Remotely Controlled AC Power Switching via Hand phone

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***Abstract*- In the past, AC power switching is being controlled manually, where users normally switch on or off their electrical appliances, air-conditioning system by pressing the button manually. As technology advances, people communicate using telephone via telephone lines and as technology further advances, they communicate using hand phones. Apart from being use to communicate, it has also other applications such as to remotely control AC switching.**

Thus, the objective of this project is to develop an affordable low cost, portable, easy to use and versatile system that is able to control AC power switching via hand phone.

This versatile system can also do other task, such as, garden watering system, automatic pet feeder, remotely control of house appliance, light and air-conditioner.

The main development tools used for this system are ATMEGA328, DTMF SHIELD, 4 Channel Relay, Arduino IDE 1.0 and hand phones.

Due to its wide applications, it is hoped that the developed system presented has the potential to be commercialized.

Keyword: Arduino Uno, DTMF Shield, Four Channel Relay, Arduino IDE, Mobile Phone

I. INTRODUCTION

In today's life, people are so busy with their routine work and especially for those who frequently go outstation will find it difficult to manage or to monitor the safety of their house. The house breaking is a crime which is an illegal entry into another person building for the purpose of stealing. They are also called burglars or thieves. Nowadays, burglars are smart in undertaking their jobs. They usually monitor their victims' movements by observing whether the owner has gone outstation or the house is empty.

"Malaysians observe a number of holidays and festivities throughout the year. Some holidays are federally listed public holidays and some are public holidays observed by individual states. Other festivals are observed by particular ethnic or religion groups." [1]. In Malaysia, house breaking are very rampant during the festive season as most people will leave their house for a few days to go back to their hometown or will go for a holiday. Burglars will normally target houses that have not switched on their lights for a few days; an indication that the owner has gone outstation.

With the Remotely Controlled AC Power Switching via hand phone, their home can be control just by a phone call to turn lights, television, and music on and off at regular times while they are out of the house to give the illusion that someone is home [2]. They feel more secured of intruders while they are off to work or on vacation.

This versatile system can be combined with other system that can suit the user's requirement. For the garden enthusiast, a garden watering system is an example that this system can facilitate and accommodate. By installing this system with some modifications such as adding some motor pumps, their gardens or indoor plants [3] can be taken care if they are away for a week or more just by using their hand phone remotely.

Since the design is portable, easy and cheap, it is suitable for those who are always on the move, that is, who frequently transfer from one place to another. They only have to bring these devices along them and install into their new homes rather than installing a new system that is very costly.

II. METHODOLOGY

This part will show the flow chart, block diagram and procedure of this project. The project consist four main components which is Arduino Uno microntroller, DTMF shield, four channel relay and mobile phone.

A. Hardware system

The figure 1 shows the flow charts of the Remotely Controlled AC Power Switching via Hand phone, which will show how the system works.

User will make a phone call using mobile phone 1 to mobile phone 2. Mobile phone 2 is attached to the system hardware. Before making any phone call, mobile phone 2 is set to automatic answer. Once mobile phone 2 receives a phone call and answer automatically, mobile phone 1 is then ready to press any key, that is, 1, 2, 3 or 4 depending on the coding that has been encoded.

The acts of pressing the key will results to an input to the microcontroller. The microcontroller will carry out the process depending on the command that has been encoded into the microcontroller. As an example, when user press key number 1, relay 1 will be turn on and in return send a double beeping sound to the user.

Thus, this indicates to the user that the switch is on. When the user press key number 1 once again, the buzzer will give one beeping sound; an indication to the user that the switch is off. All these actions are being controlled by mobile phone 1.

