SMART ENERGY SAVING CLASSROOM AND MONITORING SYSTEM USING PROGRAMMABLE LOGIC CONTROLLER

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ELECTRICAL & ELECTRONICS ENGINEERING
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FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
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CERTIFICATION OF APPROVAL

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Approved:

____

Pn Zazilah Binti May
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

January 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Yasir Ashiq Ali Bin Mohd Yaseen

Abstract

The rise in energy costs urged the need in minimizing the energy consumption. As significant amount of energy is used for illuminating in educational buildings such as lecture halls and lecture rooms, improvements is needed to avoid energy waste for unoccupied and daylight hour. The lighting will be controlled based on demand to save the energy costs. The project is to design a smart energy saving classroom system using programmable logic controller (PLC). It integrates the lighting and air conditioner control system. Software for this project includes Simatic Manager, Wincc Flexible and Microsoft Visio 2010.The hardware includes Siemens S300 series PLC, Siemens 10 inch touch screen, network cable and MPI cable. The inputs are sensor at the door and sensors at each of the student seat while the outputs are the projector dc motor, lights, air-conditioner and touch screen. The proposed system offers a costs-saving solution with low maintenance and gives great performance results.

ACKNOWLEDGEMENTS

I hereby would like to grab this opportunity to express my deepest gratitude and gratefulness firstly to God, The Almighty for giving me a chance to acquire new knowledge and with His will, this project was successfully completed. My special thanks and appreciation to my supervisor, Pn Zazilah Binti May for all the guidance, advice and commitment in assisting me throughout this project. A warmness thanks to my fellow friends for all the help, support and opinion given in completing this project. My resolute appreciation to Mentari Automation Sdn Bhd for trusting me with their hardware and software. Last but not least I would like to thank my beloved parents and brother for giving me moral supports and all parties that involved in completing this project.

Table of Content

List of Figures

List of Tables

CHAPTER 1: INTRODUCTION

1.1 Background of study

In this modern world nowadays, electricity becomes one of the important energy in human life. The abundances of the electricity in this world makes people take it for granted thus do not have the awareness of the importance of electricity. This become one of the reason the rise in cost for managing, conserving and distributing. In Malaysia particularly, all university are having the same problem. The usage of electricity is very high especially in the lecture halls. Students simply do not have responsibility to reduce the usage of electricity. Thus, a smart and energy saving project will be created. From a previous case study, after a particular lecture session ends, the lighting and air-conditioner are left on and unattended. Students and lectures often forget to turn off the lighting system and air-conditioner before leaving the lecture hall.

Students in university especially in UTP often skip the class and ask their friend to sign the attendance on behalf of them. Some lectures will call the name of each person and ask them to come sign the attendance individually. Some lectures will head count the student in the class and compare it with the number of students sign the attendance. Both of this method are very time consuming and burden the lectures.

The smart system in this project basically to automate the control of lighting and air-conditioner.. Plc (programmable logic controller) will be used together with software to program the plc.

1.2 Problem statement

Basically, the automated lighting and air-conditioner system can save a lot of energy by utilize it efficiently. The existence systems which are implemented in the UTP lecture halls are not efficient and cause a lot of waste in electricity energy thus increase the cost. On the other hand, the old method which relies on the lecturer to monitor the student's attendance is a burden to lecturer and time consuming.

1.3 Objective

1) To automatically control the switching of light and air-conditioner using PLC (Programmable Logic Controller)

2) To create a monitoring system for a classroom

3) To control the luminance of artificial light based on the amount of daylight

1.4 Significance of project

The goal is to produce a solution by creating an automatize classroom system which the energy is managed more efficiently and smartly

1.5 Scope of project

The scope of the project is to design a model using a Programmable Logic Controller (PLC) for UTP lecture hall. In order to achieve the objective of the project, there are several scope had been outlined. The project is divided into two parts which are hardware development and software development. For the hardware development, the PLC that will be used is Siemens S7300 series, 32 Bit Digital Input Output and 3 switches and 3 lights. On the other hand, for the software development, I used Simatic Manager, WinCC Flexible and Microsoft Visio.

CHAPTER 2: LITERATURE REVIEW AND THEORY

Several research papers had been analyzed in order to understand the relevancy and scope of the energy saving system for classroom. A paper entitled lighting system to save energy in educational classrooms by Luigi Martirano published in 2011 was studied. This paper was about a several strategy that he comes out with to design an energy saving system. His strategies include zoning strategy, scheduling strategy, daylighting strategy and occupancy strategy. Luigi Martirano describe in his paper about two distinguish smart control system which are using dimming and switching. Both are same in concept but different in components.

