

Home Door and Windows Monitoring System

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Abstract-Intrusion always happen if the door or windows of the house are left open. Apparently there is no warning system to monitor the door and windows state. The situation became more critical if there is a child in the house that tends to wander off to the street. It becomes worst especially at night or when the owner is on vacation where there is risk of breaking in. This paper presents the development of the Home Door and Windows Monitoring System to monitor the state of the door and windows by using Short Message Service (SMS) to interact between the system and the user. The system uses Arduino UNO to manage the operation, the GSM Shield to receive command and send message through SMS and the magnetic switch to trigger the system operation. The push button is use to gain access to enter or leave the house. The system is password protected and it can be set into three different operating modes. The Asking Mode where the user can ask the system about the state of the door and windows, the Notify Mode where the user can be notify about the state of the door without being ask, and the Secure Mode where the user can be alert if the door and windows are open. The prototype have been tested and functioned properly as to remind the user of the state of the door and windows of the house.

Keywords-monitor; SMS; Arduino UNO; GSM Shield; password protected; different operating modes; security; alarm; wireless.

I. INTRODUCTION

The electronic security system has been evolving throughout the history for about 150 years ago [1]. It began with monitoring the changes of current on a loop of wire to a wireless alarm and access control system. Nowadays, new ideas and technology have been developed and implemented to meet the current design and features of the house and it needs to fit the user's lifestyle. Security is the condition of being protected against burglary, theft or harm [2]. It can be done by giving an early warning so that one can have time to take safety measures and to react.

According to the statistic collected by the Department of Statistic Malaysia, two third of the burglary offense happens at night and another one third in the daytime [3]. This shows that the burglary happens when the house is vacant or when the residents are asleep at night. There are three main elements of the security system which are the line of sight, the timing and the noise [4]. The line of sight is the lighting condition of the compound of the house. Burglar tends to enter a house with

dark compound and have many blind spots such as unorganized plant. The timing is the time to get into the house and out of the house. It means that installing spikes or high fencing can help to increase the get-in time and decrease the probability from being robbed. The noise is the use of sound to scare off the intruder. The intruder will flee away if they heard sound of a noise because for them it means that they have been detected. The most common break-in entry point is the front door, back door and the first floor windows. This is because it is the easiest way to get in and out of the house.

The worked presented by [5] used the "One-Touch Dialing" function which is very good because the system will keep on sending SMS alert to the user if it fail to receive a confirmation of delivery from the message sent. The problem with this system is that if the user failed to locate the remote control or lost it, the system cannot be activated or deactivated. Another work presented by [6] is the system will send breach alert when an intrusion was detected and controlling the home appliances by using SMS. The problem with the system is that it only recognized SMS send from the pre-configured number in the system. The user will have some difficulties if the phone is running low on battery or credit. However, the system presented by [7] will alert the owner and the local authorities when someone is just standing in front of the gate. This can led to the increase of false alarm activity. The paper proposed by [8] is about monitoring a tank water level. The system will alert the user by SMS if the water level reached the minimum level. This could help to reduce the risk of shortage of water supply. The system proposed by [9] is about monitoring the humidity in industrial application where the set point value can be set by using SMS. As for [10] it is about home automation with security feature. It used the built-in locking system which only can be open by using a correct password through a keypad. SAFE HOME An Advanced Home Security System [11] is using the same method but replacing the keypad with a thumb detection unit.

II. METHODOLOGY

The Home Door and Windows Monitoring System is built base on the prototype of a house with a door and two windows. This system is a device to monitor the current status of the door and windows.

A. Hardware

Figure 1 shows the system hardware block diagram. It consists of four push buttons, three magnetic switches and a buzzer connected to Arduino UNO and GSM Shield. The push buttons are used to get authorization from the system while the magnetic switches are used to determine the state of the door and windows and the buzzer is used as a siren to scare off the intruder. The operation of the system is managed by the Arduino UNO and the GSM Shield is used to communicate with the user through SMS.