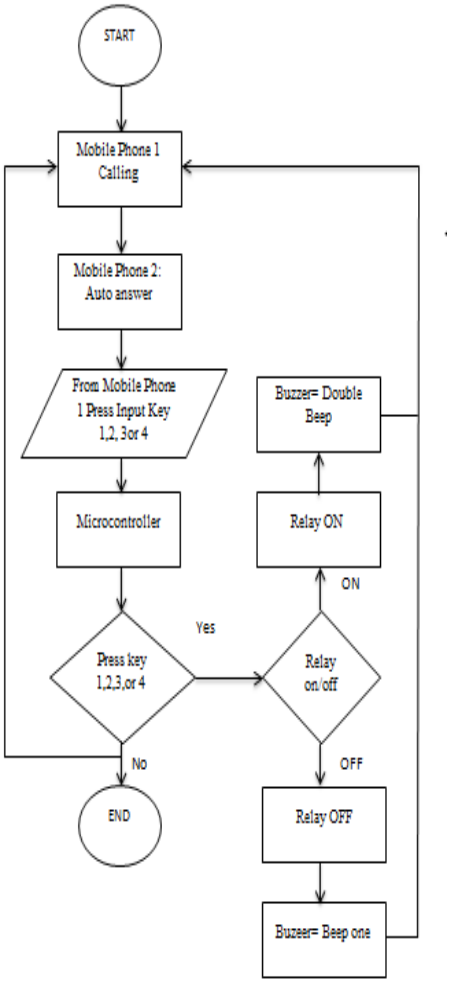

Figure 1: Flow Chart of Operation Remotely Controlled AC Power Switching via Hand phone

Thus, to further understand the project, a block diagram of the system is shown in Figure 2.

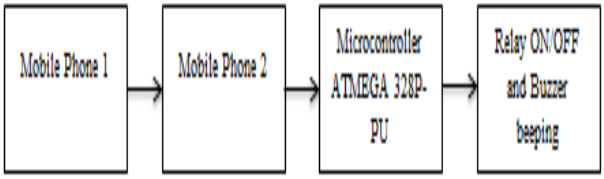

Figure 2: Block Diagram of the Remotely Controlled AC Power Switching via Hand phone

Toward archiving this project, there is need some plan and flow chart to be followed. The figure 3 shows the design process for overall project. The flow chart consists of combination between hardware design and software design flow. Each element of procedure in the flow block must be follow step by step archiving the project outcomes.

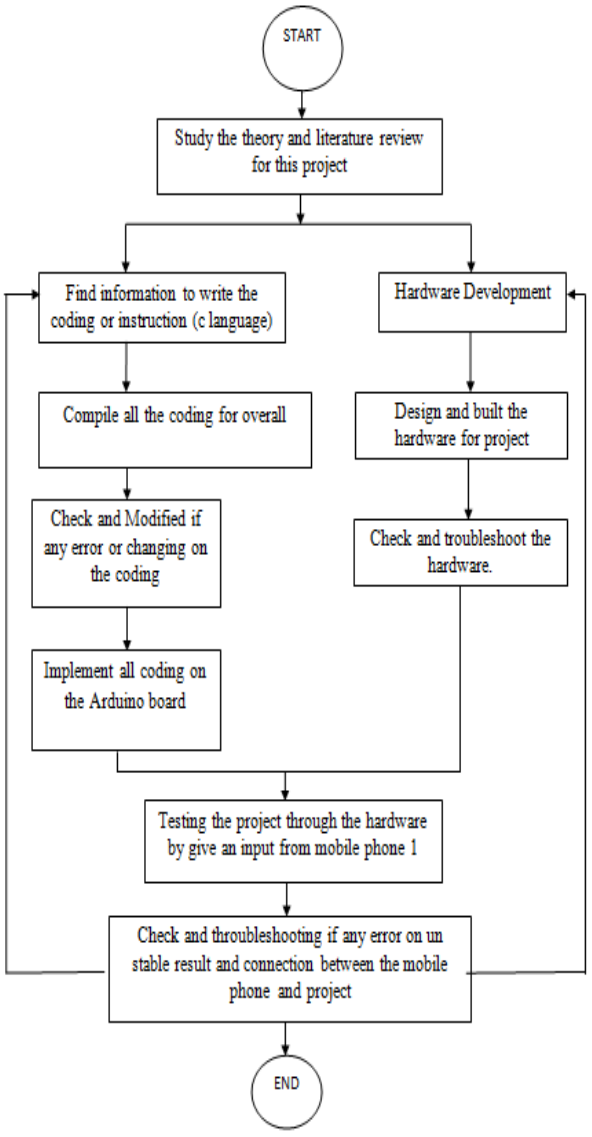

Figure 3: The Overall flow of design project.

