Implementation and Development of Smart Mobile Phone Security Access System

Wan Ikhsan Bin Wan Ishak
Faculty of Electrical Engineering (Electronic), Universiti Teknologi Mara (UiTM)
40450 Shah Alam, Selangor, Malaysia
wanikhsanwanishak@yahoo.com

***Abstract* – Home security system is very importance for all residents who put safety as a priority in their daily lives. In line with this, a project is developed to constructs a security system that is connected via mobile phones when the alarm is activated. The whole projects were developed with both hardware and software implementation. This project consists of keypad as the input for password key-in, PIC16F877A microcontroller as a main controller and the output is DC motor. Once the system damaged by the intruders, the alarm will be activated and notify to the user mobile phone. The alarm will be deactivated when the correct password were entered. For the software implementation purpose, the programming languages MPLAB and C program is used. From analysis, probabilities for intruders breaking in the security system are less since the system using 6-digit passwords. Therefore, the system has been proven working if the passwords inserted are correct and the motor lock function without no alarm activated.**

Keywords – Security, Mobile phone, PIC microcontroller

I. INTRODUCTION

Nowadays, security systems are preferably necessary to ensure the house security from intruders. Installing a security system can improve the safety of family and property. In Malaysia, robbery cases have been reported to be increasing dramatically from the year 2000 to year 2006. These cases increased from 12 000 cases to 18 000 cases, which are approximately 1000 cases increased per year [1]. This statistic indicates the importance of implementing the security system in the residential area. Furthermore, it is crucial to have advanced alarm system, which could secure the premises.

Security is the degree of protection against danger, damage, loss, and crime [2]. Security systems are separated into two types, which are monitored and unmonitored. An unmonitored alarm system is the simplest of home alarm system monitoring devices [3]. In the case of unmonitored alarms; the system simply sounds like an audible alert when there is a breach of security. In many cases, invasion occurred while homeowners are not at home, so the probability of someone hearing the alarm is slim. The alarms system inclines to scare away intruders. Mostly, intruder will retreat quickly when confronted with any type of audible alarm. In contrary, monitored security system is one of the most popular systems. The system aims to control the overall operation within the security system monitored by a control center in 24 hours per day such as closed-circuit television (CCTV).

One of the important features the system can inform the consumer in the event of his mishap, whether the user is in the house or be outside. This can be done via mobile phone. This system belongs to the monitored securities because it is equipped with the alarm system that will connect with a mobile phone in the event of invasion. Mobile phones are become necessary for a variety of purposes, including keeping in touch with family members, conducting business, and having access to a telephone in the event of an emergency. Some people carry more than one mobile phone for different purposes, such as for business and personal use.

In this paper, an implementation and development of the smart mobile phone security access system are presented. The system includes two parts: micro controller system and alarm system. Micro controller system operates to control the input and output overall system. The difference between the microprocessor and the microcontroller are arisen because of their different end-usage [4]. The microcontroller that will be used is the PIC16F877, which is at the upper end in the mid-range series of the microcontrollers developed by Micro Chip Inc. The inputs of the microcontroller are keypad and pressure pad. The keypad is used to key-in password. The pressure pad acts as a reset action for the system. Both inputs are connected to PIC microcontroller. The outputs from the PIC microcontroller system are liquid crystal display (LCD), DC motor, buzzer, light-emitting diode (LED) and alarm system. The relation between the LCD and password will give the most commands to the system. The DC motor functions to lock and unlocked the door, whether the password correct or incorrect. A significant sound will be heard from the buzzer when the PIC microcontroller compares the password being inserted. The magnetic switch sensor acts as an indicator when the intruder breaks into the house by force, and the alarm system will be activated. At the same time, mobile phone at the alarm system will directly call to the user cell phone.

II. METHODOLOGY

2.1 Block Diagram of the Smart Mobile Phone Security Access System

This system has two circuits, which are microcontroller system in the Figure 1 and alarm system in Figure 2. Each of

the block diagrams consists of three main parts which are inputs, main controller and the output. The inputs for microcontroller system are digital keypad and pressured pad. Programmable Integrated Circuit (PIC) as the microcontroller to control overall system. The PIC controls the output at LCD display, DC motor, buzzer, LED and alarm system. The output alarm system will be active or inactive, which is controlled by the PIC microcontroller system. Hence, the mobile phone at the system will call through user phone and siren sound in few minute if the alarm has been activated.