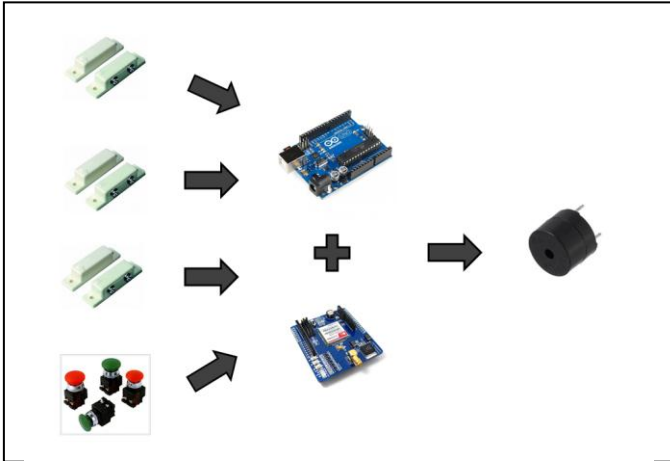


Figure 1. Hardware Block Diagram

The Arduino UNO is the brain of the system. It is a microcontroller board uses an ATmega16U2 that consists of 14 digital input/output pins, 6 PWM outputs, 6 analog inputs, 16 MHz clock speed, 32k flash memory, USB connection and a power jack. To get started, just power it up with a DC adapter or battery or just simply by using a USB cable connect to a computer [12].



Figure 2. Arduino UNO

Figure 3 shows the GSM Shield from IComsat. It is based on the SIM900 Quad-band 850/900/1800/1900MHz. It is controlled via AT command and fully working on Arduino UNO. The operating temperature for this GSM Shield is between -40°C to +85 °C

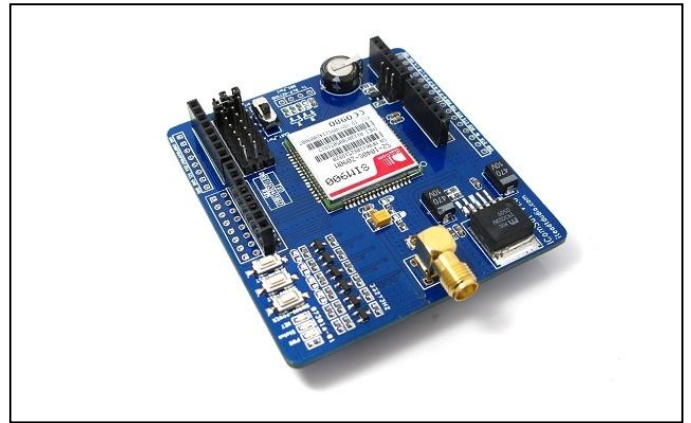


Figure 3. GSM Shield

The magnetic switch consists of 2 dry-reed contacts embedded in cast resin and mounted in a corrosion resistant brass casing. The circuit can be made broken by the motion of the magnet and contact. During the contact, as the air gap between the contact studs become closer, the magnetic field increases by the squared power [13].

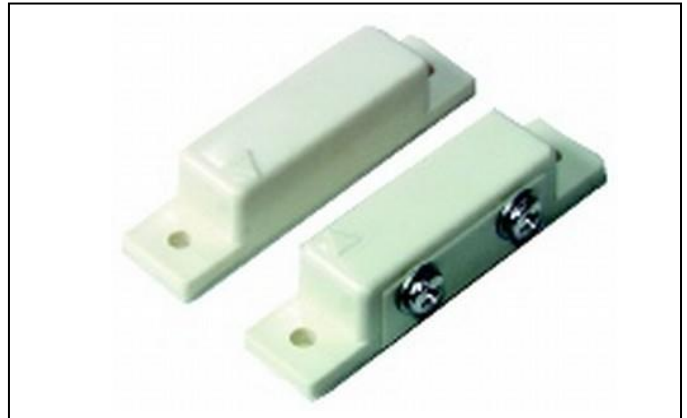


Figure 4. Magnetic Switch

The buzzer is a very famous device in any security type of system. It is used to give alert to the user if something triggers. The buzzer or beeper can be mechanical, electromechanical or piezoelectric.



Figure 5. Buzzer

Push-buttons are used to gain access or control of a process. It has a flat surface so that the human finger can fit on it. The material used to make the push button is usually a hard material such as plastic or metal so that it will not easy to break.



Figure 6. Push-button

B. Flow Chart

The Home Door and Windows Monitoring System consist of three stages of operation and two types of modes. The first stage is the Login Stage, the second one is the Mode Stage and the third one is the Default Stage, while the modes are Secure Mode and Asking Mode.