B. Hardware Design

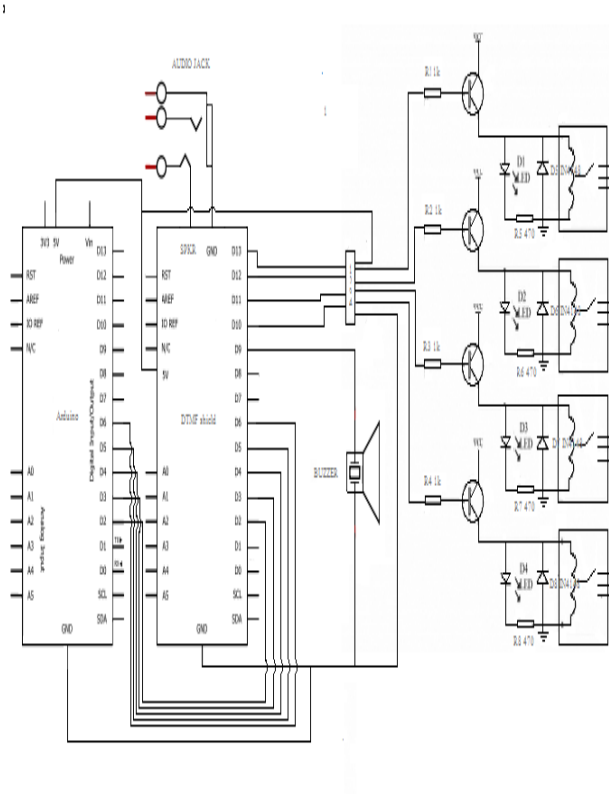

Figure 4: The schematic of the whole system.

The figure 4 shows the schematic of Phone Remotely Control AC Power Switching whole system. In the schematic diagram, the pin connections with the other components are shown. The type of microcontroller used in this project is Arduino Uno.

Figure 5 shows the microcontroller that is used in the project. For some reason of choosing this type of microcontroller is that, the Arduino is easy to use in term of hardware and software. Due to Arduino also known as is an open source electronics prototyping platform based on flexible usage [4,5], and then it can be combining to many things as long as the other component it work by respond to electricity.

Arduino Uno is specifically chosen for this project as it is easy to use in term of hardware and software. Since Arduino is also known as an open source electronics prototyping platform based on flexible usage [4,5], it can be combined with other system as long as it responded to electricity.

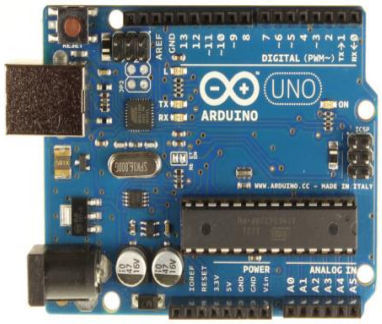

Figure 5: Arduino Uno

In this project, Arduino Uno will be the main brain to control the whole system of the project. Arduino Uno is using the ATMEL group microprocessor, which is ATMEGA 328P-PU [4,5,6,7]. The DTMF will be connected to Arduino Uno. Several ports will be reserved when the Arduino is stack together with the DTMF shield. Figure 6 shows the DTMF shield.

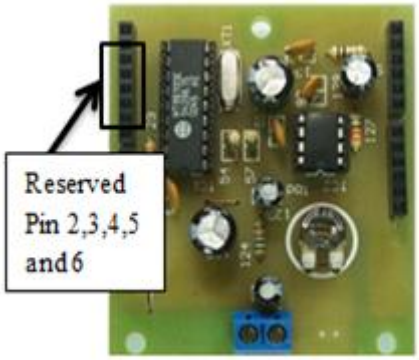

Figure 6: DTMF shield

When both modules are stack together, the reserve pin is 2, 3, 4, 5 and 6. Pin 2 until pin 5 will be used to generate value 1, 2, 4 and 8 for frequency identification. Pin 6 is reserved to check the state of readiness of the DTMF chip to accept and decipher DTMF signal. The figure 7 shows the Arduino Uno microcontroller and DTMF shield, when there are stack together.

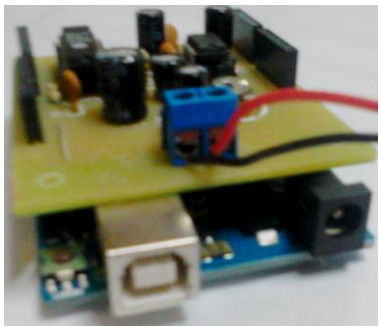

Figure 7: Arduino Uno stack with DTMF shield

The function of the DTMF shield is to recognize the signal of the mobile phone 1 when the key is pressed, the relay will then function depending on the pressed key [9]. When the key is pressed, two simultaneous tones are generated by the system. This will be decoded by the exchange to determine which key has been pressed.

