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# Low Cost Smart Home Design

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## Abstract

In this paper, we are presenting the design of a smart home which is controlled by Arduino microcontroller and an android based smart phone. It controls the switching of all household appliances besides controlling the speed of a fan, brightness of a lamp using a mobile phone. This paper also presents a low cost smart door controlled via an electromagnet. Our system includes an android based smart phone, a Bluetooth module, Arduino microcontroller and various domestic appliances. Thus this work aims for a low cost smart home design available to all sections of the people.

**Keywords:** Android, Arduino, Bluetooth, Relay, Smart Home, TRIAC

## 1. Introduction

Gradually the world is moving into the arms of technology. It is becoming an issue of increasing priority that whatever be the system should be remotely and wirelessly controlled. This advancement of technology to comfort the needs of individuals led to the development of Smart Homes. A Smart Home is nothing but to control various domestic appliances wirelessly and remotely. In place of the existing complex electrical wiring we make use of controllers to reduce the wiring and increase the ease of accessing to these appliances. With the advent of Smartphone's life became a whole lot easier as with a single mobile application we can control a complex system. For example, parking a vehicle can be done using a mobile application.

The aim of us doing this project is to design as well as implement a wirelessly controlled Smart Home.

Here, we are using an android based smart phone as an user interface and a Bluetooth module for the interface between the mobile and the Arduino microcontroller. However we may also a Zigbee module for increasing the range of controlling. Arduino works as a medium of communication with the domestic appliances. To interface mobile and the Arduino, we developed an android application with which we are going to control the appliances. We are also using an electromagnetically operated door which gives safety to the home and gives a buzzer in case of forceful entry. Moreover such a system is eco-friendly.

The paper is organized as: Section II existing designs of smart home, in section III, we present our design. Finally, in section IV, we give our implementation result and the advantages of this design.

## 2. Existing Smart Home Designs

Number of home automation devices existing in the market is of use only for the sub products which the brand produces as a whole, but some of them are compatible with standard technologies like Insteon, X20, Z-wave, etc. The major difference between the products is the interface between the user and the controller. Some systems may require a PC with a custom made software while others may be web compatible, so that we can control using a mobile or any other device having an internet facility. Few of the systems readily available in the market are Belkin's Wemo that allows controlling almost all home appliances through an app, but is relatively costlier. All most all systems for home automation are costlier. Here we propose our design for a relatively low cost smart home design.

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## 3. Our Proposed Design

Our proposed system consists of an android based smart phone, a basic need these days making it as zero investment, a Bluetooth module and an Arduino microcontroller, which is the heart of the entire system.

As we know, most of the household devices at present work on A.C supply. But as the output from the Arduino is D.C., we used a relay driver circuit to interface the ac appliances with the Arduino so as to trigger the appliances.

The figure below shows the sequential procedure of our design.

Here we are using an android mobile as the user interface and the Bluetooth module for the interface between the mobile and the Arduino. The relay driver circuit is used as a mode of communication between the A.C appliance and the output of the Arduino. We used ULN2803 IC to actuate 8 different devices by triggering 8 different relays. At a time 8 relays can be connected to one single ULN2803 IC there by it is possible to control the state of 8 appliances using a single ULN2803 IC. We can conveniently increase the number of IC's as the number of appliance to be controlled increase. We also used a TRIAC circuit to control the brightness of a bulb and speed of a fan.

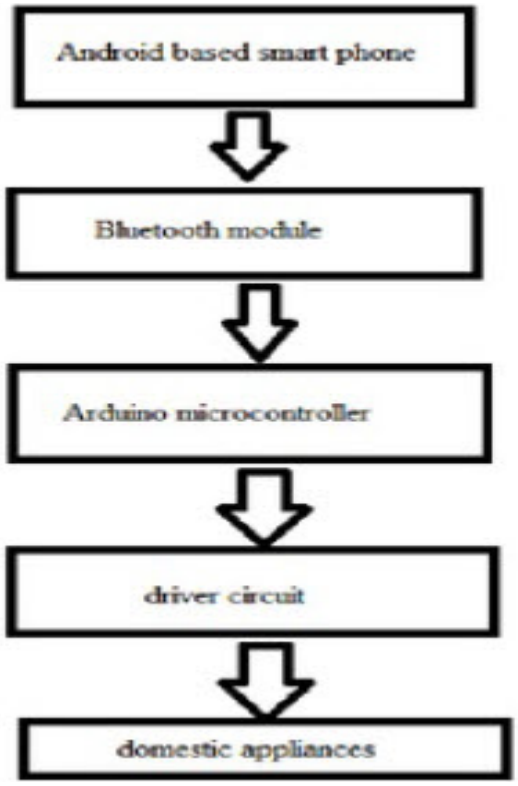


**Figure 1.** Sequential flow chart of the entire process.

Now let us go for a detailed description:

