# *Phone Call Controlled Garage Door*

Romul COPÎNDEAN, Rodica HOLONEC and Florin DRĂGAN

***Abstract****. This paper presents one way of operating a garage door by using a programmable logic controller (PLC), a Global System for Mobile (GSM) modem and a mobile phone as remote controller.*

**Keywords:** programmable logic controller, GSM modem, AT commands, H bridge, function block programming

## 1. INTRODUCTION

The everyday modern convenience is indispensable for our lives. As drivers, we can appreciate the benefits of automated garage doors.

The automation of garage doors facilitates the access, eliminating any effort necessary to open the door manually.

At the same time, the automated doors are safe to exploit, the situations in which the manual door blown by the wind hits the car's door is excluded.

The most used garage doors are:

**a. Sectional garage doors**

The door is made from overlapped panels, which open on the ceiling with minimum space needed. The entire surface of the garage can be used and there is a parking space even in front of the garage door.

**b. Swinging garage doors**

The door is made from overlapped panels that open on the ceiling. One can use the whole garage surface and can park in front of the door.

**c. Roller garage doors**

The closing/opening system works by vertical sliding and the rolling of the blade carpet to the upper part on a horizontal cylindrical axis placed above the opening.

No matter of the door type, a mechanism that includes a two sense rotating electrical motor and the actuating circuits is necessary.

## 2. GENERAL PRESENTATION

We used the following for our experiment:

- a sectional door operated by a direct current motor
- 2 position sensors
- a Mitsubishi Alpha XL (AL2-14MR-A) programmable automated device;
- GSM MAM GM6 modem
- RS232 interface module, GSM (AL2-GSM-CAB) connection modem;
- SIM card;
- mobile phone for the door command

Figure 1 presents the electrical principle diagram of the garage door automation.

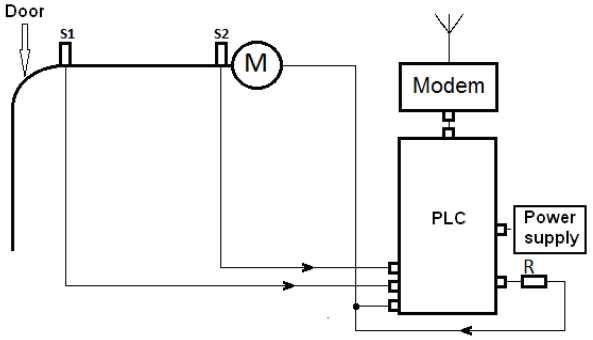


**Fig. 1.** Principle diagram of the garage door.

The 12 V DC motor actuates the garage door through a mechanism with gear box.

We used the S1 and S2 sensors for the stroke limits, sensors which stop the motor's power circuit on the moment of actuating.

To avoid accidents in case of the car, objects or even a person remaining in the door's working area, we used an R resistor that senses a current increase and commands the door to stop.

All these are connected to a PLC, its command being controlled by the Mitsubishi ALVLS program [4].

## 3. DEVICE'S DESCRIPTION

The connection of the sensors and motor to the PLC is made according to figure 2.

We use two proximity sensors of the type E2E-XF, OMRON [5] to notice the complete opening and closing of the door. The connecting way can be followed in figure 3.

The motor is controlled by an H bridge of the L623 SGS-THOMSON Microelectronics type [6].

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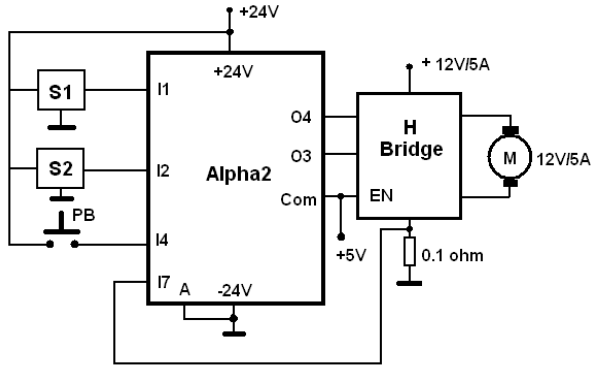



**Fig. 2.** PLC connecting electrical diagram.

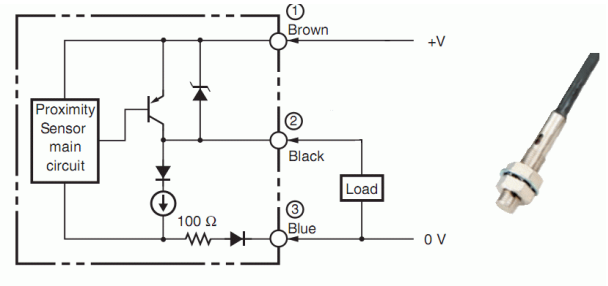



**Fig. 3.** Proximity Sensor.

The H bridge control is made according to the following table [6]:

| Inputs | | | Output Mosfets (*) |
|---|---|---|---|
| | IN1 | IN2 | |
| $V_{EN}$ = H | L | L | Sink 1, Sink 2 |
| | L | H | Sink 1, Source 2 |
| | H | L | Source 1, Sink 2 |
| | H | H | Source 1, Source 2 |
| $V_{EN}$ = L | X | X | All transistors turned oFF |

L = Low H = High X = DON't care
(*) Numbers referred to INPUT1 or INPUT2 controlled output stages

## 4. PROGRAMMING

The program designed with block functions [4] can be followed in figure 4:

To control the H bridge, respectively the motor, we use two SET/RESET block functions. The motor cut is given by the sensors connected to the I1 and I2 input. The safe cut, in the case of an object under the door, is made by the motor's electrical current information read from the resistor through the I7 analogical input. The B14 comparison block fixes the motor's stop limit.