Figure 8: 4 Channel Relay Modules

Subsequently, pin 10, 11, 12 and 13 will be connected to the relay module. The relays has been specifically chosen so that they are able to support 240V AC.

In the relay module, there are 5 LEDs that will show the status of the relay. One of the 5 LEDs is used to indicate whether power source has been connected to the module [10]. Figure 9 shows the whole connections of the hardware and how they are assembled.

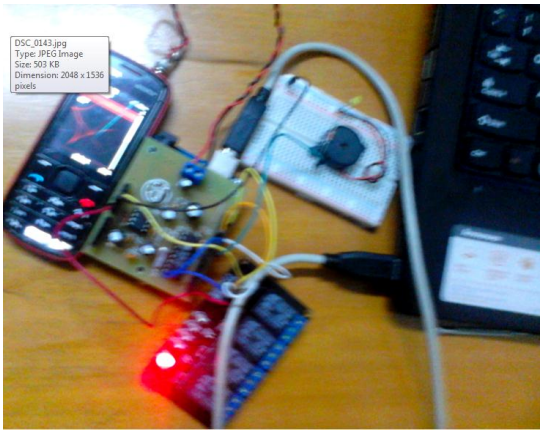

Figure 9: Testing and Troubleshooting

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C. Software Design

The Arduino Uno compiler uses a wiring-based language, that is, which using syntax and libraries to program the coding into the microcontroller board. The programming code language is quite similar to C++ with some simplifications and modifications, and a Processing based integrated development environment. Figure 10 shows the programming codes for Remotely Controlled AC Power Switching via Hand phone that has already been compiled to the software.

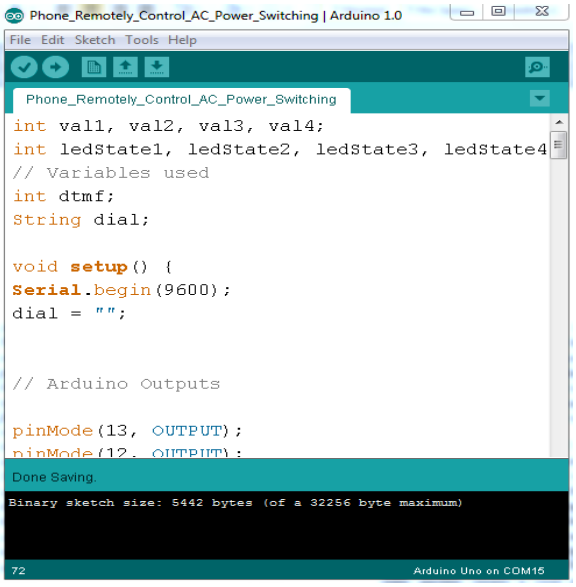
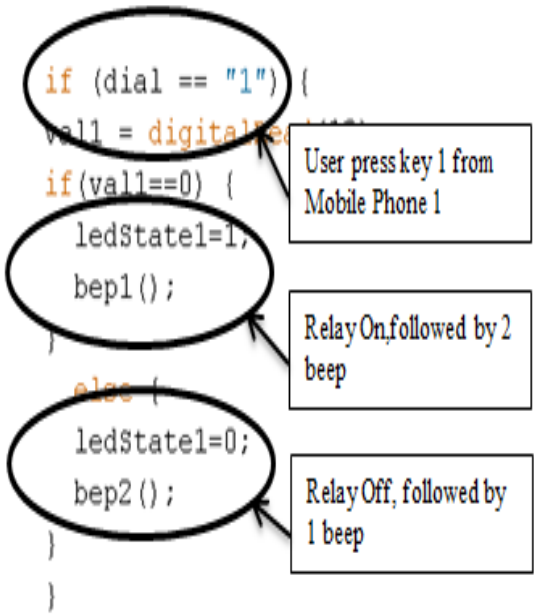


Figure 10: Program code to be compiled into software

The DTMF shield is directly interfaced to the Arduino, no libraries are needed here. Figure 11 shows an example of the coding when user pressed key 1, this will turn the relay on, then followed by 2 beeping. When the key is pressed again, the relay will be turned off and followed by 1 beeping sound



The figure 11: Part of coding example

III. Result and Discussions

Table I shows the different types of mobile phone used to test the system.