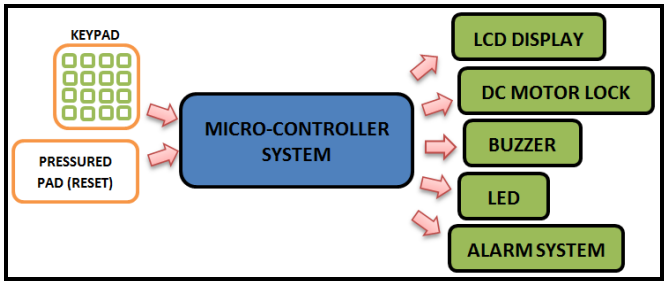

Figure 1: The general diagram of Microcontroller System

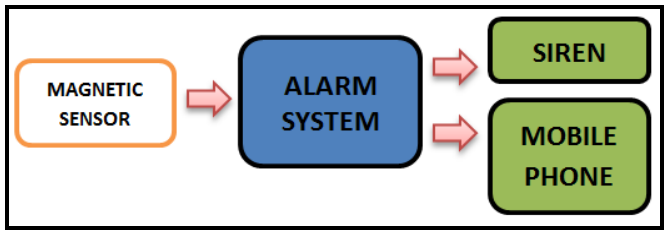

Figure 2: The general diagram of Alarm System

The structure of the Smart Mobile Phone Security Access System is shown in Figure 3. The system consists of five parts, which are the PIC 16F877A microcontroller circuit, alarm system circuit, magnetic sensor, DC lock motor and GSM mobile phone.

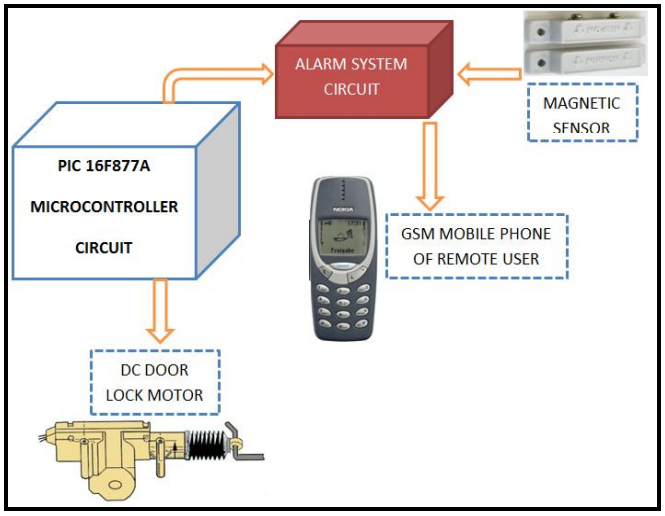

Figure 3: The structure of Smart Security Access System

2.2 Hardware of Smart Security Access System

The hardware for this system can be divided into four major parts which are:

A. The PIC16F877A Microcontroller Circuit.

Figure 4 shows the point A to K which are connected to the component circuits. Table I shows the component descriptions:

TABLE I: COMPONENTS DESCRIPTION

Points	Components Description
A	Connected to power supply and alarm system
B	Voltage regulator circuit
C	Keypad connector
D	ICSP connector (5x2)
E	Buzzer connector
F	Reset connector
G	LCD connector
H	LED connector
I	Crystal oscillator
J	Output relay for alarm
K	Output relay for DC motor

