Faculty:		SCHOOL OF ELECTRICAL ENGINEERING		
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SKEE/SKEM/SKEL 3742

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APPLIED CONTROL LABORATORY
STUDENT PACK

Introduction to PLC and Design (Lift System)
Using Omron SYSMAC CPM-2A PLC – Task 1

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Stamp	:	Stamp	:
Date	: 1 April 2020	Date	: 1 April 2020

1. Problem/Project Guide:

A PLC is an industrial microprocessor-based control system that continuously monitors the state of input devices, makes decisions using a custom program, and controls the state of devices connected as outputs. Although PLC's are relatively bulky compared to a microcontroller, they remain the most commonly-used industrial data acquisition and control devices in manufacturing and electromechanical automation. Industries such as packaging, pharmaceuticals, refineries, mines, machine shops, power plants and food all automate their systems/machinery to produce more outputs with consistently, quickly and efficiently through the use of PLCs.

As it is easily programmable to accomplish a variety of control operations, it quickly gains wider applications in industry by replacing its predecessor, the electromechanical relays. The relays are now commonly used as switches and no longer as logical controllers.

Logical systems are normally represented graphically by using state diagrams or other similar methodologies. The representation is then transformed to ladder logic diagrams and implemented in PLC by using its programming language which resembles the ladder logic diagram. The purpose of this study is to control a lift system by using a PLC approach.

(a) Problem objectives:

- To design a lift control system using PLC
- To incorporate a safety features with the proposed design
- To analyse the efficiency of the proposed system

(b) Tasks

- An old bungalow house has a problematic lift, which always stop at the undesired level. Sometimes it moves by itself, unexpectedly.
- Your team, as a technical expert in automation system, is specially hired to look into the problem and come out with a good solution. The solution needs to include a PLC programming incorporated by a fully operated system.

- The lift is composed of cabin with automatic door that moves itself inside the three floors lift-shaft. Each floor is also provided with an automatic door. The lift also equipped with electromagnetic brake and several push buttons in the cabin and on the floors. An automatic cycle must be realized for an effective operation of the lift both in normal conditions and in case of emergency events, such as a shortage of electric supply. Examples of essential operations those should be included are:
  - The call of cabin to the floors through a push button
  - The reservations that may occur at any time
  - The movement of the cabin is only performed if reservation occurs from floor other than the floor where the cabin is located
  - The electromagnetic brake operates every time its supply is off.
  - When the cabin reaches the target floor, a simultaneous opening of both the cabin and the floor doors is performed.

- The tasks to be included for the laboratory are:
  - Design and write a suitable program for the DL2122 Lift Model using the CX-ONE PLC programmer software. Try to include as much as possible the inputs/outputs port of the system.
  - Test the PLC program with the control system to provide a comprehensive analysis of your design.

- A report supported with the experiment results is expected to be produced at the end of the task. The collected data and analysis should be well presented and discussed in detail in the report.

(c) Problem-solving Time-line

Activities	Week 1	Week 2	Week 3
1. Briefing, PLC exercises, brainstorming, oral interview, submission of proposal			
2. Design/programming/experiments, oral interview, individual report			
3. Analysis, oral interview, demonstration of final designed			

(d) Proposal write-up

You are expected to submit a handwritten project proposal on one page of paper + attachments (e.g. a flowchart for software based project). Each write-up is to be submitted as teamwork on the first week of the laboratory. Please ensure that each team member is responsible enough to contribute in completing the work. Your proposal may include the following information:

- title
- objective
- problem statement
- methodology (flow chart/block diagram/list of equipment, materials)
- expected outcome

(e) Report writing

A group report needs to be submitted in the post week after the third week of laboratory session. Your report should follow the general guide by the Laboratory Coordinator such as abstract, introduction, methodologies etc.

Other than the general guide, your report for this laboratory may also include:

- Review and circuit diagrams
- Data and graph as a results
- Photographs of the actual circuit construction
- Photographs of your group members

(f) Questions That Can Help You Tackle The Problem

- How does the lift system work?
- Main components of the lift system?
- The flowchart of lift operation
- What are the necessary inputs/outputs from the lift system to be used with the PLC.

