

# Modern Home Automation System Using Android Mobile App and Web Based Server

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**Abstract:** Automation of any task is the uses of control systems and information technologies to minimize the need for human work in the produce of goods and services. In the scope of industrialization, automation is a step beyond mechanization. This paper presents a lower cost, Secured and flexible home monitoring and environmental control system. It employs an embedded micro-web server in Arduino microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely. These devices can be controlled through a web application or via Bluetooth Android based Smart phone app. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor, gas sensor and motion sensors have been integrated with the proposed home control system. In modern age it would be a good application for both paralyzed people and home security.

**Keyword:** Please Smart Home; Home Automation; Android Smartphone; Arduino; Web Server

## 1. INTRODUCTION

Now a day's security systems perform a significant role in the safeguard of lives and investment. This is achieved by the establishment of various subsystems into the security system with a single monitoring unit such as surveillance, intruder control, access control, fire detection, etc. A smart home is one that is prepared with lighting and heating and electronic devices that can be controlled remotely by smartphone or via the internet. A Bluetooth and internet based home automation system focuses on controlling home electronic hardware devices whether you are inside or outside in your home [1]. Home automation system gives an individual the power to remotely or automatically control things around the home which can be set on any room. A home appliance is a hardware device or instrument designed to make a specific function, particularly an electrical device, such as a refrigerator, for building use. The words appliance and devices are used interchangeably.

The current developments in technology which authorized the use of Bluetooth and Wi-Fi have enabled various devices to have ability of connecting with each other [3]. Using a Wi-Fi shield is to opera

tion as a Micro web server for the Arduino extract the need for wired connections between the Arduino board and computer which minimize cost and enables it to work as a standalone device. The Wi-Fi shield needs connection to the Wi-Fi internet from a router and this would act as the gateway portal for the Arduino to communicate with the internet server. With this in mind, an online and offline based home automation system for remote control of home appliances is designed.

## 2. SYSTEM DESCRIPTION

Our designed home automation system is a flexible system that can control and make a communion between nearly all load appliances of the house. All appliances can control from indoor also outdoor from any places. Our automated home can be called a smart home. If one forgets to switch off the lights or other appliances while going out, it allows you to turn off the appliance with your cell phone. By using web app, you can get status of your home and also can control your home power devices. This is a simple automation system which contains remote mobile host controller and several home appliances. We have several features in this project. We implement home automation using Bluetooth, WI-Fi, Temperature Sensor, PIR (passive infrared sensor), Light Sensor, and Gas Sensor. At first, we set up Bluetooth then Wi-Fi. The main features of this system are:

- Control through android mobiles.
- Control by Web Server where device I capable

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of recognizing the user.

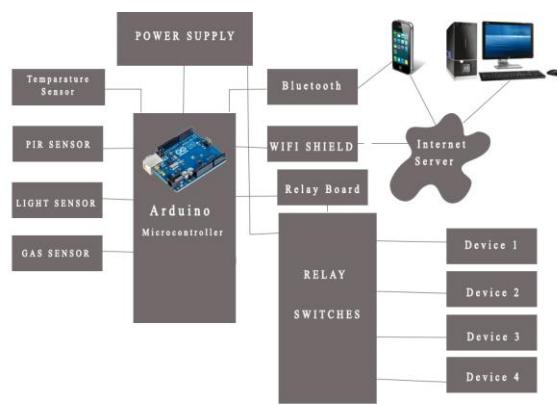
- The user can control appliances through Web Browser.
- Another feature is detecting humans or intruders by using motion detector or PIR sensor.

While the development of the first four features of this system has been completed, the last one feature is still under development.

### 3. OVERVIEW OF THE SMART HOME

The block diagram of the smart home automation system is shown in figure 1. A micro-controller which set on Arduino is used to gain values of physical environment through sensors connected to it [4]. These integrated sensors module such as the temperature sensor read the temperature values, the gas sensor device detects smoke and cooking gas to avoid fire outbreaks. The automatic switching on and off of the light of the rooms is controlled by the Light Dependent Resistor which visualize the day light intensity. All this information's from sensors also sent data to the Arduino for record the switching devices. To incorporate security in our design, a movement detector is integrated using PIR Sensor to identify movements of any objects or human in the home when the security system is turned on.

The relay switches which connected to the relay board is used to send control signals from the Arduino to the electronic device through the relay used to achieve the power on and off actions. A web gateway is designed with a one-factor authentication system (required username and password) to check authenticity of the home user for security purpose. It acts as an input device to control the appliances and also acts as an output device to read the value of physical conditions. The mobile application is also utilizing this same procedure to act as an input or output device.



