Security Home Door Automation Using Multi Sensors

Kristi Mahardi, Joni Welman Simatupang, and Evi Rismauli

Study Program of Electrical Engineering, President University, Bekasi 17550, Indonesia
Corresponding author: joniwsmtp@president.ac.id

ABSTRACT

The System is using Smart Relay as main control that is commonly used industrially and commercially as a control system. Using the smart relay can reduce the use of control relay and writing of the system significantly. The smart relay has a GSM-SMS for messaging and controlling the system. Only the listed number at the system that can message and control the system. By using smart relay, we can costumized our design as our requirements. Automatic door is commonly used in commercial and industrial. The relay output will be connected to door motor (for opening and closing), buzzer for alarm and pilot lamps for indication. Finaly the system is expected to have several functions as follow : Automatic opening door using fingerprint detection, automatic opening door using GSM command, automatic opening door using push button for inside command, automatic opening door using passcode, automatic closing door after door is fully opened with no movement and send the notification by GSM. By Implementing this system, it will be easier to lock the door and activate the alarm from a considerable distance.

Keywords: Automatic door, smart relay

I. INTRODUCTION

Based on statistical data released by BPS, there are 4390 cases of theft crimes during 2014 in West Java. The case of theft is mostly a theft with a weighting or it can be called a special theft. Theft with this objection is set forth in the *Kitab Undang-undang Hukum Pidana* (KUHP) 363. The meaning of theft with a denunciation is the ordinary theft which in its implementation is accompanied by an aggravating circumstance. Some of these are:

1. Conducted at night to the house or its enclosed yard.
2. Performed by 2 people together or more.
3. Performed by disassembling, breaking, or climbing or by using fake keys.

With such a strong economic insistence, the threat of imprisonment for a maximum of 7 years is not a big deal for perpetrator.

This makes it easier for thieves to commit disgraceful acts. In order to prevent the occurrence of theft, especially in our homes, the author wanted to share ideas to develop a prototype security door locking system. This system consists of several sensors and uses PLC as a data processing center.

II. LITERATURE REVIEW

Automatic door system is developed and implemented using smart relay as the system controller which is used in commercials and industries. To support this system, there are some literature study.

A. Smart PLC Zelio SR3B101BD

It is a relatively small size logic controller instead of a conventional control system. It is called as automatically control because it is relatively small size but has a high control ability.

Table 1. Smart PLC Specification

Description	Spesification
Range of product	Zelio Logic
Number or control scheme line	0-500 with FBD Programming 0-240 with ladder programming
Cycle time	6-90ms
Backup time	10 years at 25°
Clock drift	6s/month at 25°C 12min/year at 0-55°C
Checks	Program memory on each power up
(US) rated supply voltage	24V
Supply voltage limits	19,2-30V
Supply current	100mA (with extensions) 100mA (without extension)
Power dissipation in W	3 W without extension 8 W with extensions
Discrete input number	6 conforming to EN/IEC 61131-2 type 1

Discrete input type	Resistive
Discrete input voltage	24V DC
Discrete input current	4mA
Counting frequency	1kHz for discrete input

B. Fingerprint SX-X6

This machine has an engine / device (tool) for matching the fingerprint data that has been recorded and fingerprints that perform absenteeism. The stored data can be exported and imported to USB devices and computers.

C. Motion Sensor DL602

A motion sensor uses one or multiple technologies to detect movement in an area.

D. Modem GSM-SMS

These GSM modems are most frequently used to provide mobile internet connectivity. Many of them can also be used for sending and receiving SMS and MMS messages.

Table 2. Modem GSM-SMS Specification

Description	Spesification
Bandwidth	Dualband GSM 900/1800 MHz
Data package	Supporting Data/SMS/Voice/Fax
Maximum power output	2 W (900 MHz), 1 W (1800 MHz)
SimToolKit	Class 2
SMS Feature	Text and PDU
	Point to point (MT/MO)
	Cell Broadcast
	UCS2

E. Modem Interface SR2CM01

Some of Telemecanique's most recognized product ranges include Magelis HMIs, Altivar AC drives and TSX PLCs. Contact us if you have any queries about any Telemecanique part, including SR2COM01, and someone from the Northern Industrial team will be more than happy to assist.

F. Glass Break Sensor

This sensor commonly used in electronic burglar alarms to identify whether the glass is broken or not. These sensors are commonly used near glass doors or glass store-front windows.

G. Limit Switch

Limit Switches commonly are used in a variety of application and environments because of their ruggedness, ease of installation, and reliability of operation. They were first used to define the limit of travel of an object; hence the name "Limit Switch".

