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## Home automation using Arduino with android application

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### ABSTRACT

*In Today's world almost everyone has a personal smartphone or a smart device. With the help of Home Automation using an Android application one can quickly do everyday household tasks with touch of a finger. Nowadays automation is playing a key role in making our life easier and maintaining our safety and security. With the help of automated tasks one can very easily control the lights, increase or decrease the temperature of the room using smartphones. Home automation has been a major area of research in recent times. Home automation based on android platform is designed to interface Arduino (8-bit microcontroller) to control a number of home appliances like lights, fans, bulbs and many more using Relay. Bluetooth has been used for short range communication. Different types of sensors have been used which are explained below. This paper provides a modern approach to automate the household appliances and eliminate the traditional method of switching. It is a step towards to ease the daily household tasks and help the elderly and disabled people.*

**Keywords**— Home Automation, Bluetooth, Arduino Uno, Relay, Smartphone, Android

### 1. INTRODUCTION

From simple to smart, mobile phones have transformed dramatically and are becoming communication and information hubs. With the advent of Android, many mobile applications have been developed. Smartphones are already equipped with many features and can be made to communicate with any other device with a proper connectivity options like Bluetooth or Wi-fi. Today, electronic appliances like fans, lights, air conditioners etc. are used in every other home. There is a large demand for smart home automation, where appliances react automatically to the changing environment. With the revolution in home automation these electronic devices can be easily controlled through our smartphones.

Automation system reduces human labor and makes our home a more comfortable and livable space. It also manages energy consumption which helps us in saving both our time and money. Besides that, it also eases the work of senior citizens and disabled people and helps in maintaining the security of our home.

The project mainly deals with the Android-based home automation system. The proposed system uses Bluetooth Hc-05 module for efficient short-range wireless communication. Additionally, there is a severe need to detect temperature, fire or gases as they can be deadly. Different sensors like DHT11 and MQ5 have also been interfaced with Arduino to ensure the safety of home.

This project represents a possible solution whereby the user controls devices by using their mobile phones. This paper provides a modern approach to enhance home automation and eliminate the traditional method of switching. Home Automation System is an advanced technology to ease our daily tasks by connecting numerous appliances and controlling them with a single Android application. This paper illustrates the design and implementation of a low cost and reliable home automation system.

### 2. LITERATURE SURVEY

In recent years, different Home Automation Systems came into existence.

**N. Vikram and K. S. Harish** [5] designed a cost-effective model of home automation using Wi-fi. It is based on the concept of internetworking of smart devices. In this system the user can easily control the devices via the Android application based Graphical User Interface (GUI) on a smartphone.

**Toufiq Ahmed, M.J. Alam** [8] designed a PLC based home automation system with smart scheduling. A Logo PLC system

was used as a central controller. They used wired x10 technology which is a protocol for communication between the electronic devices.

**Nelsha Wilfred** [5] worked on IOT based home automation system. They used wireless sensors to control and monitor the home appliances. They worked on home automation using the internet of things. IoT provides a platform that allows devices to connect, sensed and controlled remotely across a network from anywhere around the world using the internet connection.

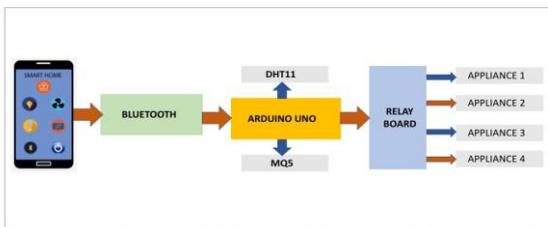
**Shrikrushna Khedkar, G. M. Malwatkar** [2] presented a Raspberry Pi and GSM based home automation system. For RPi operation the programming language used was Python.

**Pasd Putthapipat, C. Woralert** [3] proposed a speech recognition gateway for home automation system using PiFrame framework. Users are able to implement more functionality to the system.

**P. N. Arathi, S. Arthika, K. Srinivasan** [5] introduced to gesture-based home automation system. In the proposed work MATLAB and object detection algorithm was used. Firstly, an image is captured by the camera and then it is processed by the MATLAB. If the present gesture is matched with the existing gesture then only data is sent to the microcontroller. This model uses a PIC microcontroller and GSM to control the devices.

### 3. SYSTEM ARCHITECTURE

In this project we have used an open source android platform. Arduino and Bluetooth based Home Automation allows the user to control any home appliances using the Android application through their smartphones. This project also detects the temperature and humidity and monitors CO2 content in the house by DHT11 and MQ5 Gas sensor respectively. It alerts the user by making an alarm sound, whenever a certain amount of smoke/gas gets detected.



**Fig. 1: Block diagram of Bluetooth based home automation system**

For this project we need an Arduino Uno with Atmega328p microcontroller, HC-05 Bluetooth module, Relays, Gas sensor, Temperature and Humidity sensor. The user sends the command using the android application to the controllers via wireless communication that is Bluetooth.