2. Equipments list:

(a) DL 2122M Lift Model which represents the actual lift system
(b) Omron SYSMAC CPM2A PLC

3. Components list:

(a) Connector
(b) Jumper wire, wire

4. Software:

(a) PLC programming software: CX-ONE Programmer
(b) Microsoft Excel

5. Additional resources:

Materials related to the problem/project. Can be technical papers, short manual on how to use CX-ONE programmer software or other software for a particular problem/project, links to websites etc. Examples as follows:

(a) Omron, 2001, “A Beginner’s Guide to PLC”, Omron Singapore.
(b) Omron, 2001, “CX-programmer User Manual version 2.1.
(c) Lift DL 2122M – Automation Laboratory Manual Book, De Lorenzo Group, Italy.
(d) Please refer to page 2-24 (A Beginner’s Guide to PLC) to get examples of PLC electrical wiring.
(e) Figures of the DL 2122M Lift Model as follows:

DL 2122M Lift Model

Inputs/outputs panel

Some important prefixes:
- ML : Main load motor
- Md : Main door motor
- M1~3 : Level door motor
- EB : Electromagnetic brake (Enable LOW)
- Black ports: outputs, Red ports: inputs

6. References:

APPLIED CONTROL LAB- ONLINE LAB

Experiment Lift System

Guide to all students:

1. This PBL lab will use the same lab-sheet as before.

2. The experiment on Lift System in the lab will be replaced by PLC Simulator software (Open to any PLC simulator software proposed by students: you need to define in your proposal)
Example of the simulator:

a) CX-One Omron
b) Tia Portal by Siemens (30 days full trial)
c) Do-more Designer
d) PLC Open Editor
e) PLC Ladder Simulator- Android App
f) PSIM PLC simulator

3. The student must use State-Diagram to design their sequences of the system followed by the ladder diagram to simulate the "offline" programming to complete their task. The complete steps as follows:

a) Identified Input and output of the system and draw the wiring diagram
b) Design the state diagram to represent the system operation.
c) Check all the inputs and outputs to match the function in the system.
d) Translate the state diagram to the ladder diagram
e) Check the operation function for each rung.
f) Use the PLC simulator to simulate the ladder diagram to fulfill the system requirement.

4. The system should include the SCADA capabilities to support interoperability with a wide range of third party hardware and software, for easy integration with existing operating environments. The student needs to design the HMI using any suitable SCADA Software for monitoring and control the system.

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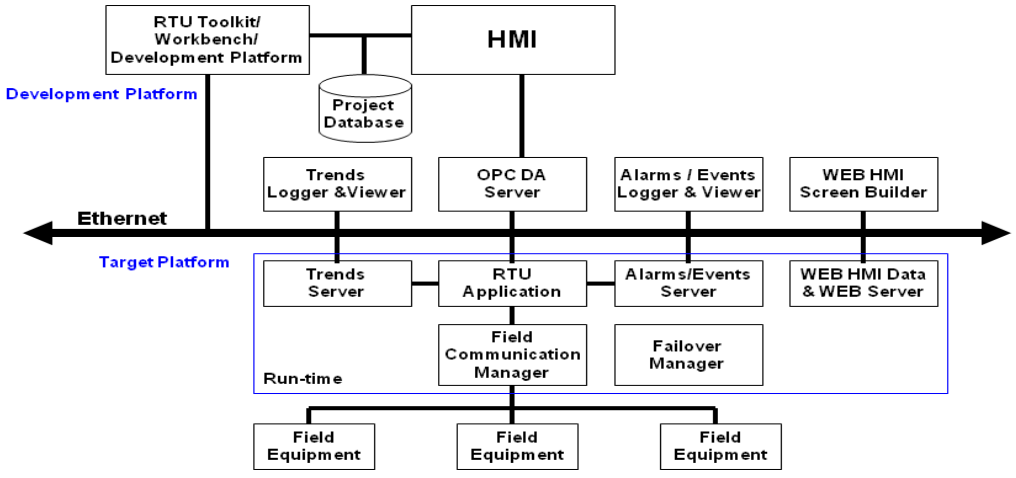

Figure 1: SCADA System Architecture