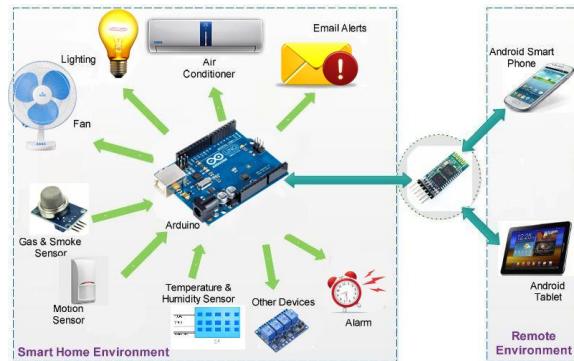
*Figure 1 Block Diagram of the Smart Home System*

### 4. DESIGN AND IMPLEMENTATION

In Our Design a low cost and efficient smart home

system is presented. Here are two main modules in this system: the interface module of Hardware and the module of software communication. At the heart of this system is the Arduino Uno R3 microcontroller which is also able of operates as a micro web server and for all the hardware module interfaces. All of the communications and controls in this system data pass through the microcontroller.

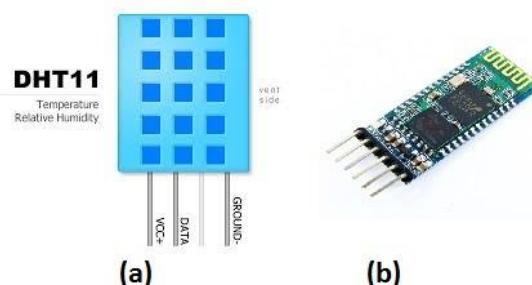
Here we can see in figure 2, the smart home system offering characteristic such as environmental control using the temperature, humidity, and gas and smoke sensors. It also offers power switching feature to control lighting, fans/air conditioners, and other home appliances are connected to the relay board. Another feature of this automation system is the intrusion detection of any object or human which it offers using the motion sensors and all these can be controlled from the Android smart phone application or web application.



*Figure 2 System architecture of the smart home system.*

### 5. HARDWARE MODULE

Arduino can feel the community by receiving input signal from array of sensors and can alter its environment along actuators [5]. An analog heat sensor is a chip that tells you what the surroundings heat is. The DHT11 is a primary, ultra- cheap-cost digital temperature and human movement sensor [6].

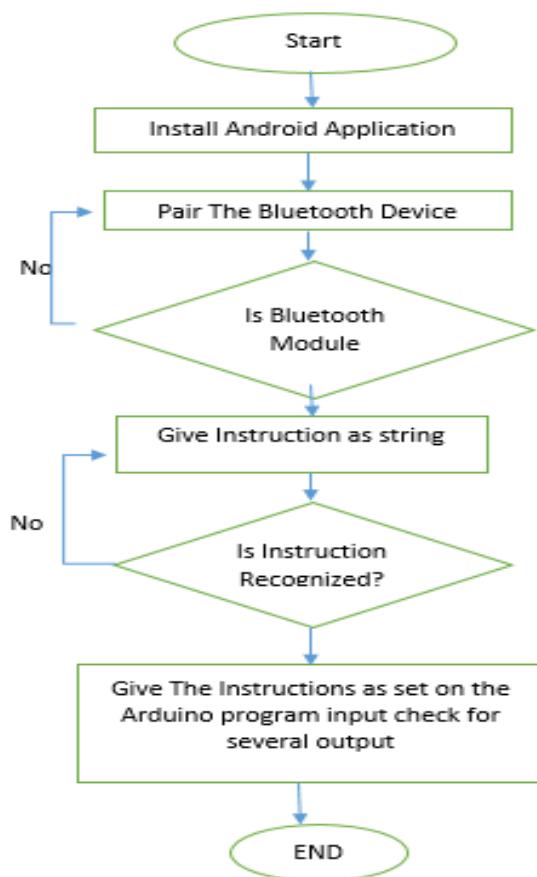


*Figure 3 (a) DHT11 Sensor (b) HC-05 Bluetooth Module*

It uses a capacitive human movement sensor and a thermistor to measurement the surrounding air, and

brand out a digital signal on the pin of data (no need any analog input pins). It is categorically easy to use, but prescribes safe timing to grab data. The only actual downside of this sensor is that you can only get newest data from it once each 2 seconds, so when manage our library; sensor indication can be more than 2 seconds old.

HC-05 Bluetooth module designed for transparent wireless serial connection setup and easy to use as Bluetooth SPP (Serial Port Protocol) module.