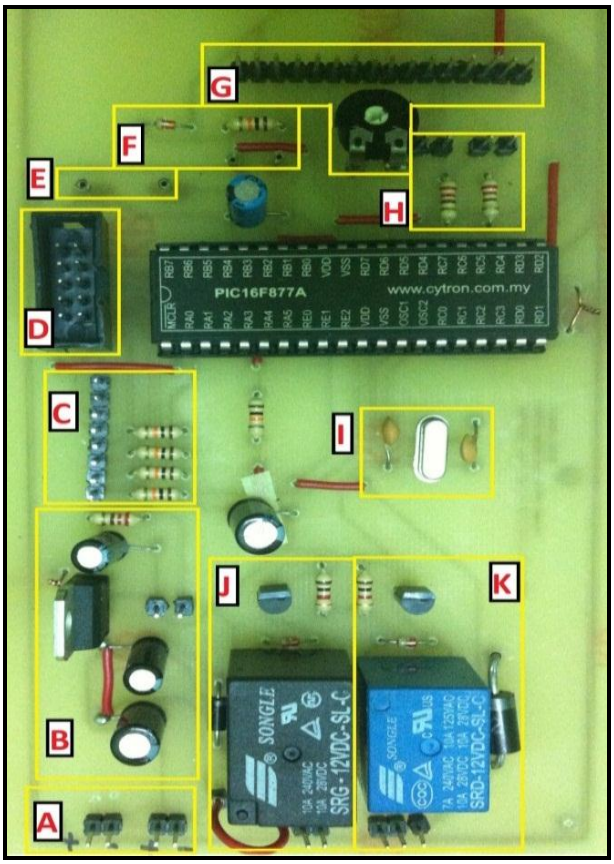

Figure 4: The Microcontroller Circuit

Shown in Figure 5 is the diode (D3) to protect the circuit from wrong polarity supply. The capacitor C1 and C7 use to stabilize the voltage at the input side of the LM7805 voltage regulator, while the C2 and C8 are used to stabilize the voltage at the output side of the LM7805 voltage supply [5]. The blue LED (LED2) is employed to indicate the power status of the circuit. The resistor R2 is used to protect (LED2) from over current.

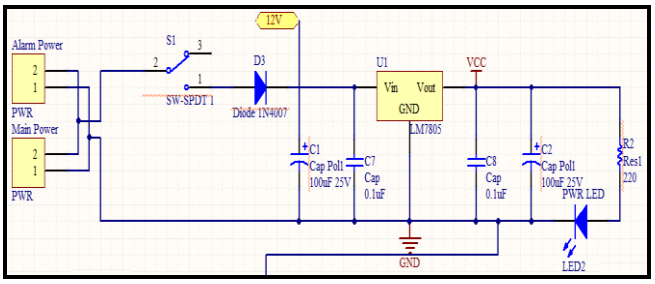

Figure 5: Voltage Regulator Supply Circuit

The keypad consists of eight pins as shown in Figure 4 at point C. The remaining pins are separated into two groups, four pins (K1-K4) are connected to the input of microcontroller and the other four pins (K5-K8) in Figure 6 are connected to the output. User can decide any digital I/O pin for the input and output. The input pull high to 5V using a resistor and this configuration will result from an active-low input.

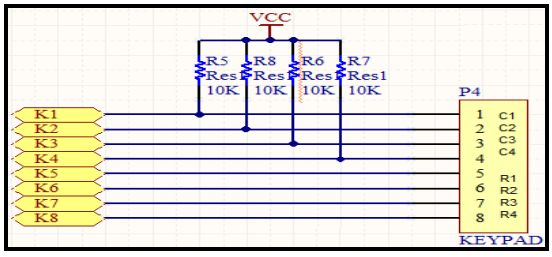

Figure 6: Keypad Interface

Point D in Figure 4 is the ICSP (In Circuit Serial Programming) connector (5x2). It describes the serial programming interface for PIC microcontroller in Figure 7. ICSP gives a user the convenient way of programming PIC microcontroller without removing the chip from the development or production board. MCLR, PGC and PGD need to be connected to the ICSP box header to program the PIC microcontroller.

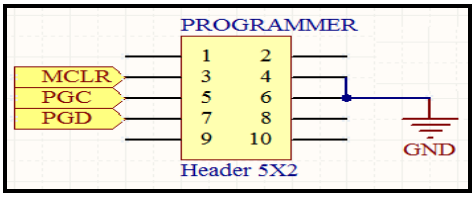

Figure 7: ICSP Interface

Point E in Figure 4 is the buzzer. Buzzer will act as a detector if the password key in is granted or denied. If the access is granted the buzzer will sound beep once and if the access denied the buzzer will beep twice. In Figure 8 is the circuit for the buzzer connected to the microcontroller circuit.

