Industrial Processes Automation

MSc in Electrical and Computer Engineering
Scientific Area of Systems, Decision, and Control

Winter Semester 2011/2012

1st Laboratory Assignment [1]

Alarm System for Intrusion Detection

This work aims the implementation of an intrusion detection alarm system, in a restricted space as a retail store having one single small room. 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 aforementioned 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 first 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.

Part B

The second part of this laboratory assignment consists of the implementation of an automated solution to the identification of a key pressed, on the available keyboard with 12 keys. This device is central to the user to interact with the intrusion detection alarm system under design. The solution foreseen is the design of one or more ladder subroutine sections (optionally on structured text or instruction list), to identify the key pressed. A suggested name for the main subroutine identifying the key pressed is `SR_get_key`. If no key is pressed the `SR_get_key` subroutine must store -1 in a memory as the result. In case a digit, '0', '1', ... , or '9', is pressed, the subroutine stores the corresponding value in the memory. In case the key '*' or the key '#' is pressed, the subroutine stores in the memory 10 or 11, respectively. The `SR_get_key` subroutine is desired to reject multiple keys pressed at the same time. A 0.5sec light signal shall be provided as soon as a key is detected.
Note: will be required to read and validate sequences of keys in the next assignment.

[1] 2008-2010 original guide by Prof. Paulo J. Oliveira, 2011 rev. by Prof. José Gaspar

Q1. Identify the PLC inputs and outputs, from/to the keyboard, to be used on the intrusion detection alarm system. Indicate also the timer(s) and memory cell(s) used for the output of `SR_get_key`.

PLC Input (chosen variable name)	**PLC Identifier (physical address)**

PLC Output (chosen variable name)	**PLC Identifier (physical address)**

Memory or timer (chosen variable name)	**PLC physical address (if specified)**	**Short description of the memory or timer**

Q2. Describe the reading/identifying strategy to be implemented to solve the proposed problem.

Q3. Upload the program proposed to the PLC and run. Comment on the results obtained.

Q4. Consult in the manuals how to use PLC system words to obtain (i) minimum and (ii) maximum scan-cycle times when the PLC is running just the `SR_get_key` called by one section of MAST. Indicate those times in milliseconds. Comment the next sentence: "Even in case of having access just to a low resolution time clock, e.g. a TON timer, it is possible to estimate a typical value for the scan-cycle".

Q5. Comment the following statement: "The solution to read and identify one key requires the keyboard to be scanned once, but not periodically. This is relevant in case one has relay instead of transistor based outputs."

Annex - Functional Specifications of the Alarm

The Alarm has free 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 afterwards 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 on the use of a code previously set by the human owner (e.g. 9665). 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. 9665).

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. 9665).

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 0000 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:

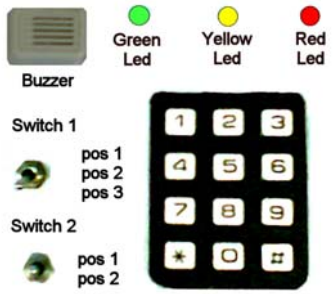
12 buttons keyboard

12V buzzer

1 three positions switch

1 two positions switch

3 LEDs



The solution for this automation problem must be based on the languages described on the IEC 1131-3 standard, i.e. ladder diagrams, instruction list and structured text.