This work aims the implementation of an intrusion detection alarm system, in a restricted space as a single room retail store. The intrusion will be detected resorting to an infrared sensor, installed in such a way that points towards the main entrance of the space to be protected. A switch is also installed on a window of the space.

The automation system that constitutes the alarm is to be implemented in the Schneider PLCs available on the laboratory, model Premium TSX P57 1634M or TSX P57 2634M. This document is composed by two parts: the first describes the guidelines for the session on the lab and the second (see annex) describes the functional specifications of all the work that will be developed in the next weeks.

In this part of the work, the 12-keys keyboard available in the console is combined with the switches to build the primary interaction device with the alarm system under design. Sequences of keys must be validated resorting to the subroutines implemented in the previous part of this work. The integration of the complete system is suggested to be done in the ***GRAFCET / Sequential Function Chart (SFC)***.

**Implementation guidelines**

The basic presence detection and active alarm system already developed are supposed to be running continuously. Note however that the function of selecting the operating mode (presence detection / active alarm) cannot be based just on switches, must be moved to an upper integration level (SFC).

Keyboard reading is also a function assumed to be running continuously. The upper integration level can validate codes saved in a buffer. Keyboard input is cleared if a timeout occurs or any other condition recommends flushing keys already read.

It is recommended to allow testing the hardware before entering into the active alarm mode. This option can be made available before entering the activation code by pressing the # key of the keyboard. After the hardware test, and in case the active alarm mode switch is ON, one can enter the activation code and therefore enter the active alarm mode.

In order to facilitate the interaction, any return to the OFF mode must be marked with 3-short-beeps done with the buzzer. Suggested timing is 0.02sec for each beep and a pause of 0.1sec in between.

**Summary of the assignment**

Please develop, implement, and test one or more sections in *GRAFCET / SFC* that, according to with the interaction with the user, activates a presence detection mode, validates sequences of keys to activate the alarm, to change the code, restart the code to factory settings, as well as other specifications in the annex. Please write the receptivity functions in *Ladder*, *Instruction List*, or *Structured Text*.

# Annex A - Functional Specifications of the Alarm

*(please do NOT include this annex in your report)*

The Alarm has three main modes of operation, OFF, Presence Detector, and Active. The three modes are selected by a three positions switch. The three modes operate as detailed next:

**(Mode 1) OFF** – this mode deactivates the alarm completely.

**(Mode 2) PRESENCE DETECTOR** – the infrared sensor is used to detect the movement on the room/space, that be signalized resorting both to a lamp and to the buzzer on the panel. The lamp should be on for 5 seconds, upon the detection of each person, and an acoustic signal with the duration of 1 second should be emitted.

**(Mode 3) ACTIVE** – in this mode, the alarm is to be used.

Detailed specifications for mode 3, **ACTIVE**, are the following:

a) When requested for activation, a period of 30 seconds of inactivity is set to allow the user to abandon the space, and afterward remains permanently activated.

b) Upon intrusion detection, by the infrared sensor or the window switch, the alarm evolves to the warning phase.

c) The alarm lights a warning on the panel and after 5 seconds the buzzer must be activated. The warning must be a periodic signal with 1 second on and 2 seconds off.

d) The alarm can be deactivated pressing the # key on the command panel.

**Advanced Characteristics of the Alarm:**

An advanced alternative for the alarm activation/deactivation consists of the use of a code previously set by the human owner (e.g. 9887). To implement the activation function, the following procedure must be implemented:

a) switch the alarm mode to ACTIVE.

b) introduce the activation code (e.g. 9887).

c) press #, and wait for 30 seconds to allow the user to abandon the space.

d) start the intrusion detection function, i.e. the alarm is fully operational.

To deactivate the alarm, upon intrusion detection or to allow the use of the space, the following instructions must be accomplished:

a) Introduce the secret code (the same as the activation one, e.g. 9887).

b) Press #

c) Change the alarm mode to a mode other the ACTIVE.

**Special Characteristics of the Alarm:**

A safer mode of operation for the intrusion detection alarm is to allow the user to change the activation/deactivation code. The code 1234 is initially used, as a factory preset. To change the code, the following operations must be done:

a) Press \*, followed by the pre-programmed code.

b) Introduced the new code to be used, finished by \*

In the case where a mistake occurs, press the code \*\*\*\* to reset the code to the factory default.

**Available Material**

In the laboratory, there are six different working places, all with similar PLCs but different consoles. All workplaces have a PLC Schneider model P57. All of them have a power supply with 24V and/or 12V and a desktop PC, with the Unity Pro v6 development software and the PLC manuals, in PDF format.

In each workplace there will be also an alarm console with the following components:

|  |  |
| --- | --- |
| 1 three positions switch  1 two positions switch  3 LEDs  1 keyboard (4x3 buttons)  1 buzzer (12V) |  |

The solution for this automation problem must be based on the languages described on the IEC-61131-3 standard, i.e. ladder diagrams, instruction list, and structured text.