Limit switches may be directly mechanically operated by the motion of the operating level. Proximity switches operate by the disturbance of an electromagnetic field, by capacitance, or by sensing a magnetic field.

III. DESIGN IMPLEMENTATION

Smart PLC Zelio is the main core of this project, smart PLC is set into 5 inputs and 5 outputs. Zelio roles is to manage 5 inputs such as push button, motion sensor, glass breaking and limit switch. And there are 4 outputs such as open and close motor door, warning buzzer, buzzer alarm, and indicator lamp.

Push button works when the button is pushed to open the door and the door is opened immediately.

Finger print and passcode are used by registering fingerprint to the fingerprint system then finger print will store the registrated fingerprint data and sent to Zilio by arranging the command to send the data to output door motor to open or close.

Motion sensors are required to open the doors and alarms. To activate the motion sensor, a door opener must send an SMS with a special code to GSM modem. After that GSM modem sends the SMS data back to Zelio. Then Zelio analyzes the SMS whether the code and number are registered in Zelio system. If it is registered and match, Zelio will directly send command to output door motor to be opened.

Glass breaking sensor is working as a security which is arranged by Zelio. Glass breaking is activated as it receives frequency or vibration. It will then activate the alarm.
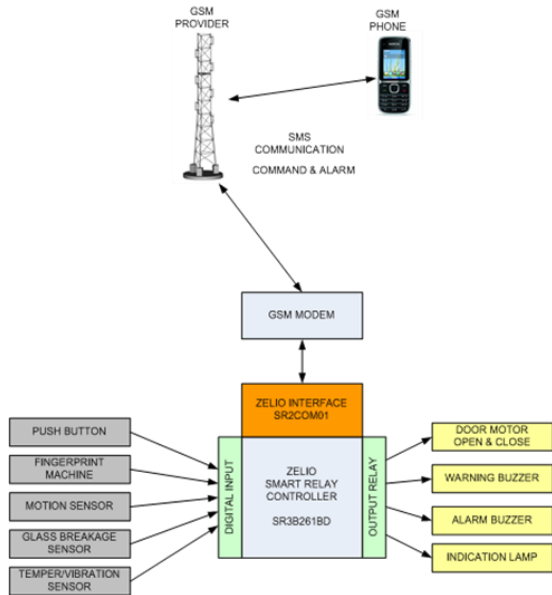
Figure 1. Block diagram of the system

Figure 1 shows the block diagram of the system that is linked to the Zelio. Then, Zelio is connected directly by GSM modem and GSM modem get the signal from the GSM provider, so GSM provider is an intermediary mobile between mobile phone and GSM modem. Mobile phone sends SMS in the form of code or command to GSM modem and GSM modem analyze command what is desired. Then GSM modem send the data to Zelio and activate the input that is activated by the mobile phone. Then Zelio gives commands to the output of the desired command.

In Figure 2, it shows the flowchart of home door automation use multi sensor from the remote GSM until the connection of all system to generate the system.
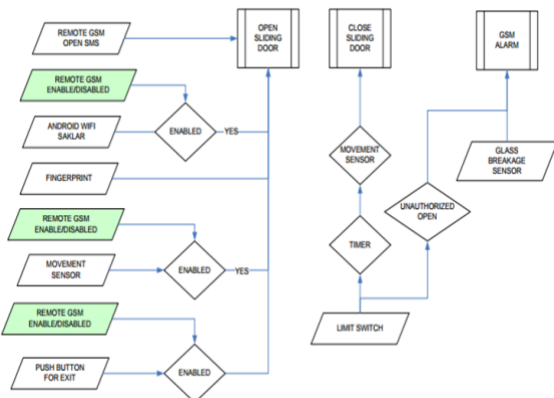
Figure 2. Flowchart of home door automation using multi sensors

