Home Automation Control System Design with Switches that Prevents Physical Contact

Wilfredo Ramirez[1], Grimaldo Quispe[2], Omar Alvarez[3], Heyul

Chavez[4] and Luis Rivera[4]

[1] Facultad de Ingenieria, Universidad Continental, Lima, Perú
[2] Facultad de Ingenieria, Universidad Nacional Autónoma
Altoandina de Tarma, Junín, Perú
[3] Facultad de Ingenieria, Universidad Nacional Mayor de San
Marcos, Lima, Perú
[4] Facultad de Ingenieria, Universidad Peruana de Ciencias
Aplicadas, Prolongación
Primavera 2390, Lima 15023, Perú

ABSTRACT

Security is an important human need for peace of mind when seeing their possessions safeguarded. This research project consists of the design of a mechanism that is capable of initially controlling a luminaire, opening and closing a curtain and the locking and unlocking of a room door. The general objective is to design a robust, reliable and intuitive mechanism when making use of it and that is capable of increasing the security and biosecurity of any

enclosure that is to be protected.

Keywords: SIM800l, Microcontroller, SGM network, servo motor, PCB board design.

INTRODUCTION

Since ancient years, security has been a basic human need for which various mechanisms have been designed to protect it and it is considered the second most important human need and is located only below the need for subsistence (Manuel, Jorge and Teresa, 2017). These mechanisms have been constantly evolving since the creation of the first lock made by the Egyptians until reaching the 19th century with the creation of the first cylinder lock by Linus Yale, until reaching our days with the technological advance of electronic keys (PSAM, 2021). So, the present work is born from a global problem, COVID-19 can sur-vive up to three days on plastic or metal surfaces (BBC News Mundo, 2020)., for this reason the design of a system capable of controlling different equipment using a switch was undertaken without touch and that will activate different de-vices with just gestures of a finger or using a smartphone, there are devices on the market that use biometric systems but all necessarily have parts that have to be touched with the fingers and are too expensive, complex and difficult maintenance. In this sense, an electronic lock has been designed that has local and remote lock-ing and unlocking by GSM network through a SMARTPHONE with ANDROID operating system which will be equipped with an application, for the control of the luminaire and curtain another module similar to the one will be used. of the door, but each gesture of the finger will activate or deactivate some device con-nected to our equipment. "The locks can be programmed", "the locks can be con-figured for operating hours and activated remotely" (Mobile, 1982).

STATE OF THE ART

Microcontroller. Integrated circuit that inside contains a CPU, memory units (RAM and ROM), input and output ports and peripherals. These parts are interconnected within the microcontroller, and together they make up what is known as a micro-computer (Formaci and Tecn, 2008) (Khromov and Dvornikov, 2016).

SIM800L Module. Quad-Band GSM / GPRS module that works with frequencies of 850/900/1800/1900 MHz for this system we focus on configuring the SIM800L module to be able to send data using the network GPRS to a database hosted on a free host, the configuration of the module was achieved using simple AT com-mands (see Fig.1).
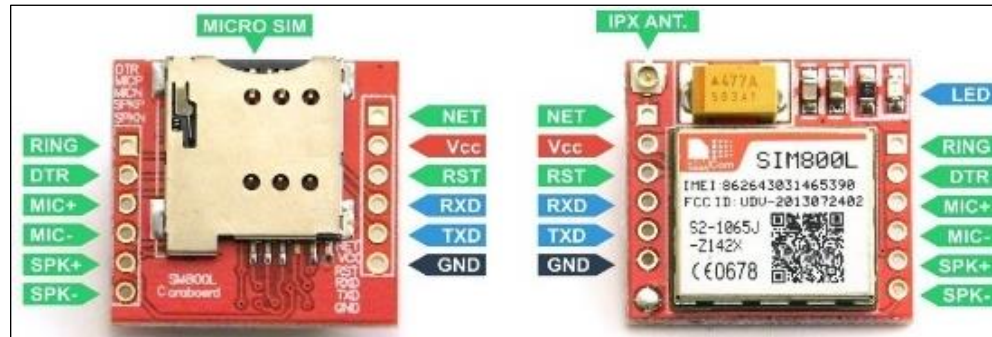
Fig. 1. SIM800L

AT commands. AT commands are coded instructions that make up a communication language between man and a MODEM terminal. The purpose of AT commands is communication with modems, GSM mobile telephony has also adopted this language to be able to communicate with its terminals. In this way, all GSM mobile phones have a specific AT command set that serves as an interface to configure and pro-vide instructions to the terminals (Vergara, 2018) (Monday et al., 2019).

GSM. The GSM network (Global System for Mobile Communications) is at the beginning of the 21st century. It is called the second generation (2G) standard because, unlike the first generation of portable telephones, communications occur in a completely digital way(Flores, 2018).