Figure 7 shows that how the system operates on its first stage of operation. The first step is that the system waits for the correct login password before it could work properly. If the password is wrong the system will not starts its operations. After a correct password is entered the system will send a SMS to the user as a confirmation that the password is correct. Then the system will go to the second stage of the operation which is the Mode Stage.

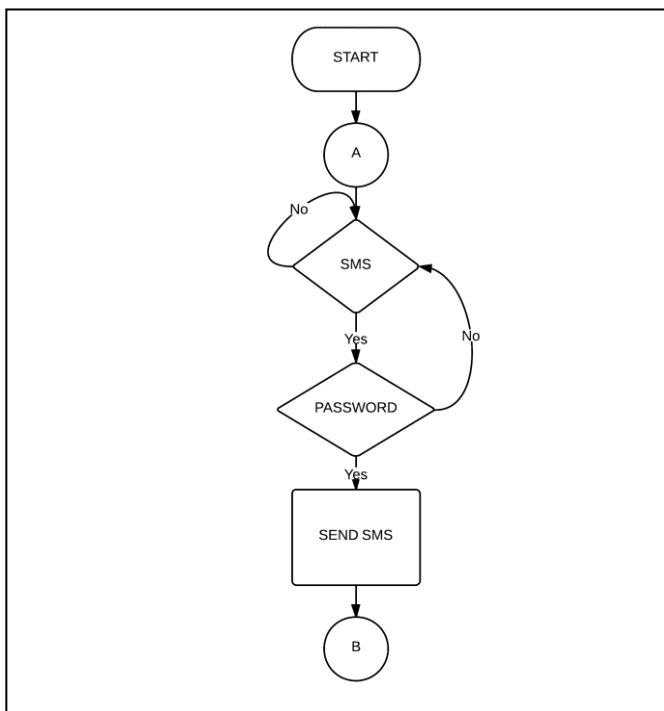


Figure 7. Flow chart of the Login Stage

Figure 8 is about the Mode Stage of the system. In this stage the system will switch to the mode that is request by the user. There are two available modes for this system which is the Secure Mode and the Asking Mode. The purpose of these modes is to suit the user's need in any occasion or situation. It is like switching from normal to silent modes in the mobile phone.

When the system is successfully switched to the mode that is desired by the user, it will send a SMS saying that the mode is activated. In this stage also, when the user is logout of the system, it will send "SYSTEM DEACTIVATE" through SMS to tell the user that the system has been log off. When there is no mode switching command or log off SMS, the system will proceed to the next stage which is the Default Stage.

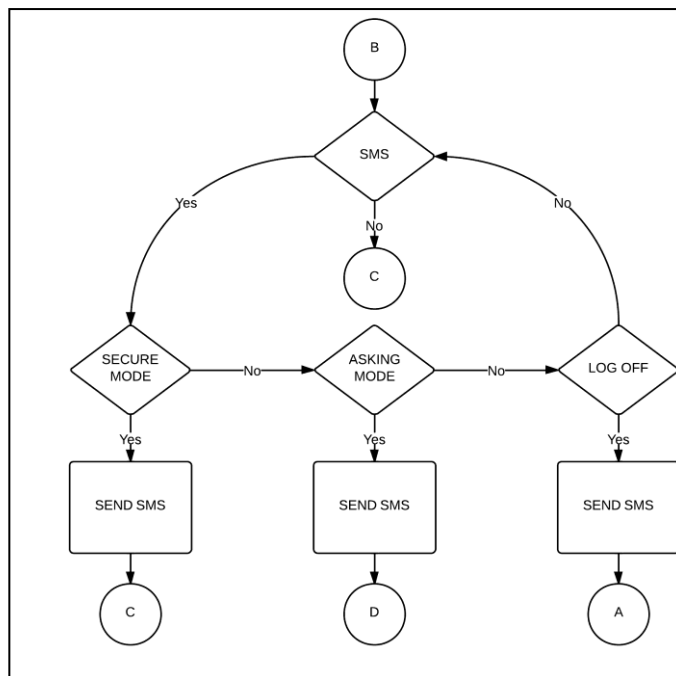


Figure 8. Flow chart of the Mode Stage

Figure 9 is the Default Stage of the system which is the Secure Mode. The Secure Mode is the protocol within the system. In this type of protocol, the system will monitor the state of the door and windows. When someone opened the door, the system will not trigger the alarm immediately. It will wait for 10 second for the person that entered the house to push the correct sequence of the push-buttons if not the alarm will be triggered and the system will send a SMS to the user telling that the house has been breached. It goes the same ways when someone wanted to leave the house. They must push the correct push-buttons first before they leave so that they will have access to open the door. When the door is open, the buzzer will be beeping until it is closed. It is not the same for the windows. If one of it is open, the system will trigger the alarm and send a SMS to the user.