Remote GSM-SMS is useful to open the sliding door. By using remote GSM, it is possible to send command to GSM module in the form of enable or disable. Besides, the fingerprint and passcode have direct path to open the sliding door. Motion Sensor also has the access to open the sliding door, but it must work with the remote GSM to enable motion sensor. After sending command from remote GSM, the motion sensor will be active and can directly open the sliding door. Push button also has a direct path to open the sliding door. While the limit switch works with Timer and motion Sensor to close the sliding door. The limit switch can detect if the door is opened by an unauthorized person after it goes to the glass break sensor. Then the alarm will be turned on.
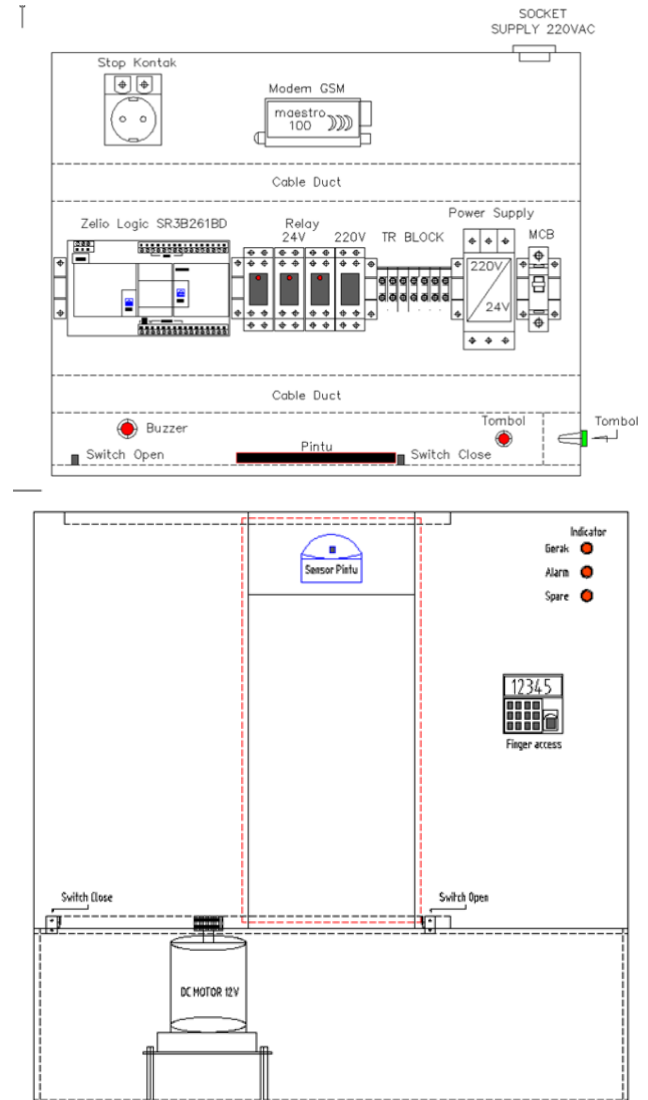
A. Hardware Implementation

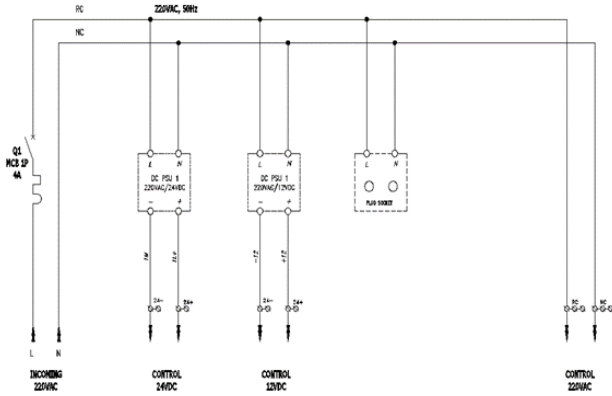**Figure 3. Layout of control component arrangement**

B. Electrical Design

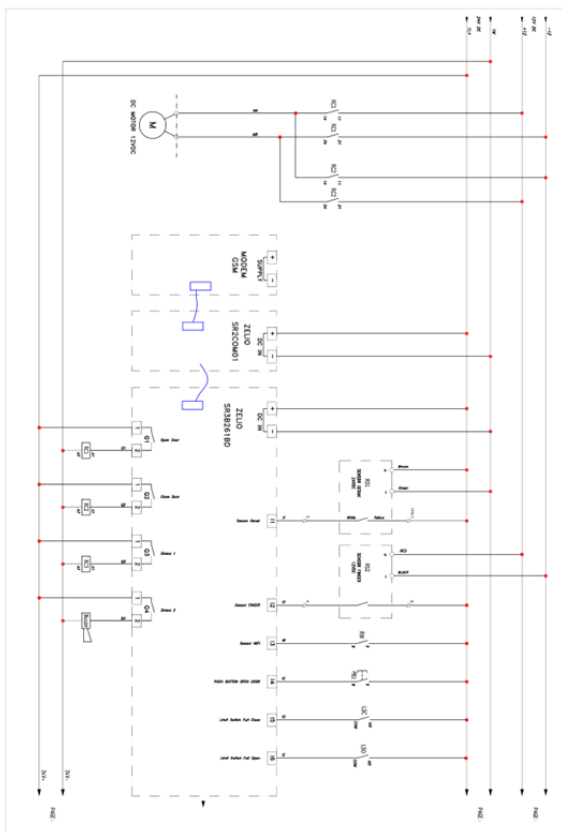**Figure 4. Wiring diagram power sources**