C ++ programming. Programming language designed in 1979 by Bjarne Stroustrup. The intention of creating it was to extend to the C programming language mechanisms that allow the manipulation of objects. In this sense, from the point of view of object-oriented languages, C ++ is a hybrid language (Garcia Breijo, 2008).

METHODOLOGY

PREPARATION OF THE SIM800L MODULE:

- The SIM is inserted into the module socket.
- The 3.4 to 4.5 Vdc supply with a peak current of 2 A. In the upper right part of the module there is a led that when flashing for 5 seconds, indicates that the module is already connected to the network ('SIMCom 5G MMW Module Boosts Sports Events', 2020).

- To configure the module, AT commands will be used and it is necessary to connect it to the PC, for this the connections are as indicated in Fig. 2 (Figueroa Lorenzo *et al.*, 2019).
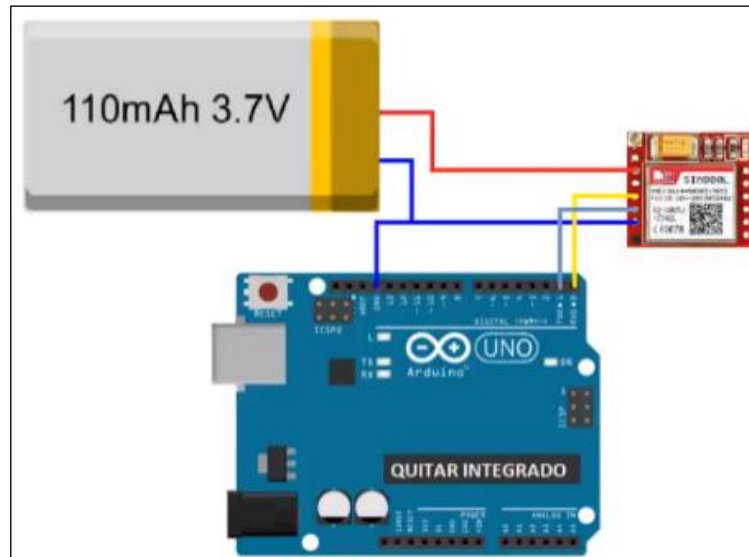
Fig. 2. Serial connection

Table 1. SIM800l module configuration

Item	AT command	Description
1	AT+IPR=9600	Communication speed at 9600baud / sec.
2	AT+CSCS= "IRA"	Text type, international alphanumeric.
3	AT+CMGF=1	Message format, SMS (1).
4	AT+CNMI=2,2,0,0,0	SMS that arrives sends it to the serial port.

PIC16F876A MICROCONTROLLER PROGRAMMING

The microcontroller software is divided into 2 parts:

Attention when unlocking the door. The program starts with the configuration with the input and output ports, enabling the external interrupt in which the IR sensor is connected, will activate the pulse count. Password entry failures will be counted, if there are 3 the system will restart.

Sending and receiving of configuration and control SMS. The SIM800l module sends a string of characters to the serial port that includes the sender's number, date and time (see Fig. 3):

Fig. 3. SMS reception.

APPLICATION CREATION (APP)

The application was developed in AppInventor 2; it has been divided into 3 parts:
Login to the application. When entering, it will ask us for a username and password , If the "Register" is selected, the contact number, a username and a password will be entered; When selecting "Enter" the system compares the entered data with stored data.

Control command sending. The structure of the SMS to be recognized by the microcontroller is # xxxx # (see Fig. 4):
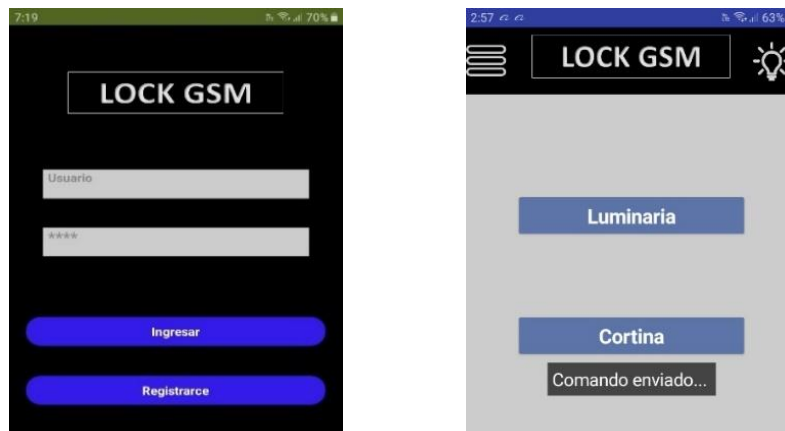

Fig. 4. Command ending screen.

When you press a button first, the contact number is searched in a database, in case there is not one, the software tells us that we have to add one, after selecting the contact number the pre-established message for each button is attached, then shipped.