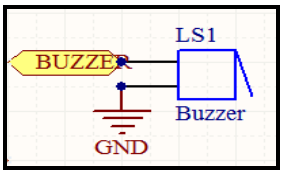

Figure 8: Buzzer Interface

Point F is a reset connection. One I/O pin is needed for one push button as input of PIC microcontroller. The connection of the push button to the I/O pin is shown in Figure 9. The I/O pin should be pulled up to 5V using a resistor (with value range 1K-10K), and this configuration will result an active-low input. When the button is being pressed, reading of I/O pin will be in logic 0, while when the button is not pressed, reading of that I/O pin will be logic 1.

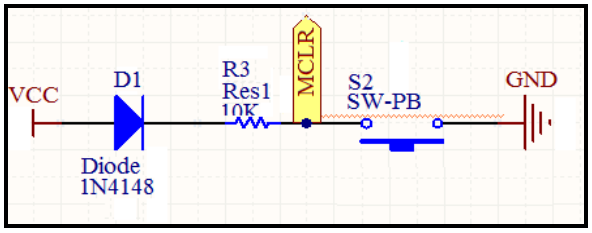

Figure 9: Push Button Reset

Figure 10 below is a circuit diagram for Liquid Crystal Display (LCD) connected to the microcontroller circuit. The variable resistor functions as a brightness changing.

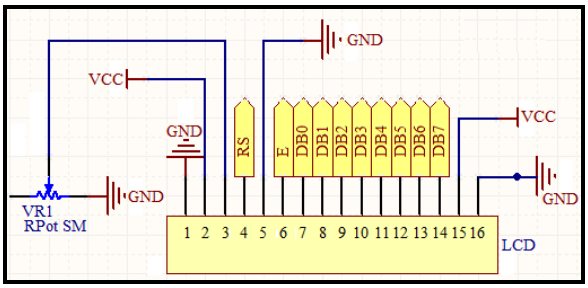

Figure 10: LCD Display

Figure 4 at point H shows the connection for LED. The connection for a LED to output pin is shown in Figure 11. The function of R10 and R11 is to protect the LED from over current that will burn the LED When the password key in is access granted the Green LED (DS1) will turn ON. If the user key in wrong password the Red LED (DS2) will turn ON.

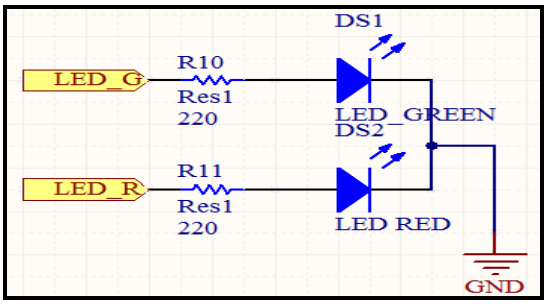

Figure 11: LED Indicator

There are two relays as output, which is for DC motor lock and alarm system in indicated by Figure 12 and 13 respectively. Flow of current through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. Relays have two circuits which is a control circuit and a load circuit [6]. The control circuit has a small control coil while the load circuit has a switch. The coil controls the operation of the switch. The coil current can be ON or OFF so relay have two switch positions. Current flowing through the control circuit coil (pins 4 to 5) creates a small magnetic field which causes the switch to close, pins 1 and 3 when the relay in energized. When current stops flowing through the control circuit, pins 1 and 3, the relay becomes de-energized.