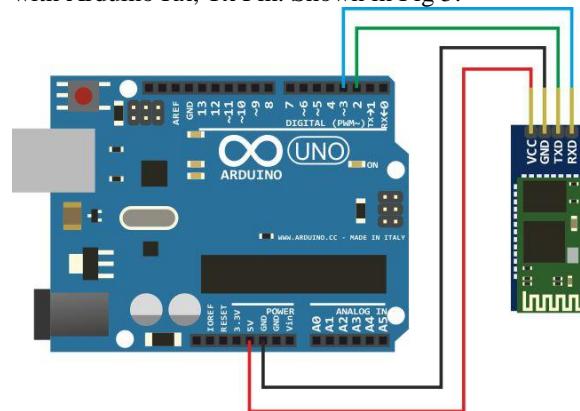


*Figure 4 Flowchart Procedure for Bluetooth Connect and Giving Instruction*

Serial port of Bluetooth module HC-05 is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver. CSR Blue core 04-External single chip its uses Bluetooth system with CMOS technology and with AFH It has the footprint as small as 12.7mmx27mm. We Hope it will simplify your overall design/development cycle.

Our first work is using Bluetooth. To create the Bluetooth connection, we needed one Bluetooth device, one Arduino, two input one channel relay shield, one android app to control the system and two bulbs to be able to demonstrate how the system works. Now we describe how the whole system was combined by

us. The Bluetooth module HC-05 has 4 pins, which are Vcc, ground, Rx, and Tx. Rx is the receiver and Tx is the transmitter. We connected Bluetooth Rx, Tx with Arduino Rx, Tx Pin. Shown in Fig 5.



*Figure 5 Bluetooth Module Connected Through the Arduino*

The Passive Infra-Red sensor assume one to sense movement motion, nearly always and is used to find whether a human moved inside or outside of the sensors limit. PIR sensor is a pyroelectric instrument that discovers movement motion by measuring variations in the infrared level emitted by adjacent objects. This movement motion can be found by examine for a high level signal on a signal I/O pin. They are small amount, inexpensive, lower-power, simple to use. For that purpose, they are generally found in machinery and gadgets used in homes or offices.

The MQ series of gas detector is used for a small fireplace inside with an electro-chemical sensor. These are impressionable for a limit of gasses and used in inside at room temperature. The output will be analog signal and can be read by an analog input of the Arduino. The Gas Sensor is necessary for gas leakage find out in home and office. It can find LPG, propane, methane and alcohol, hydrogen and smoke. Some of those modules have an integral part of variable resistor to synthesize the sensibility of the sensor.

To qualify connectivity on the microcontroller, a Bluetooth module HC-05 and for internet server connectivity Wi-Fi shield is used. The Bluetooth take steps connectivity via the serial I/O pins on the Arduino with the Android based Android mobile application instruct with the microcontroller. The Wi-Fi shield makes internet connectivity for the embedded web server which assumes internet accessibility and controls through a web application.

Our android application software was developed using the Google App-Inventor Integrated Development Environment (IDE) and Java programming language. The app has both a Bluetooth module and a Wi-Fi module which interfaces with the micro-

controller and allows the android smart phone to transfer data with the micro-controller effectively and efficiently. Range is approximately 10 Meters (30 feet).

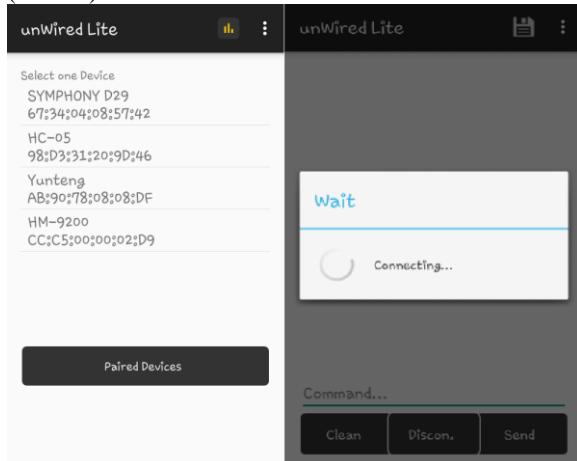


Figure 6: Smart phone app Device list page and Command page after connected to the module

The android application allows the user to control devices and monitor conditions in the home using the Bluetooth module connection. The android app is efficient, flexible and has a user friendly Graphic User Interface (UI). The app has a user authentication page to verify that the authorized user is logged in and has full control of the home-appliances. The app Device list page and Command page after connected to the module are shown in figure 5.

## 6. ALGORITHM AND PSEUDOCODE

Here we have implemented simple search and take decision algorithm. The algorithm which we have implemented the pseudo code is following:

**Gas detection code:** If gas sensor detects abnormal gases, then alarm system activates (light change, sound alarm, send SMS, auto call), then gas controller activates, open windows and open ventilation system.

**Smoke detection code:** If smoke sensor detects any abnormal amount of smoke, alarm system activates (sound alarm, light change, send SMS auto call), then the smoke controller power up, open sprinklers, open ventilation system, dissolution come down fire, smoke and insulation to isolate the scene of fire for the rest of the house.