### 3.1 Relay Driver Circuit

As shown in the figure, this circuit consists of a ULN2803 IC, relays and an external 12V dc supply. This circuit is mainly used to actuate ac appliances i.e. switch on and off an ac device. This is done as follows:

The relay which is generally in normally open position, when receive an excitation signal comes into normally closed position thereby closing the contact of the ac appliance connected to it and the ac supply.

### 3.2 ULN 2803 IC

Generally ULN2803 IC is used to interface TTL logic to high voltage or current loads. In our project this IC is used to actuate number of relays i.e. we can connect 8 relays to this IC, thereby reducing the overall size and cost. ULN22803 IC is also used here to connect the 5V Arduino output to the 12V relay.

### 3.3 RELAY

A relay is nothing but an electromagnetic switch. It consists of two input coils to connect the input terminals, command coil to vary between the NC (normally closed) and the NO (normally open) coils and output coils. Based on the triggering we can switch between the NO and NC coils.

### 3.4 Speed and Brightness Control of Fan and Light

Unlike in other designs where only on and off of the devices is done, we are also implementing the speed control of

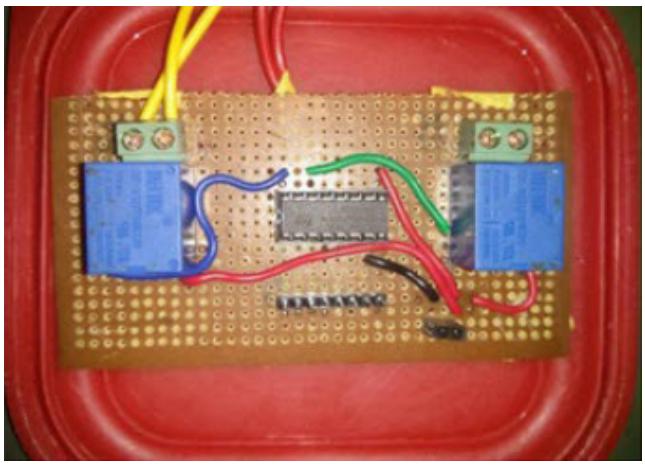

**Figure 2.** Relay driver circuit.

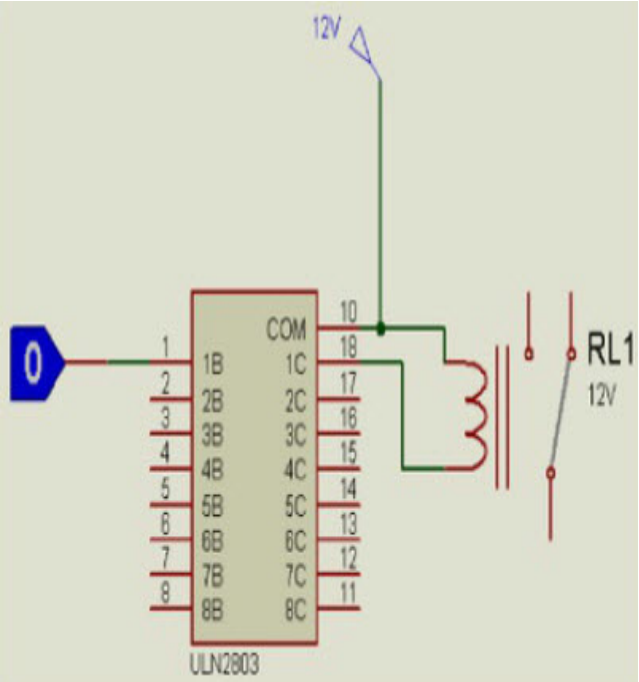


**Figure 3.** Pin diagram of ULN2803 IC.

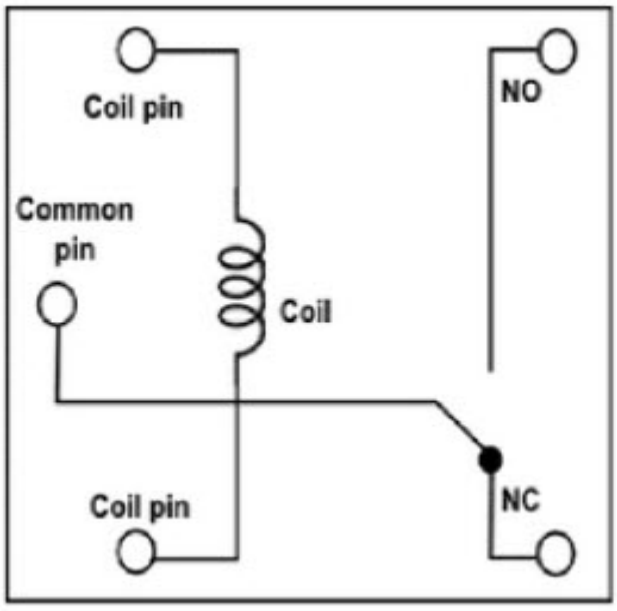


**Figure 4.** Schematic diagram of relay.

single phase induction motor and the brightness control of the light.

For this, we are using a TRIAC circuit as shown below:

A TRIAC is a bidirectional device used for switching purposes of the alternating current. By varying the supply

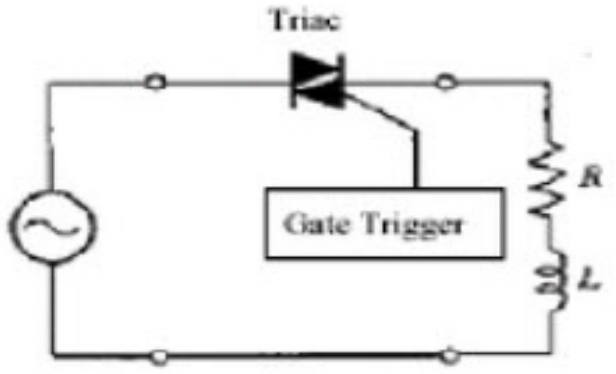


**Figure 5.** TRIAC circuit.

given to the gate terminal of the TRIAC, we can control the input to the ac device and thereby we can control the brightness of a light and speed of a fan using this driver circuit.

By using the PWM from the Arduino we can vary the supply to the gate terminal and can control the operation of the ac appliances

## 4. Implementation

As said earlier we are using a mobile phone as the interface between the user and the arduino. We develop an app called Smart controller for this purpose through which we can control the switching state and operational characteristics of various ac devices.