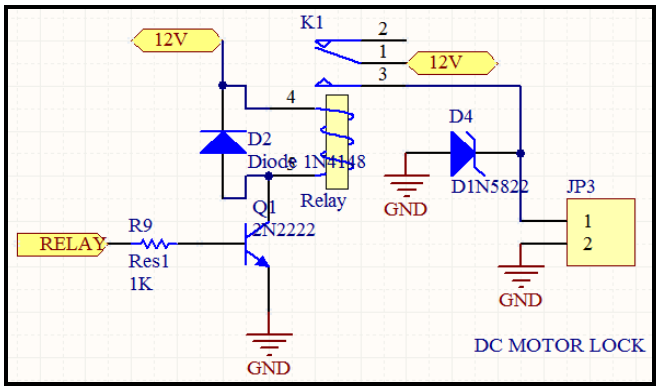

Figure 12: Relay for DC Motor Lock

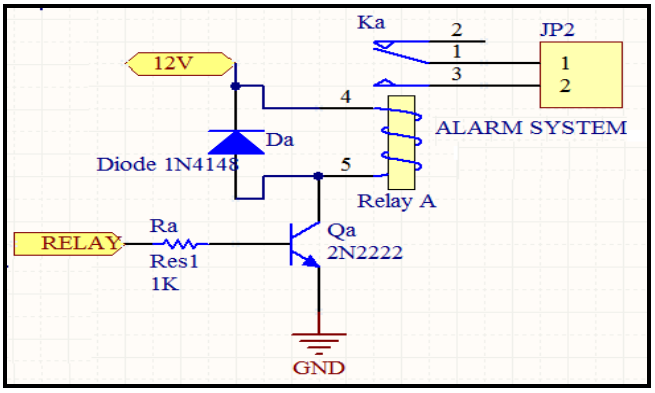

Figure 13: Relay for Alarm System

B. *Alarm System Circuit*

An alarm system consists of seven points, which is A, B, C, D, E, F and G in Figure 14. Point A and B are connected to the power source and ground at circuit microcontroller, which is at the alarm relay. Point C is connected to the magnetic switch sensor which is used to detect the intruder broke into the home by force. If the distance magnetic switch sensor exceeds 2cm, the alarm circuit will activate. Point E is a variable resistor serves as a sensitivity range in the magnetic sensor switch. The relays at point F and G function as a switch which is connected to the mobile phone as a speed dial and end call.

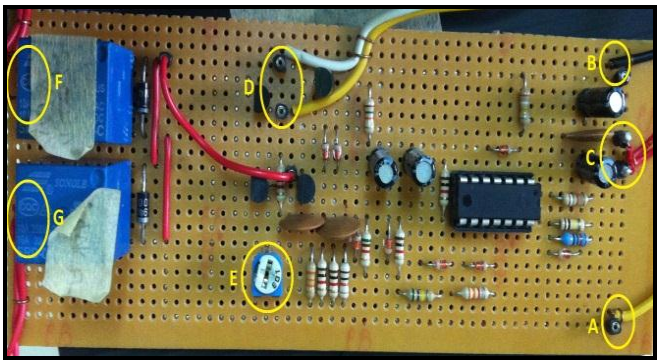

Figure 14: Alarm Circuit

C. *DC Motor Lock*

A DC motor controller (Direct Current) is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads. Figure 15 shows the circuit to rotate the motor clockwise or anti-clockwise. Point A is connected to the power source. Point B is connected to the DC motor lock. Point C is connected to the relay at circuit Microcontroller. There have two switches at point D, which is acted as a switch.

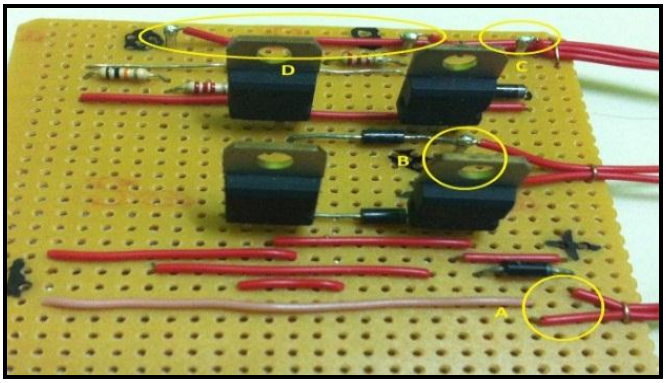

Figure 15: DC Motor Lock Circuit

If the DC motor rotates into lock condition (clockwise) or unlock condition (anti-clockwise) the switch will turn off the motor in Figure 16. So that the motor will not operate until the lock access granted or the reset button is pushed.

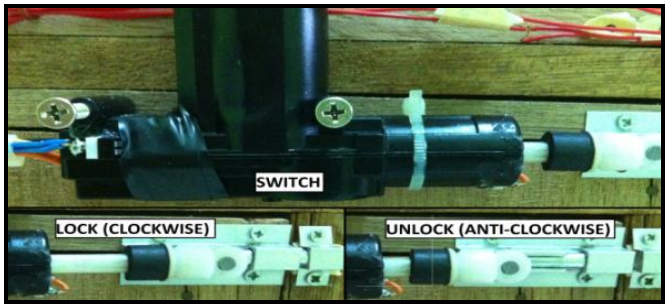

Figure 16: Motor Lock

D. GSM Mobile Phone

GSM is an acronym that stands for Global System for Mobile Communications. GSM is a second-generation wireless telecommunication standard for digital mobile cellular services. The used mobile phone has been chosen as a device link to the user phone in the event of invasion. The connection of speed dial and end call from mobile phone are connected as shown in Figure 17. The connections are linked to the alarm circuit output relays at point F and G. The mobile phone will call the user automatically if the alarm detects the intruder. If the alarm off after 15 minutes the relay at point G will switch, and the phone will end call.