**Vibration detection code:** If vibration sensor detects any vibration on the building (glasses or door breaking), the alarm system will activate (sound, light will change, send SMS, auto call), then the controller closes all windows and doors with iron windows and iron doors for safety.

**Motion detection code:** If motion sensor activates and detect any kind motion, alarm system activate

(light change, sound alarm, auto call send SMS), then controller close all windows and doors with iron windows and doors for safety.

## 7. WEB APPLICATION

This modern age is based on the internet communication. Bland by name and superficially viewed as gee-whiz technology never to be convinced, the IoT has meaningful efficient to transform business. IoT is an inspiring technology which allows different things and devices to be controlled with the internet. At its heart, IoT is an extensive-ranging ecosystem of everyday anatomical objects connected to the Internet, capable of identify themselves and informing data to the objects on the internet network [9]. In this work it is implemented using the Arduino hardware as a micro web server which will connect by the Wi-Fi shield through which we can connect to the hardware's and receive status updates from them and then send control information's to the microcontroller of Arduino.

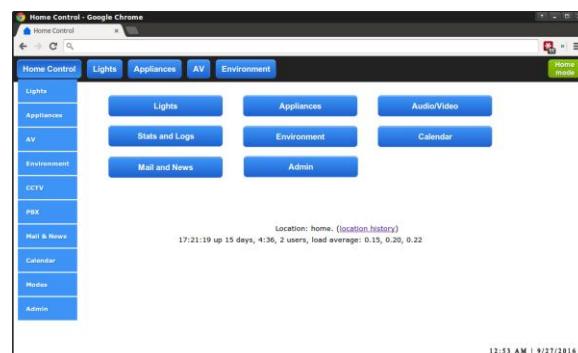


Figure 7: Showing a logged in user profile.

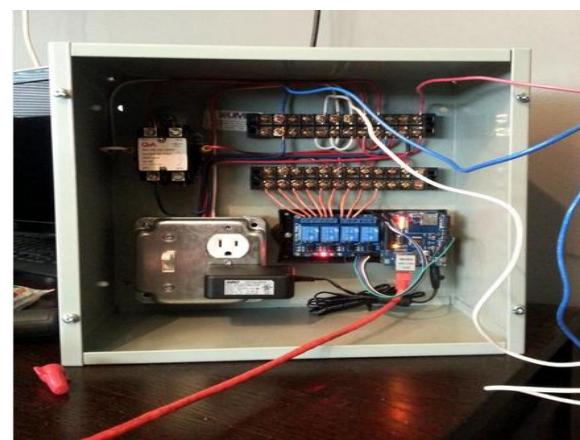


Figure 8 Arduino and modules are inside on Board for implementation.

For our web application, which is shown in figure 7, we used Sublime Text Editor as our programming environment and we used Hypertext Pre-Processor (PHP) for back-end and also JavaScript (JSON) and

also Ajax (for user validation) for our programming languages. The design of the website pages was chosen to be in metro mode as it gives user friendliness and also a gorgeous display of the web items as in figure 7.

The web application will control the Arduino micro controller by passing through the information data to it as converted codes. In this case, the Arduino micro-controller device work as a client and the PHP will work as a server (Xampp, IIS or Apache servers can be used) because PHP is not a client based programming language. The web page will display all the variables value being read from the micro-controller and also be able to perform the functions as the mobile application. The Wi-Fi shield connected with the Arduino board will be the link between the web pages and the Arduino. When connected to the IP address of the Arduino, the PHP and the Ajax http request will be able to send information over this IP address which in turn is interpreted by the Arduino. Here is an Implemented Hardware Board shown in Fig 8.

## 8. RESULTS

All the implemented features of this project are functionally working. This project includes Android based control and sensors based detection of home intrusion that is actually the main part of security and privacy mechanisms. Others are Bluetooth system, Wi-Fi auto synchronize system that are also helpful for security and privacy. We are successfully done with our proposed hardware devices implementation of the project. All five features are working as expected.

## 9. CONCLUSION

We have implemented here a prototype for lower cost, flexible and Secured home control and automation system using Android based Smart phone. The presented design utilizes a web server and Bluetooth communication as an application layer for communicating between the remote user and the microcontroller connected home devices. Any Android based Smart phone with made to support for Bluetooth and Wi-Fi can be used to access and control the devices at home. Our Future Implementation plan is, when a Bluetooth or Wi-Fi connection is not available, mobile phone networks such as 3G or 4G internet network can be used to access the system and including the SMS and call alerts, and reducing the wire changes for installing the shown hardware system in pre-existing houses by creating a wireless network among the home environment for directing and watching the smart home environment and synchronize the history of every instruction given by the device controller.

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