In order to design the light control system, he used a formula which is:

LENI = W/A [kWh/(m2 × year)]

where

A is the considered useful area [m* m]

W is the sum of annual energy used for lighting, equal to

$$W = W_L + W_P \text{ [kWh/year]}$$

As the total of the W_L estimated annual lighting energy and W_P parasitic energy (emergency and standby controls)

2.1 PLC Introduction

Basically, Programmable logic controller (PLC) is a digital computer used for an automation of electromechanical processes, such as to control the machinery in factory assembly lines, cars, lorries and light fixtures. PLCs become a must in many industries and machineries from packaging machine to high tech machine such as semiconductor machines. As compare to computer, the PLC is designed in such a way so that it can receive multiple inputs and output and very heavy duty. The PLC is heavy duty in terms of it have very high temperature ranges, safe from electrical noise, and resilience to any sort of impact and vibration. Normally, the entire machine operation programs are kept in battery –backed or non-volatile memory.

A PLC includes a Central Processing Unit (CPU) consists of an application program and an Interface modules contains Output and Input, which is connected to the surrounding I/O devices. Basically, a program is needed to control the PLC so that when it receives an ON signal from an input device, the necessary action is made. Normally, the response would be turning ON an output signal to output devices.

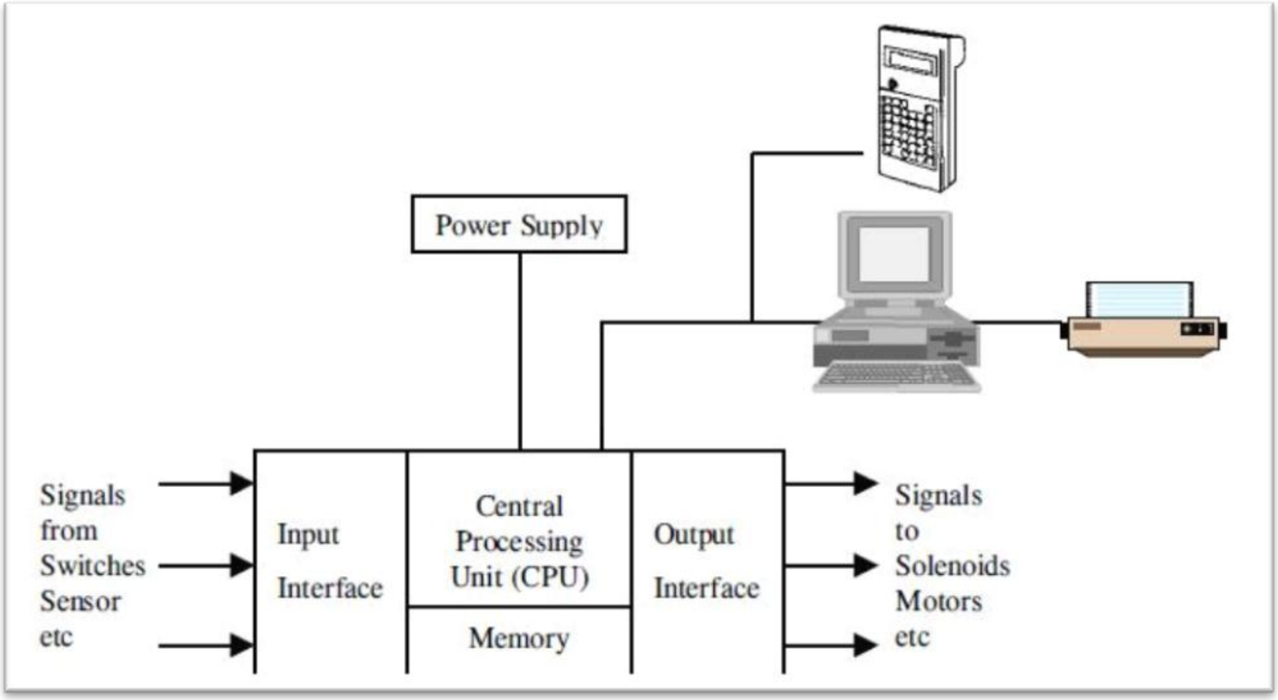


Figure 1: Block Diagram of PLC

2.2 PLC compared With Other Control Systems

PLC	MICROCONTROLLER
Little electrical design is required	High cost since it is custom- designed controller
Highly customizable	Rarely customizable
Economical compared to custom-built controller design	uneconomical

Table 1: PLC compared With Other Control Systems

2.3 Siemens S7 Introduction

The S7 PLC's is in terms of function, speed and memory capacity. We can configure it for various type of application such as conveyer belt system. The PLC basically consists of power supply, central processing unit (CPU) and communication process module. The entire PLC program is stored in a flash memory card. The card holds the information even though during a power out.

