)

HC-06 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-06 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data. The Bluetooth module HC-06 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to

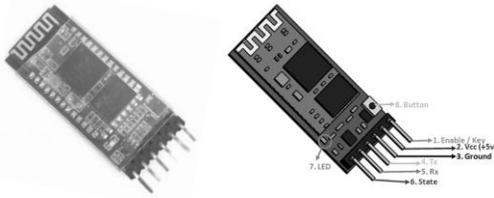establish connection between MCU and GPS, PC to your embedded project.



**Figure 3. HC-06 Bluetooth module**

## 2.5. MIT App Inventor 2

MIT App Inventor is to develop applications for Android phones using a web browser and either a connected phone or emulator. The App Inventor servers store inventor designs and create fully functional apps without writing any code of your projects. The App Inventor development environment is supported for Mac OS X, GNU/Linux, and Windows operating systems, and several popular android phone models. Applications created with App Inventor can be installed on any Android phone.
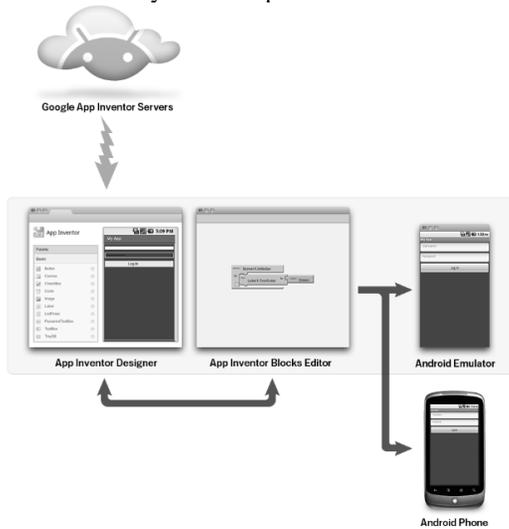


**Figure 4. Function of MIT app inventor 2**

## 3. Implementation of the Project

For this project of Smart Home Automation System, open source android platform is used. Android application from any mobile devices connects to the Bluetooth module HC-06 and controls the home appliance devices such as rooms lighting, water pump motor and garage motor. For the safety purpose of this project, Bluetooth connection of application and Bluetooth device need password when paring for authorized using. After that confirm message for Bluetooth connection is successful and then list on available devices in android application can control as remote devices. This project also monitor $CO_2$ content in the house by MQ-2 gas sensor and make alarm sound by speaker when the certain amount of smoke detected in the house. Block Diagram of the implemented project shown in Fig. 5. Our proposed project consists of the following three sections.

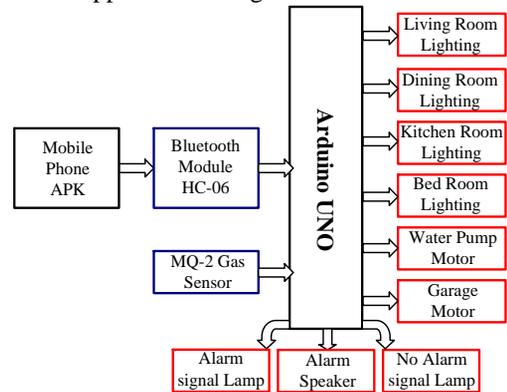(a)  Input from Bluetooth module via android application and gas sensor



**Figure 5. Block diagram of the implemented project**

(b) Arduino UNO microcontroller processing

(c) Output of process indication and alarm

First development of our project, all the component modules are made simulation by Proteus Design Suit version 8.0 simulator and check for the working output condition. Hardware components simulation of this project consists of Arduino UNO, Bluetooth module,

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motors, output of gas sensor and rooms lighting by android app control are shown in Fig. 6.
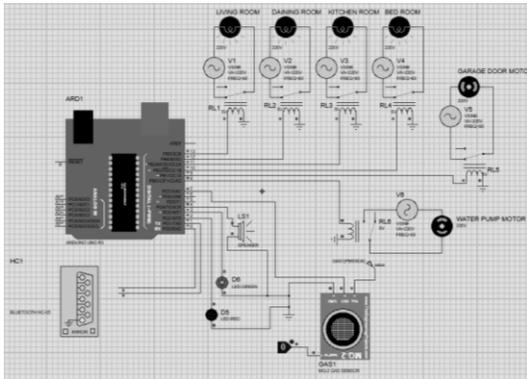


**Figure 6. Simulation output of Bluetooth based home automation system**

The connection and placement of hardware components has been elaborated with the help of circuit diagram of the system interconnection.

The required DC power supply that to run the system can get from 9V battery or computer USB port and feeds the microcontroller and Bluetooth module. The Bluetooth module receives the signal sent from an android smart-phone, where the application software made by MIT app inventor is installed. The microcontroller, thereby, sends instruction, when executed codes in C language of Arduino IDE. Rooms lighting and motors can be controlled by using android based application software. The hardware of this project consists of Arduino module, Bluetooth module and gas sensor module. The Bluetooth module is connected with the Arduino UNO board for the right connection with RX, TX, ground and power pins. Through the Bluetooth module for monitoring and controlling the particular rooms lighting and motors reaches the board and process accordingly and output of the Arduino goes to the particular hardware components with control them. In this method, Bluetooth wireless connection is used, the user must be present within in range (< 15 meters) to control the system. When user sends signal or data to the

Arduino board then the corresponding pin of Arduino goes to high state and switches the home applicant hardware to open or close. The circuit diagram of this project including output home appliances are shown in Figure 7.