We are using a Bluetooth module for establishing the connection between the mobile and the Arduino micro controller.

Arduino program algorithm:

Step 1: Check if data is available

Step 2: Receive data from phone via Bluetooth

Step 3: Compare it with the pre-programmed commands

Step 4: If the received data matches with the pre-programmed data, take corresponding action

Step 5: In case of miss match, ignore the data

Now the output of the Arduino is given to the relay driver circuit where we are using 3 relays and a ULN2803 IC for switching on and off the ac appliances. We configured pins 1, 3, 5 of the IC as the input pins (connected through the Arduino) and pin 9 as the common ground. We are using a 12V dc adapter to supply the relay driver circuit. This set up is just to trigger the appliances.

Now to control the operational characteristics, we are using a TRIAC circuit as shown above. Based on the gate pulse triggering we can control the speed of the single phase induction motor and also the brightness of the lamp. This TRIAC circuit gets actuated after the relay circuit gets triggered.

We are also implementing an electromagnetically actuated door for safety purpose. On forceful entry this door gives out a buzzer alarming the residents.

This design of the door is very cheap and robust than the other designs present in the market.

## 5. CONCLUSION

There by we can see that the cost of the entire design is hardly $50. The efficiency of any design is primarily dependent on minimising the number of connections which we efficiently handled in this design. Henceforth a low cost smart home design is presented and implemented.

## 6. References

1. Ghobril BKLM, Malek S, Kanj R, Kayssi A. Low Cost Arduino/Arduino-Based Energy-Efficiency Home Automation System with Smart Task Scheduling. 2013 fifth International Conference on Computational Intelligence, Communication Systems and Networks; 2013 Jun 5-7.
2. Yong Tae, Sthapit P, Jae-Young P. Smart digital door lock for the gome automation. IEEE Region 10 Conference; 2009 Jan 23; South Korea. TENCON 2009-2009; 2009.
3. Available: http://www. glacialwanderer.com/ hobbyrobotics