The system must have a Default Stage so that it can start the operation without waiting for any command from the user. The Security Mode is chosen as the starting mode because it is to ensure the safety of the house at all time so that the user will feel safe, "No Text, No Threat".

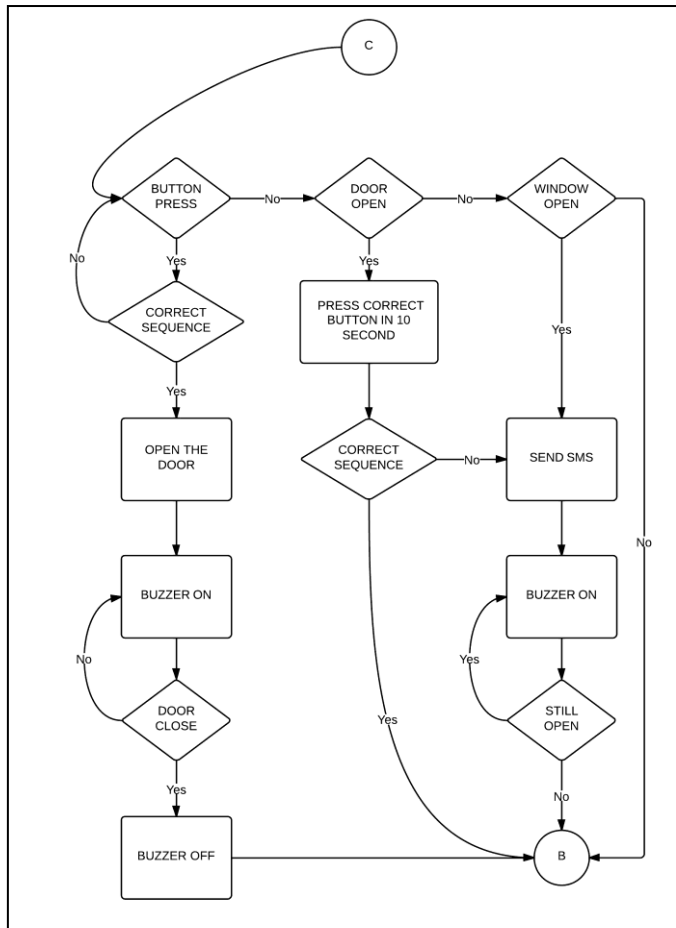


Figure 9. Flow chart of the Default Stage

Figure 10 shows the Asking Mode of the system. The system will give the user information about the state of the door and windows after the user ask for it by sending a SMS to the system.

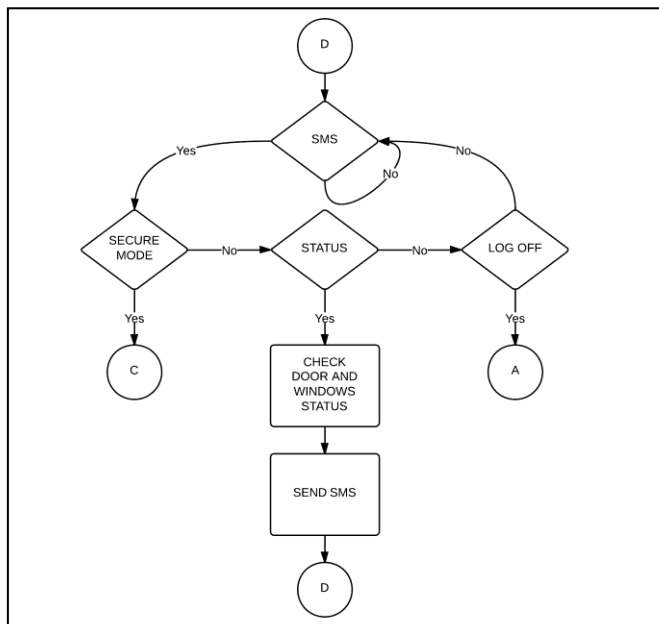


Figure 10. The flow chart of the Asking Mode

III. RESULT AND DISCUSSION

The Home Door and Windows Monitoring System is a system which are using the magnetic switches to detect the door and windows states. The Arduino UNO will process the system input and output. While the GSM Shield to receive command and notify the user through SMS.