Figure 8 and 9 are shown flow chart for system operation of Arduino UNO and created app preview respectively. The hardware consists of an Arduino UNO along with input output ports (analog, digital, power), Bluetooth module, USB port, 9 and 5 volt DC input port, Relay Control Unit for home appliances and Alarm Unit for MQ-2 gas sensor etc.
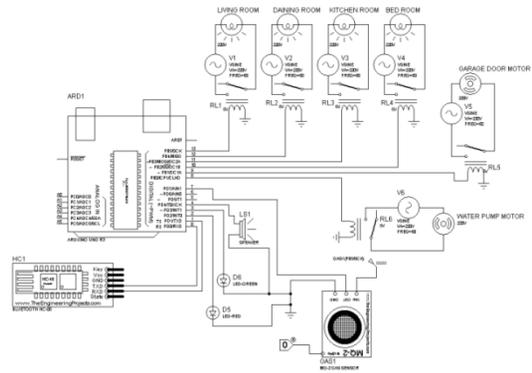


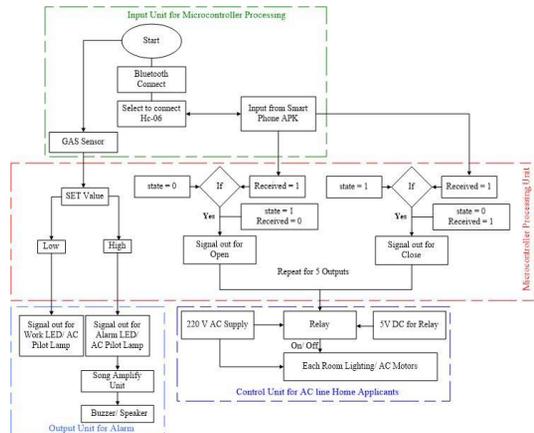**Figure 7. Circuit diagram of Bluetooth based home automation system**



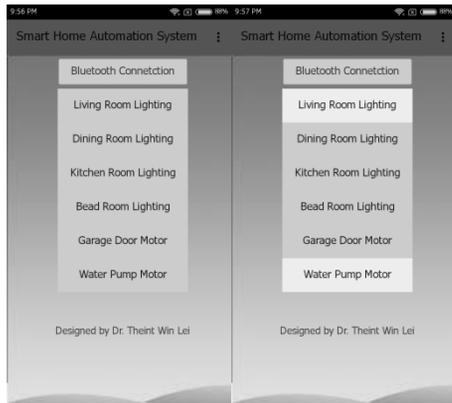**Figure 8. Flow chart of the system operation**

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**Figure 9. Created app for home automation system**

In this present project, Bluetooth module that has been set to slave mode is used to communicate the controller with the smart phone application. Application is created by App Inventor 2. App Inventor 2 is a visual, blocks language for building Android Apps. There are two main types of components in an app Inventor 2, visible and non-visible. Visible components of application are can see when the app is launched that includes buttons, text boxes, and labels. These are often referred to as the graphical user interface (GUI). Non-visible components are not seeing, so they are not part of the user interface. Instead, they provide access to the built-in functionality of the device. The non-visible components are the technology within the device they are little worker bees and they do jobs for control of the application. App Inventor 2 can easily create GUI interface for user friendly and block editor can make the relevant function of each button from application easily without writing coding.

The application installed in Smart phone and control the Arduino UNO digital output pin no. 13, 12, 11, 10, 9 and 8 for rooms lighting and motors on-off by using relay switch. 5 V DC Relay units are connected to pins 13, 12, 11, 10, 9 and 8 for switch control action of 220V AC home applicants has been achieved. MQ-2 gas sensor connect to the pin no. 7 to give analog input signal of CO2 content in the room and pin

no. 2,3 and 4 make output of the gas sensor. 2 LEDs or Pilot Lamps are connected to pins 2 and 3 for output signal of gas sensor for normal and alarm conditions. Pin no. 4 is connected with speaker via song amplifier unit to get the alarm sound of smoke detection in the room. The designed system of Home Automation has been tested and run successfully shown in Figure 10. Hardware for Relay Units to drive 220V AC lighting units, motors and other song amplifier unit for alarm system is not included and need to extend.



**Figure 10. Test run system architecture with controlled output results**

## 4. Conclusion

This project is indeed a low-cost and efficient project for home application. This project is also a cost-effective project with a simple and easy to use interface for decrepit and physically disables peoples. By using this method, home appliances can be controlled to avoid the dangerous of electric shock and convenience for users. It can make secures home by alerting people when smoke detected or gas is leaked in the home. With few additions and modifications, this project can be make commercial scale products for Home Automation System. In future we can add temperature sensors so that it can monitor some surrounding temperature parameters around the house and we can improve the communication using Internet web base

technology. This project can also promote with wireless camera, in order to incorporate other security features of Smart Home Automation System. In terms of upgrading security in the home, doors and windows are also mounted by setting alarm in case of any kind of thief or sabotage.

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