Exterior design. To enter the password, it will be by a switch for cutting the light beam, the design has 4 led indicators so a 4-digit password is required, it also has a small speaker that will be a sound indicator for error or success in the password and finally a light sensor for automatic functions when it is night (see Fig. 5):
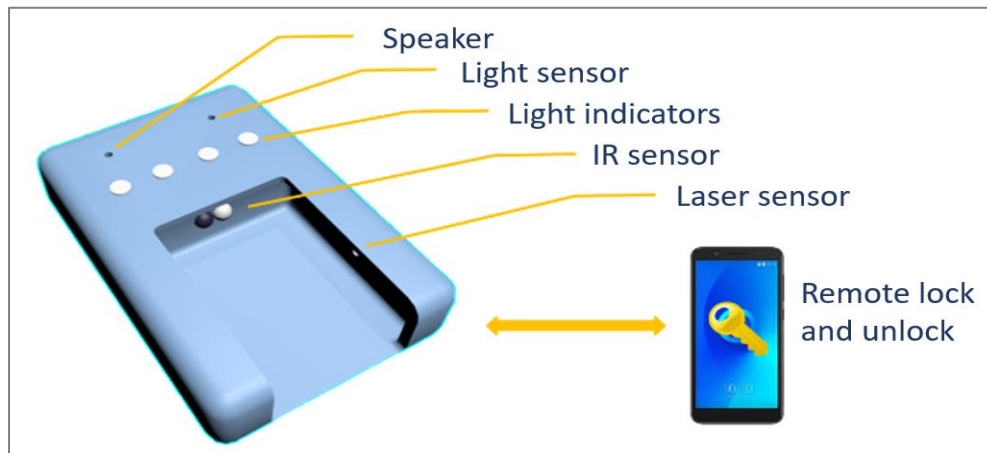

Fig. 5. Exterior model.

The dimensions of the device are: 120x60x35mm. For the locking and unlocking system of the lock, a low-power consumption servo motor is used to generate the movement of the pin to lock and unlock the door. For greater security, a Philips brand lock was chosen (see Fig. 6):

Fig. 6. Locking mechanism, author's own design

A very simple system was designed that will allow the door to be closed. The system is shown, a simple stop with an interior spring that, when the door is closed, retracts into the interior and leaves when it reaches a slot and from that way the door is closed. The complete mechanism is shown in the following figure (see Fig. 7):
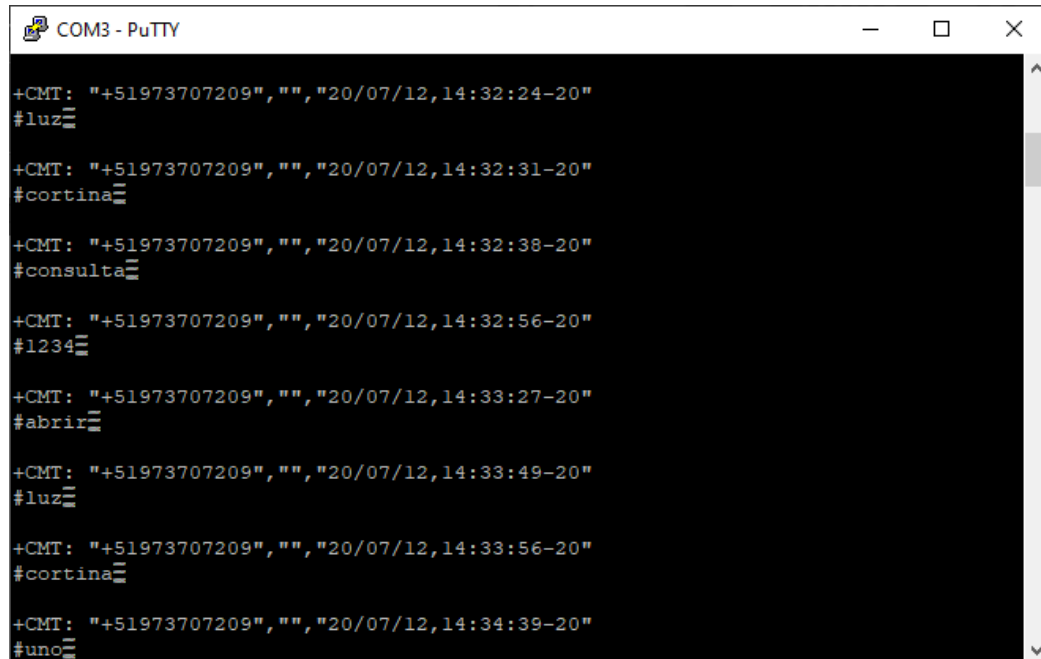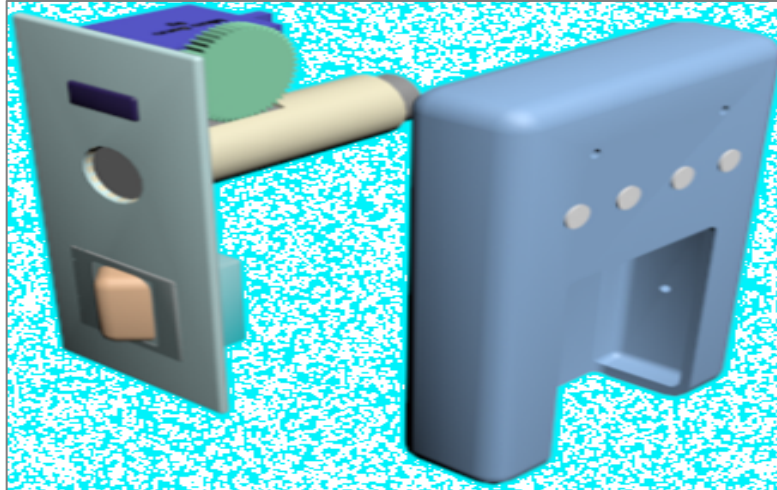
Fig. 7. Complete mechanism