The door's closing and opening is done from the button connected to I4 or through the *Call Detect* function.

We used only one control button which opens the door at one pressing, and closes it at the next. To achieve this, we used the ALT (alternate) function.

The *Call Detect* function works alternated, it opens the door at one call and closes it at the next.

The Call Detect function settings:

**A** – Display Comment – ticking this option, we can name the respective block;

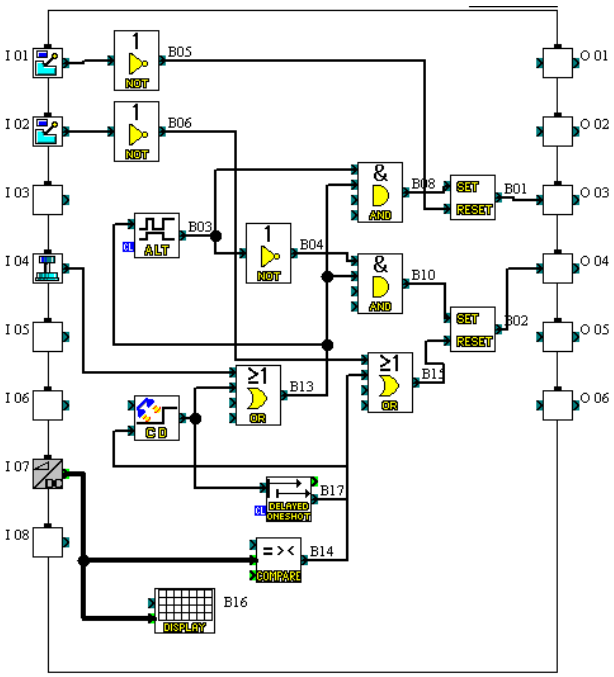
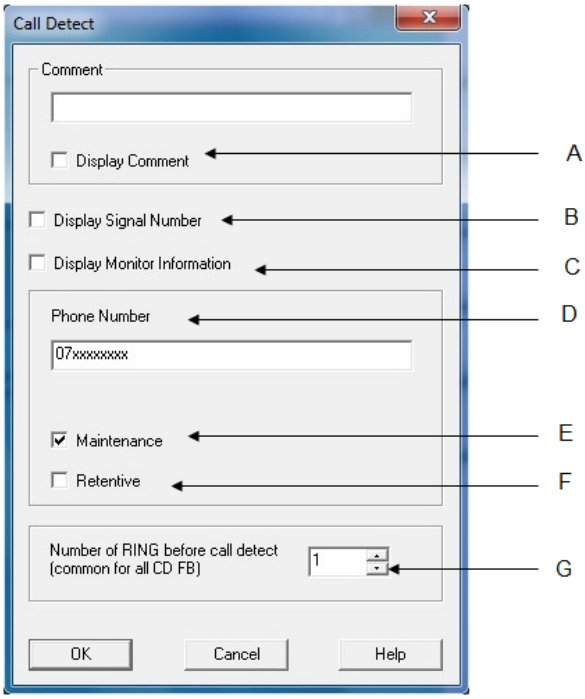



**Fig. 4.** The program for the garage door control.




**B** – Display Signal Number – if it isn't ticked, then the output from that block (B01 in our case) will not be numbered;

**C –** Display Monitor Information – if ticked, we can see information about the respective block during the program running;

**D –** Phone Number – represents the option where the phone number is introduced, number from which the call towards the modem is made;

**E –** Maintenance – information about the system's maintenance is received;

**F –** Retentive – it is advisable to tick this option, because it memorizes the last received values/data in the case of power failure;

**G –** is set for the number of calls before the program starts, with a range from 1 to 20.

For the modem to function correctly, the introduction of a initialization sequence with AT commands is necessary.

To access the GSM and serial' settings, the GSM & Serial Communication is accessed.

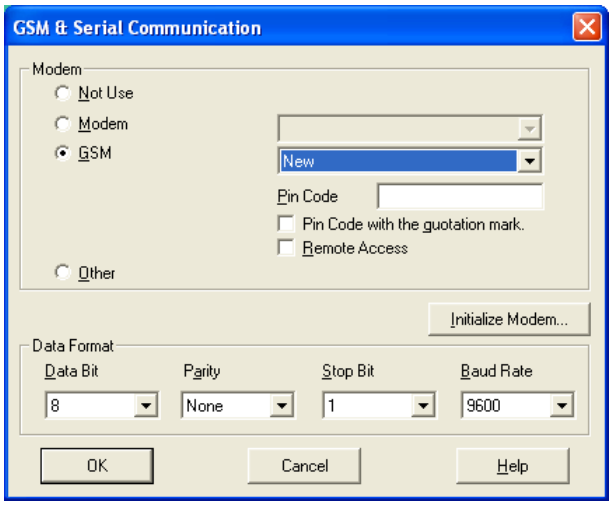



**Fig. 5.** Modem settings.

The series of AT commands is used for the initialization;


**Fig. 6.** Modem initialization.

The sequence of AT commands (Attention) for the initialization is [7,8]:

**AT+CICB=0;+CMEE=1;+CBST=7,0,0;+CNMI=2,2,2;E0S0=0;+CLIP=1;&W**

The initialization sequence is a succession of AT commands sent by the applications that control the communication through modems to its configuration. This initialization sequence is transmitted to the modem before other control commands, e.g. ATD or ATA. The set of AT commands is one of the main modem interfaces to communicate with an external application.

The significance of the initialization sequence can be followed in the bibliography.

## 5. CONCLUSION

The PLC used in the presented application offers multiple facilities, the most important here being the remote control through phone call.

To extend the application, we can add functions like the one of alarm SMS sending in case of breaking in. In this case, the sensor for door closing is used, adding also supplementary block function of the GSM or SMS types.

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