Figure 5. Control wiring diagram

C. Software Implementation

Zelio software have two programming languages, the ladder or the FBD. The ladder language is used in this project for smart relay programming.
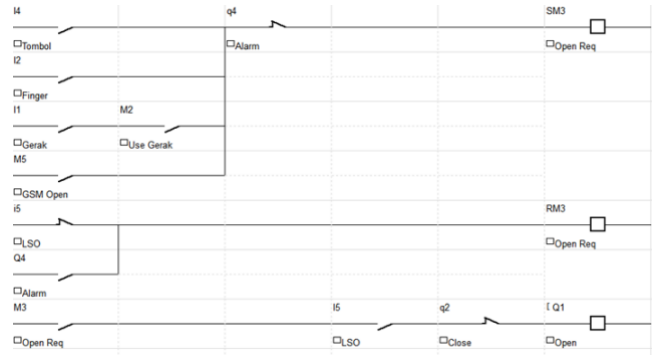

Figure 6 Opening door program

Figure 7 shows that opening request is by set-reset of auxiliary relay M3. The auxiliary relay M3 can be set if there is no alarm (Q4) exist, and auxiliary relay M3 can be set by:

1. Push button (I4) to exit the room
2. Fingerprint machine (I2) to enter the room
3. GSM-SMS
4. Movement sensor (I1) if auto open by movement (M2) is enabled

The auxiliary relay M3 is reset by:
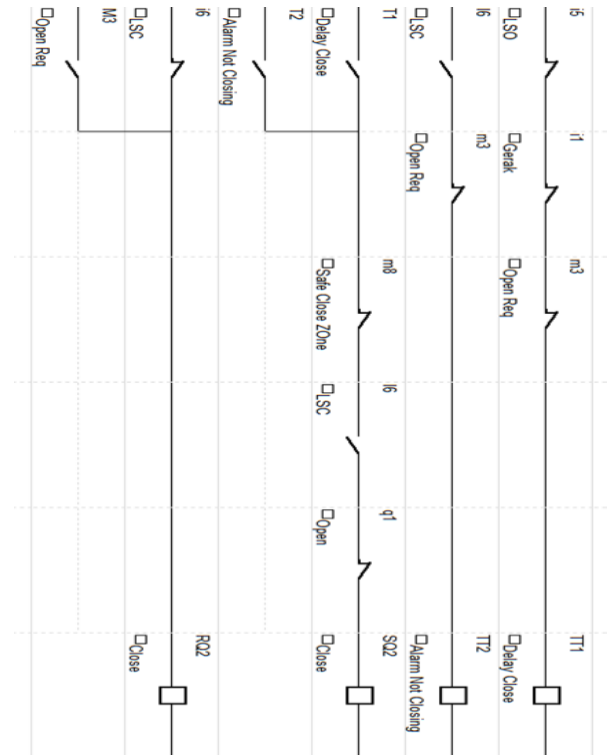1. Limir switch is fully open (I5)
2. Alaram (Q4) exists

Figure 7. Closing door program

In this logic, closing command is by set-reset of output relay Q2. Timer T1 is an on-delay timer with 5 seconds for auto closing.

The relay Q2 can be set if it is not in the safe close zone (M8), nor fully closed (I6), or there is no relay open command (Q1). The relay Q2 can be set by:

1. Timer T1 output contact
2. Timer T2 output contact

The relay Q2 can be reset by:

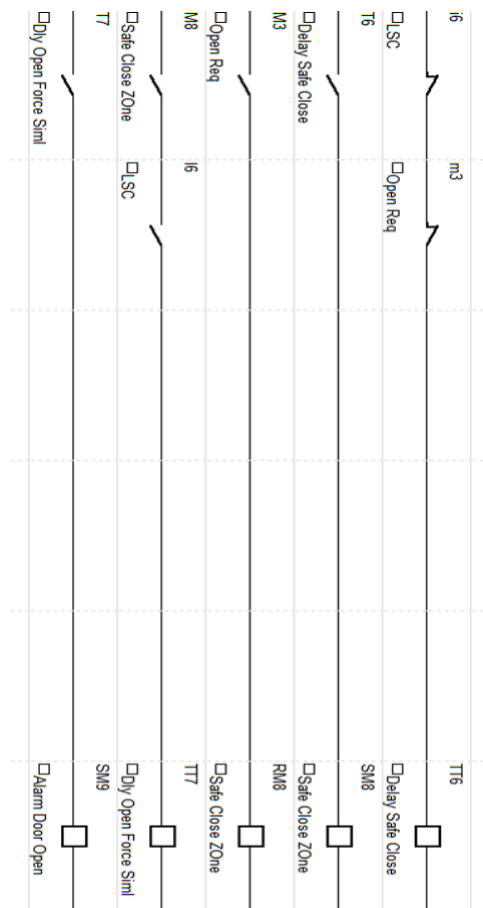1. Limir switch fully closed (I6)
2. Opening request (M3)