Table I: Testing the system using different types of mobile phones.

Type Mobile Phone	Received Input Signal
Nokia 206	Yes
Nokia Express Music	Yes
Samsung Gio	Yes
CSL i48	Yes
Sony Tipo	No
Samsung Pocket	Yes

The results from Table I showed that, out of 6 mobile phones that have been tested with the system. The important outcomes of this method is to do some experiments on how much and what kind of mobile phone that can be attach to the system and to function as receiver for the input signal There are many types of mobile phones available in the market and it important that these mobile phones can be used with the system.

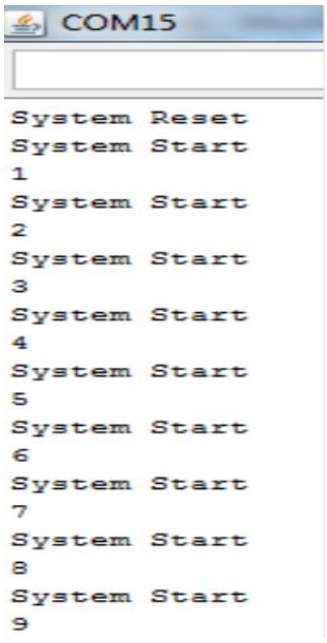


Figure 12: Result on the serial monitor.

The result on the serial monitor in Figure 12 shows when there is a received signal at mobile phone 2; the number 1 until 9 in Figure 12 is the input signal by the key pressed from the mobile phone 1 to mobile phone 2.

Table II: Testing an input key press for every Relay channel

Input Key	Relay Channel	Relay Output
"1"	1	ON/OFF
"2"	2	ON/OFF
"3"	3	ON/OFF
"4"	4	ON/OFF

Table II show a testing by the input press for button key 1, 2, 3 and 4. Table II shows testing of the input press to key 1, 2, 3 and 4. Each of the relay is provided to its own specific input key depending on the coding. Each relay has its own specific input key, depending on the coding specified. For example, the input key 1, is coded to the channel relay 1. The next figure shows the diagram of every relay that has been tested.