The user must be present within range (<15 m) to control the system. Relay board is interfaced with the Arduino and different home appliances can be connected to it. It acts as a switch between the devices and the controller. When the user presses the 'On' button displayed on the application for the device; Arduino pin goes to high state and the device is switched on.

The device can be switched 'Off' using the same button but this time the Arduino pin goes to low state. We can connect all the other devices in similar fashion.

By default, Bluetooth module has been set to slave mode and is used to communicate with the controller and the Android application. The Android application is created by MIT App Inventor. The proposed project can also control the devices using Voice Control method.

A microphone is implemented in the Android application where the users can give the command through the microphone and can easily control the home appliances.

### 3.1 Android App



**Fig. 2: Android application**

## 4. HARDWARE PREREQUISITES

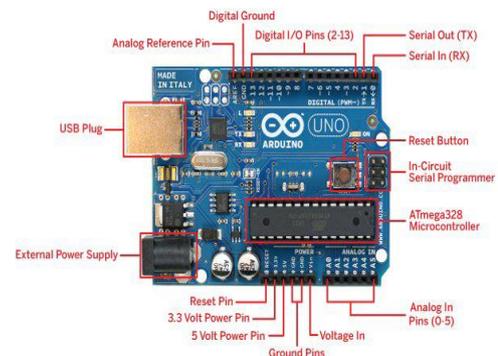
Many kinds of hardware are required in this project which are as follows - Arduino Uno, Bluetooth HC-05, Relay Module, Temperature and Humidity sensor (DHT11), Smoke and Gas sensor (MQ5), Buzzer, LCD etc.

### 4.1 Arduino Uno

ARDUINO UNO is an 8-bit open-source microcontroller. It is based on ATmega 328p (a single-chip microcontroller created by Atmel). ARDUINO UNO is the simplest and easiest board to operate. 14 digital input and output pins are present in it (of which 6 pins may be used as PWM outputs).

It also contains 6 analog inputs, a 16 MHz quartz crystal for providing clock signals, a power jack. An ICSP (In Circuit Serial Programming) header is also present that lets the microcontroller receive the program (Bootload an Arduino).

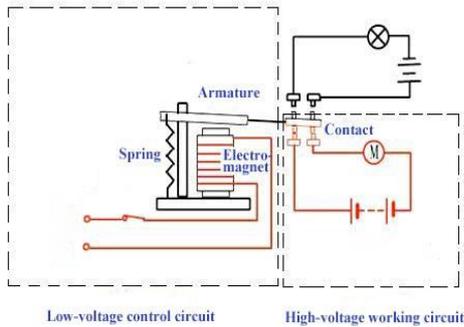
For better connectivity, a USB connection is present and a reset button to overcome any failure. It has an operating voltage of 5 volts, frequency (clock speed) of 16 MHz, 32 kB of flash memory, 1 kB EEPROM and 2 KB RAM.



**Fig 3: Arduino Uno**

### 4.2 Relay Drivers

Relay is an electromagnetic switch which can turn on or turn off a circuit. It allows the connection of two circuits magnetically as it is based on the principle of electromagnetic attraction. An electromagnetic relay consists of an electromagnet, spring, armature, movable and stationary contacts.



**Fig. 4: Working of Relay**

As shown in the above figure, there are two circuits in a relay: A low voltage control circuit which includes an electromagnetic relay coil, a switch and a low voltage power supply; ii) A high voltage working circuit which includes a high voltage power supply, a motor and the contacts of the relay. When voltage is supplied to both ends of a coil, current flows through the coil and generates an electromagnetic effect. When spring is under tension then the electromagnet will attract the armature to the iron core, to pull the movable contact of the armature to the stationary contact (normally open contact, or NO).

When no voltage is supplied, the electromagnet loses all the attraction and the spring is relaxed; the armature will restore its original position to release the movable contact from the stationary contact (a normally closed contact or NC). This pulling and releasing mechanism controls the opening and closing of an electric circuit.



**Fig. 5: Relay module**

#### 4.3 Bluetooth Module

HC-05 Bluetooth is interfaced with Arduino Uno to connect it with the Android application. It is a class-2 Bluetooth module with Serial Port Protocol (SPP) specially designed for wireless serial communication. It can be used in a Master or Slave configuration but by default factory setting is Slave. It is basically used for short-range wireless communication to connect devices like mobile phones, TVs etc. It operates on 2.4 GHz ISM frequency band and has a maximum range up to 20 metres. In total, it has 6 pins - Enable, Vcc, Ground, Tx, Rx and State; which are connected with the Arduino for stable communication. It has two modes: Command mode and Data mode. In Command mode it has a baud rate of 38400bps and uses AT commands to change the default settings. In Data mode it has a baud rate of 9600bps and are used to exchange data between the devices.