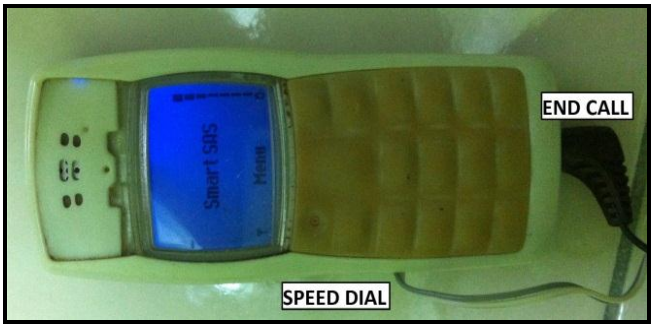

Figure 17: Mobile Phone

2.3 Programmer

The microcontroller used in this system is Programmable Integrated Circuit (PIC16F877A). This integrated circuit can be reprogrammed and erased up to 10,000 times. Moreover, this package can be programmed with basic C-programmed where it was familiar to student. However, using a DIP socket is much easier so that this chip can be plugged and removed from the development board. The PIC architecture has these advantages which are small instruction set to learn, built-in oscillator with selectable speeds, and the code is extremely efficient, allowing the PIC to run with typically less program memory than its larger competitors. The benefit of PIC compared to the other microcontroller the price is inexpensive [7].

2.4 Software Design of the system

MPLAB IDE software is used to program the PIC microcontroller in order to initialize keypad and LCD and make these two components work accordingly. Figure 18 shows the flowchart for the programming code to handle this system.

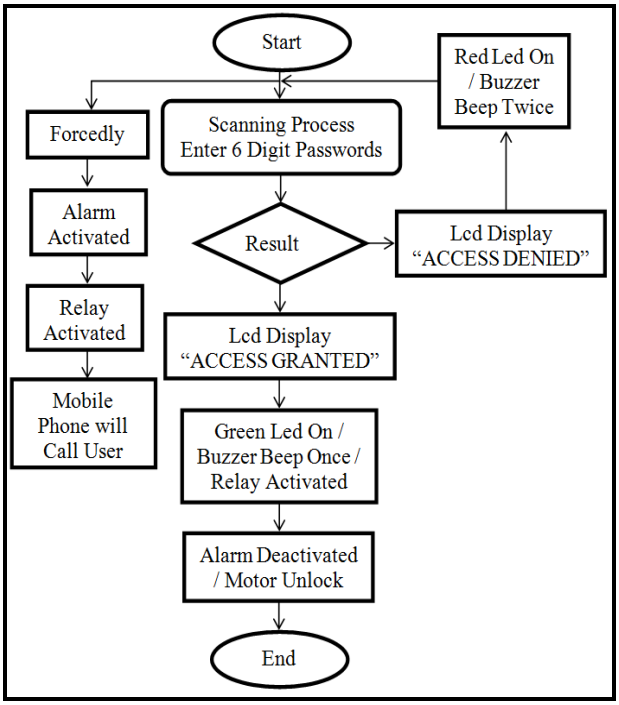

Figure 18: Flowchart

2.5 The Function of Smart Mobile Phone Security Access System

The system required six-digit password to be keyed-in by the user to deactivate the alarm system where the DC motor operates to unlock the door. The DC motor is controlled by motor control circuit. The input data from the keypad will send to the PIC compare to the password, whether correct or incorrect. When the correct password inserted, green LED will on, the buzzer beep once and the relay activated. Hence, the relay will act to switches off the alarm circuit, and the DC motor will be unlocked. Otherwise, if the password inserted is incorrect, red LED will light up and the buzzer beeps three times. When the wrong passwords are inserted three times, the system will be a delay about 30 seconds. The pressure pad act as a reset switch when users are forgot to active the alarm system once stepped out from their house. The alarm system will active and sound in a few minutes if the door is open forced by the intruder. This system enabled mobile phone to called user automatically.