Figure 8. Safe close zone program

Safe zone means the system is safe when the door is fully closed. Timer T6 with 5 seconds on-delay output will be energized after the door is fully closed and there are no opening request (M3)

D. Auto Open Using Movement Detection Sensor

All movement detection from the sensor will trigger the opening request once this function is enabled
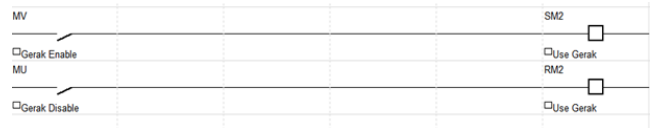

Figure 9. Auto open using movement detection sensor program

The alarm movement detection can also be enabled or disabled using SMS command of:

1. 12345678!alarmenable=1 to enable the function
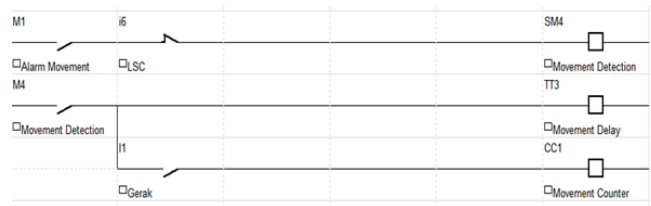2. 12345678!alarmdisable=1 for disabling the function

Figure 10. The movement counter program

When the function is enabled and the door is fully closed, the system will count the movement that is detected. If there are more than 5 movements detected within 60 seconds period, the system will generate alarm and send an SMS of "Suspicious Movement Detected".

If the C1 counter does not reach 5 in T3 period, which is equivalent to 60 seconds, then the C1 counter and the Timer T3 are reset to zero.
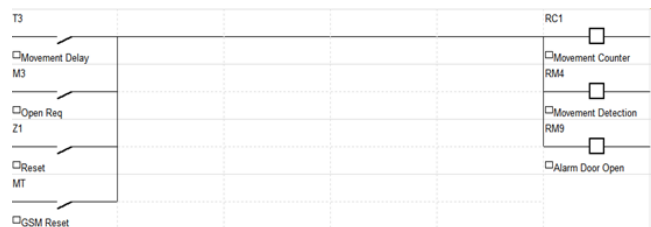

Figure 11. Reseting the counter C1 and timer T3

IV. RESULTS

This project is done in several stages. The first stage is to create a list of sensors that is needed and the basic materials to make the door. The second stage is to make the design of the prototype for the placement of the cables,

sensors, etc. the third stage is to find and to buy the needed sensors and basic materials for the door. The fourth stage is to make the door based on the design that was made in the second stage. The fifth stage will be trying to use each sensor and make sure that they are working properly. After each sensor has been tested, then all of them will be combined and tested whether they are working properly or not. Then they will be installed to the door. Finally, the sensors will be tested for the last time to check whether they are working properly or not.

Figure 12. Final prototype of the project

V. CONCLUSION

This research aims to provide people with a high-quality security system. With the tight security system, it will provide more comfort and make the owner feels safe. This research has been able to create the security for home door using multi sensors that could provide high-quality security system, thus, providing the comfort and safety for the owner.

REFERENCE

[1] Badan Pusat Statistik, "Statistik Kriminal 2014," Katalog BPS: 4401002 (Dokumen ini dapat diunduh dari: https://www.bappenas.go.id/files/data/Politik_Hukum_Pertahanan_dan_Keamanan/Statistik%20Kriminal%202014.pdf)

[2] Schneider Electric, *Zelio logic*, 2016. [Online]. Available: https://www.schneider-electric.co.id/en/product-range/531-zelio-logic/. [Accessed October 7, 2016].

[3] Amazon, *Biometric fingerprint*, 2016. [Online]. Available: https://www.amazon.com/125khz-Biometric-Fingerprint-standalone-Control/dp/B01E39BCZU. [Accessed October 8, 2016].

[4] H.A.Rangkuti & J.W. Simatupang, "Security Lock with DTMF Polyphonic Tone Sensor," ICACOMIT 2015, Bandung, Indonesia, pp.119-122 (IEEE Conference).