The figure below showing that when the user entered the wrong password which is as you can see, the user trying to switch the mode of the operation the system did not recognise the command because of the wrong password.

```

GSM Shield testing.

status=READY
SMS Present at position
1
+60187770094
123123
DELETING SMS
SMS Present at position
1
+60187770094
ASKING MODE
DELETING SMS
SMS Present at position
1
+60187770094
STATUS
DELETING SMS
  
```

Figure 11. Wrong password

When the user sends the correct password, the system will send a SMS telling that the password is correct and just after that, when the user asks about the status, the system reply it by telling about the door and windows status.

```

GSM Shield testing.

status=READY
SMS Present at position
1
+60187770094
123456
PASSWORD ACCEPTED
SMS Send

DELETING SMS
SMS Present at position
1
+60187770094
ASKING MODE
ASKING MODE: ACTIVATE
SMS Send

DELETING SMS
SMS Present at position
1
+60187770094
STATUS
CHECKING

DOOR: CLOSE
WINDOW 1: CLOSE
WINDOW 2: CLOSE
SMS Send
  
```

Figure 12. Correct password

Figure 14 show that if the door is open and the user enters the correct sequence of the push-buttons it will not trigger the alarm. When the user enters the wrong sequence of the push-buttons the alarm will be triggered and a SMS will be send to the user. The user will have 10 second to enter the correct sequence of the push-buttons so that it will not trigger the alarm when the user enters the house.

```

GSM Shield testing.

status=READY
SMS Present at position
1
+60187770094
123456
PASSWORD ACCEPTED
SMS Send

DELETING SMS
Door Open.

Check Push-button.

Correct Sequence

Door Open.

Check Push-button.

Wrong Sequence

SECURITY BREACH
SMS Send

```

Figure 13. Entering the house

The figure below shows that the correct sequence of the push-buttons is entered before leaving the house. The alarm will be beeping as to remind the user that the door is open. If the wrong sequence is entered, the system will be triggered if the door is open by the user.

```

GSM Shield testing.

status=READY
SMS Present at position
1
+60187770094
123456
PASSWORD ACCEPTED
SMS Send

DELETING SMS
Correct Sequence

BEEP!

BEEP!

BEEP!

Door Close.
Someone leaving the house.

```

Figure 14. Leaving the house

When the window is open in the Secure Mode, the system will immediately send SMS to the user and the alarm will be on. This can help to prevent breach from the windows of the house.

```

GSM Shield testing.

status=READY
SMS Present at position
1
+60187770094
123456
PASSWORD ACCEPTED
SMS Send

DELETING SMS
SECURITY BREACH
SMS Send

SECURITY BREACH
SMS Send

```

Figure 15. Window is open

CONCLUSION

As for the conclusion, the Home Door and Windows Monitoring System have successfully met the objectives and all the problems are solved. The system helps the user to save their time because the system can be operate wirelessly just by using SMS. The system is password protected so that only the user can have access to it. The system also can be switch to a different mode to meet the user needs.

The Home Monitoring system operates using Arduino UNO connected to a GSM Shield and triggered by magnetic reed switch. The push-buttons is use to gain access so that the user can enter and leave the house. Arduino UNO is a microcontroller used to manage the operation of the system. It controls the input and output of the system. The GSM Shield is use as a communication tool between the system and the user. The user controlled the system just by sending SMS to the system number. The magnetic reed switch is used because it is simple but a very effective switch to mount on the door and the windows.

The system has successfully fulfilled all the requirements and objectives of the study. For future recommendation, the system need to have a backup power supply so that when there is shortage of current or blown fuse, the system can still be operates. Another recommendation is that the user can change the configured number in the system so that when the user is out of the country, the user can change the number to a number of another person in the house by sending a SMS command to the system. Another one is the push-buttons can be replaced with an RFID tag.

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