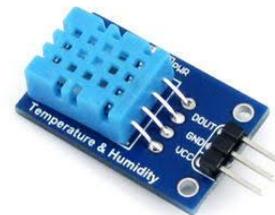
**Fig. 7: Bluetooth Hc-05 module**

#### 4.4 Temperature and Humidity Sensor (DHT11)

DHT11 is a low cost and reliable humidity and temperature sensor. It can be interfaced with any microcontroller and get instantaneous readings of temperature and humidity.

It can be used as a sensor (pull-up resistor) and as a module (power-on LED). It is a small-sized sensor with an operating voltage of 3 to 5 volts. This sensor has humidity range from 20% to 80% with an accuracy of 5% and a temperature range from 0°C to 50°C.

It uses a Negative Temperature Coefficient Thermistor to measure the temperature and a Humidity Sensing Capacitor to measure the humidity. DHT11 module contains 3 pins - Vcc (for power supply), Ground (connected to the ground of the circuit) and Data pin (outputs both Temperature and Humidity through serial data)



**Fig. 8: DHT11**

#### 4.5 Gas Sensor (MQ5)

MQ5 is a gas sensor which detects the presence of gas in a specific area. Each gas has a unique breakdown voltage (the electric field at which it is ionized). This sensor identifies and interacts with the gas by measuring these breakdown voltages and also measures their concentration.

The concentration is measured by the amount of current discharged in the device. Various gases such as hydrogen, carbon monoxide, methane and LPG ranging from 100ppm to 3,000ppm can be detected using this sensor. The sensitivity of the sensor can be set by using the potentiometer. MQ5 module is very useful for gas leakage detection in home and industry. Measurements can be taken as soon as possible due to its high sensitivity and fast response time.



**Fig. 9: MQ5**

### 5. SOFTWARE PREREQUISITES

The following software is required: ARDUINO IDE, MIT APP INVENTOR.

#### 5.1 Arduino IDE

Arduino Software (IDE) is an open source software where we can easily write our codes. IDE is supported on Windows, Mac OS X, and Linux. It is based on Processing and another open-source software and the environment is written in Java. Any Arduino board will be able to use this software.

It contains the following: i) Text editor for writing code, ii) A message area, iii) Text console, iv) A toolbar with buttons for common functions, v) Series of menus. It connects to the

Arduino and Genuino hardware to communicate with them by uploading the programs. IDE uses the concept of a sketchbook: default place to store the programs. The Programs which are written using this software are called sketches. They are usually written in the text editor and are saved with the file extension .ino.



Fig. 10: Arduino IDE

implemented. The proposed system used a smartphone application to control the home appliances. This system reduces the human labor and also eases the work of disabled and elderly people. It can control devices using voice, touch and by Bluetooth connectivity.

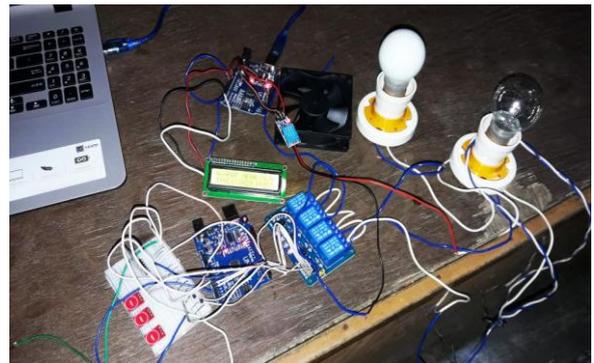


Fig. 13: Experimental setup

### 5.2 MIT APP Inventor



Fig. 11: MIT App Inventor Logo

With the help of App Inventor, you can develop applications for Android phones using a web browser. The App Inventor servers' stores and keep a track of your projects. You can select the components for your app using App Inventor Designer. You can assemble program blocks (that specify how the components should behave) using the App Inventor Block Editor. The programs are assembled visually by fitting pieces together like pieces of a puzzle.

As you add pieces to it, your app appears on the phone step-by-step so you can test your work as you build. When everything is completed you can package your app and produce a standalone application to install. The App Inventor development environment runs on Mac OS X, GNU/Linux, and Windows operating systems, and several popular Android phone models. The applications created with App Inventor can be installed on any Android phone.



Fig. 12: MIT App Inventor Software

### 6. RESULTS

Final hardware setup is shown in the figure below. The android operated smart home automation system was designed and

### 7. CONCLUSION

In this paper we have introduced design and implementation of a low cost and flexible home automation system. The project was working properly and the home appliances connected were easily controlled with the mobile application.

The full functionality of the home automation system was tested and the wireless communication between the mobile phone and Bluetooth was found to be limited to <50 m in a building. The Bluetooth client was successfully tested on different mobile phones from different manufacturers.

By using this method, home appliances can be controlled to avoid dangers like electric shocks and makes it convenient for the users to operate them. It can also alert people when smoke or gas is leaked in the home.

This project can be used to make commercial scale products with few additions and modifications. For future work, this project can also integrate with wireless cameras, in order to incorporate other security features of smart home automation systems. We can also use password protection to access our android application.

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