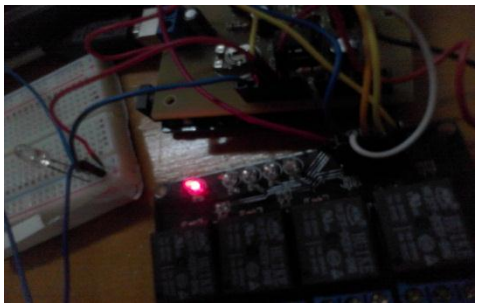


Figure 13: Red LED ON is indicated for V_{CC}

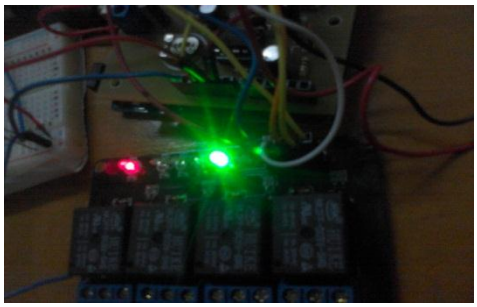


Figure 14: Green LED ON for Relay Channel 1

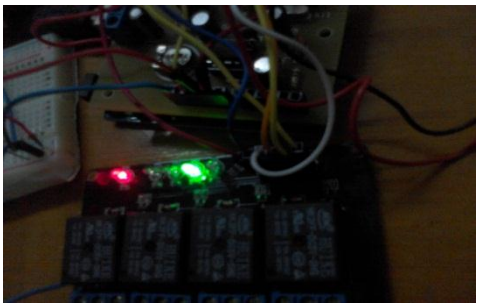


Figure 15: Green LED ON for Relay Channel 2

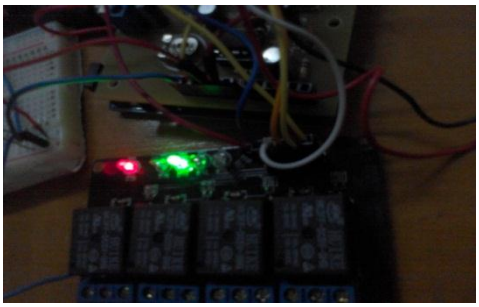


Figure 16: Green LED ON for Relay Channel 3

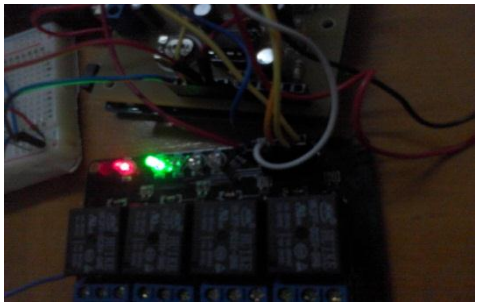


Figure 17: Green LED ON for Relay Channel 4

Figure 18 and 19 shows a sample of the testing on the AC Bulb. The sample shows that when the Green LED at the relay channel is ON, the light bulb will also be ON

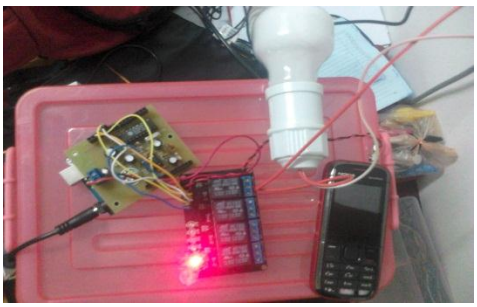


Figure 18: Before Relay Channel 1 ON

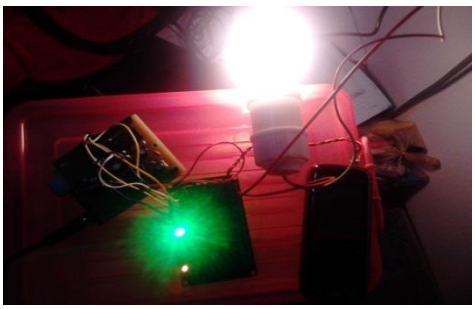


Figure 19: After Relay Channel 1 ON

Table III: List of Testing on Different Appliances

No	Appliance
1	Television
2	Bulb
3	Radio
4	Water Pump

The Table III shows list of appliances that are tested using the Remotely Controlled AC Power Switching via hand phone. This testing is to ensure the durability of the device to accept different kinds of home appliances that uses different values of ac voltage and current. The testing was successful; there is no damage or over power trips when combining with different kinds of applications.

IV. Conclusion

A prototype of Remotely Controlled AC Power Switching via Hand phone indicates that it could be a very useful tool to people in managing their house remotely. Users can manage their daily life and routine work more efficiently and able to organize and increase their home security, watering their garden and many more. Since the prototype has some limitations, thus, by adding more features and improvements, this product has the potential to be marketable.

V. Future Development and Recommendations

In order to commercialize the product, more features and improvements have to be introduced. For example, apart from using the buzzer speaker, it could be replaced with human voices. A security code could also be added to the system for a safe and secured system

REFERENCES

[1] Destination Asia: Destination Malaysia http://www.destinationasia.com/malaysia/about/holidays-festivals/

[2] Malaysia Crime Prevention Foundation: Housebreaking

http://www.mcpf.org.my/v3/node/33

[3] Department of Horticulture. Purdue University Cooperative Extension Service. West Lafayette, IN.

B. Rosie Lerner. : Indoor plant care.

[4] Banzi, Massimo (September 20, 2011). *Getting Started with Arduino* (2nd ed.). MA : O'Reilly Media

[5] Michael McRoberts. (2010). *Beginning Arduino.* United States of America, MA : Paul Manning

[6] Micheal,Margolis. (2011). *Arduino Cook Book.* Gravenstein Highway North, Sebastopol, MA : O'Reilly Media,

[7] Oxer, Jonathan; Blemings, Hugh (December 28, 2009). HYPERLINK *Practical Arduino: Cool Projects for Open Source Hardware*. MA : Paul Manning.

[8] Copafrog Dtmf Shield. : http://copafrog.blogspot.com

[9] Frank Durda, Dual Tone Multi-Frequency (Touch-Tone) Reference, 2006.

[10] 4-Channel 5V Relay Module: http://www.robotshop.com/4-channel-5v-relay-module.html.