Results

Table 2 show results obtained were a prototype of the control and configuration system, it was possible to have a successful communication between the SIM800l module, the PIC microcontroller and the mobile application. Of 100 text messages sent by the application, 98 messages successfully reached the microcontroller and the remaining two were lost. The current consumption of the system was monitored at all times, which is summarized below.

Table 2. Electricity consumption.

SIM800l		
Sending / receiving sms	1.75A	4.3v
Search for service.	500mA	4.3v
Resting	0.4mA	4.4v
PRINCIPAL CARD		
Password input	370mA	4.3v
Door unlocking	580mA	4.4v
Active luminaire	27mA	4.4v
Resting	0.3mA	4.4v

The messages sent from the application are shown in the following image (see Fig. 11):

Fig. 1. SMS received from application

CONCLUSIONS

With the implementation of the system, it was possible to avoid the use of traditional keys.
It was possible to make the mobile application that works according to plan and that offers greater security by containing alerts by sms.
It is also possible to increase the security with the application since when entering, you must necessarily enter by password.
The simplicity of the application was achieved, being somehow intuitive and easy to use.
With the no-touch switch it is possible to reduce the contact to activate the equipment.
With the 3-digit virtual password, greater security is achieved when accessing the premises, which can only be changed using software.

REFERENCES

BBC News Mundo (2020) *Coronavirus: cómo te puedes contagiar y cómo no*, *Redacción, BBC News Mundo*. Available at: https://www.bbc.com/mundo/noticias-51982673.

Figueroa Lorenzo, S. *et al.* (2019) 'A Comprehensive Review of RFID and Bluetooth Security: Practical Analysis', *Technologies*, 7(1), p. 15. doi: 10.3390/technologies7010015.

Flores, R. S. (2018) 'Cerradura Electronica Inalambrica'.

Formaci, E. D. E. and Tecn, D. E. (2008) 'Escuela politécnica nacional'.

Garcia Breijo, E. (2008) 'Compilador C CCS y simulador Proteus para Microcontroladores PIC', p. 276.

Khromov, I. A. and Dvornikov, A. A. (2016) 'Wireless access monitoring and control system based on intrabody communication', *2016 IEEE Conference on Quality Management, Transport and Information Security, Information Technologies, IT and MQ and IS 2016*, pp. 82–85. doi: 10.1109/ITMQIS.2016.7751929.

Manuel, G. S. E., Jorge, P. B. and Teresa, R. A. (2017) 'Cerradura Electrónica Con Sistema De Alimentación Integrado En Llave', p. 129.

Mobile, G. S. (1982) 'GSM (Sistema Global para las telecomunicaciones móviles)'. Available at: https://www.etsist.upm.es/estaticos/ingeniatic/index.php/tecnologias/item/471-gsm-sistema-global-para-las-telecomunicaciones-móviles.html.

Monday, H. N. *et al.* (2019) 'Design of an Improved Cost Effective Electronic Locking System', *2018 IEEE 9th Annual Information Technology, Electronics and Mobile Communication Conference, IEMCON 2018*, pp. 493–499. doi: 10.1109/IEMCON.2018.8614749.

PSAM (2021) *Las Caracteristicas de una cerradura antirobos*, *psb-psma*. Available at: https://www.psb-psma.org/category/cerraduras/.

'SIMCom 5G MMW Module Boosts Sports Events' (2020). Available at: https://www.simcom.com/news_view-149.html.

Vergara, H. (2018) 'Comandos AT SIM800 PUERTO USB PARTE 1'. Available at: https://www.youtube.com/watch?v=oslIQBlfFHc