III. RESULT AND DISCUSSION

Figure 19 shows the display of our designed security system. User is required to key in six digits default password in order to initiate the operation of the system to enter the house. The password will be requested in standby mode. Thus, user must enter the correct password as in Figure 20. As a result, if the password entered matched the default password, then the screen will appear "Access Granted" as in Figure 21. At the same time, the DC motor lock will unlock the door, and alarm will deactivate so that user can enter to their house. Then the green LED will be ON. If the password did not match, "Access Denied" screen will appear asin Figure 22. At the same time, the DC motor lock will stay to lock the door together with twice beeps sound and the red LED light will be ON.

Figure 19: Standby Mode Display

Figure 20: Enter the Password

Figure 21: Access Granted will Display at LCD

Figure 22: Access Denied will Display at LCD

In other situations, if the intruders want to try entering the passwords exceed three times; the system will be delayed about 30 seconds as in Figure 23. So that, intruder will be waiting for a long time to try and error to enter the house. If the door is opened by force, the alarm will be activated, and the GSM mobile phone will automatically call the owner of the house.

Figure 23: After 3 Times when Entering Password

The probabilities of the intruder to break passwords in (how many) times are shown in Table II. User should insert six digit password to enter their house. If the intruders want to break into the house, they can press the password 16,777216 times only (16^6) [8]. Otherwise, the intruder needs more time to try breaking the code.

TABLE II: THE PROBABILITY OF THE INTRUDER TO BREAK INTO PASSWORD

Digits	Times
1	16
2	256
3	4 096
4	65 536
5	1 048 576
6	16 777 216

Figure 24 shows graph distance (mm) versus voltage (v). The magnetic switch acts as a sensor to activate or deactivated the alarm system. When the magnetic switch sensor voltage reached 11.4V, the alarm will be activated. Otherwise, if the doors open from the distance (0-20) mm, the voltages still have, but it is not able to activate the alarm. The data analysis was conducted to measure the output voltage between distances (mm) versus voltage (V) in Table III.

TABLE III: MAGNETIC SWITCH SENSOR MEASUREMENT

Distance (mm)	Voltage (V)
0	0
5	0.5
10	0.8
15	1.1
20	1.5
25	11.4
30	11.4

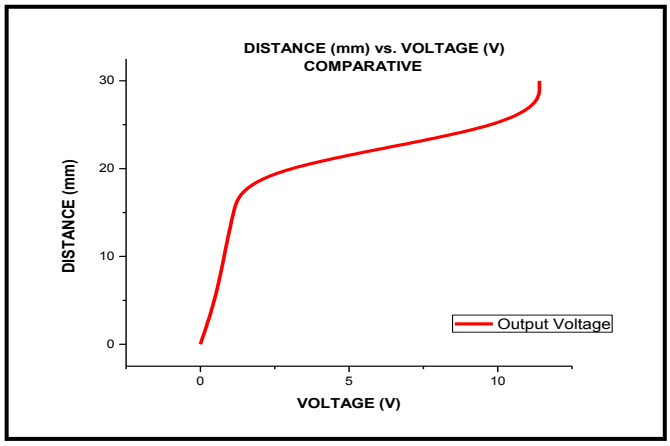

Figure 24: The Output Voltage of the Magnetic Switch Sensor

IV. CONCLUSION

In conclusion, the smart mobile phone security access system has been developed. Based on the result obtained, the systems are secured with a login password, siren and mobile phone. The system is designed for ease-of-use and self-guiding so no real training is required.This system is very safe because the six digit password is required to operate the system. For that reason, the probability for the intruder to break the password is very difficult. Besides that, it also reached the stage of high safety if once the electronic keypad broken the alarm still function.

V. FUTURE DEVELOPEMENT

For further research in the future, the analysis needs to be in a larger scope. Since the objectives have been proven right, the author suggests further improvement developments for this project. The main recommendation ensures this system is running properly it will operate with a backup battery. This backup battery will charge while this security system is running with electric power and ready to apply when there is no electricity blackout.

Furthermore, it recommended improving this system by using the radio-frequency identification technology (RFID) hence the system technology is stable and evolving, with open architectures becoming increasingly available.

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