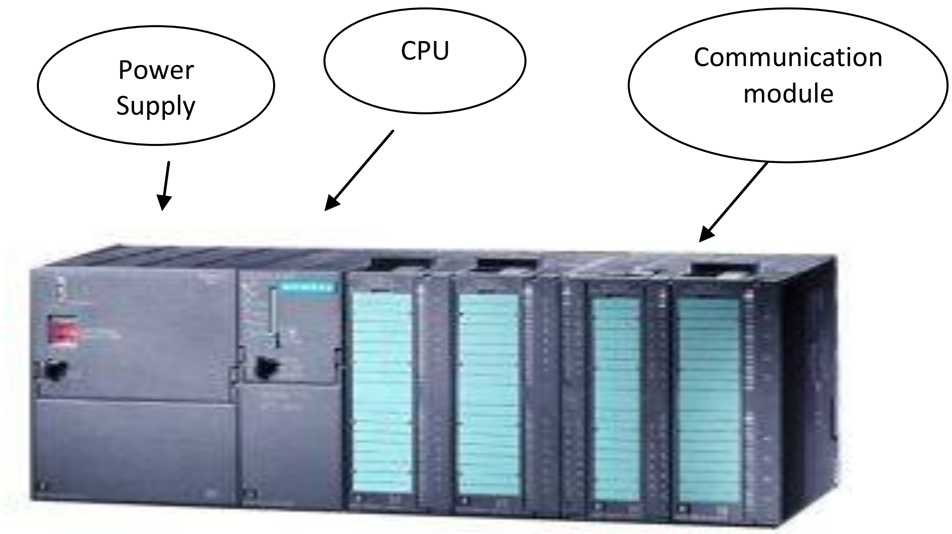


Figure 2:S7 PLC Units

2.4 PLC Features

The most significance difference between PLCs and other computers is that PLCs equipped for harsh environments (such as dust, moisture, heat, cold) and have the capability for wide-ranging input/output (I/O) arrangements. These connect the PLC to sensors and actuators. PLCs have the ability to read limit switches, analog process variables (such as temperature and pressure), and complex positioning systems. On the other hand, for the actuator side, PLCs generally operate electric motors, pneumatic or hydraulic cylinders, magnetic relays, solenoids, or analog outputs.

2.5 User Interface

PLCs will required to communicate with people for reasons such as alarm reporting, configuration or daily control. A Human-Machine Interface (HMI) is stationed for this purpose. HMIs also known as MMIs (Man Machine Interface) and GUI (Graphical User Interface).A simple system maybe use push buttons and lights to interact with the user. Displays such as text and graphical are available in touch screens. More sophisticated systems use a programming (such as Winn CC Flexible) and monitoring software installed on a computer, with the PLC connected through communication interface.

2.6 Communication

Normally, PLCs have built in communications ports with 9-Pin RS232, and optionally for RS485 and Ethernet. Usually, Modbus or DF1 included as one of the communications protocols. Others include different fieldbuses such as DeviceNet or Profibus.

Modern PLCs can communicate using a network to other system, such as a computer running a SCADA (Supervisory Control and Data Acquisition) system or web browser. On the other hand, the PLCs used in larger Input/output systems should have peer-to-peer (P2P) communication between the processors. This allows different parts of a sophisticated process to have individual control while allowing the subsystems to co-ordinate over the communication link. Today's PLCs have the ability to communicate over a wide range of media including RS-485, Coaxial, and Ethernet for input/output control at network speeds up to 100 Mbit/s

2.7 Digital And Analog Signals

Digital signal act as binary switches, yielding simply an On or Off signal (1 or 0, True or False, respectively). Examples of devices providing a discrete signal are push buttons, limit switches and photoelectric sensors. Digital signals are sent via voltage or current, where a particular range is set as *On* and another as *Off*. A PLC might use 24 V DC Input/Output, with values above 22 V DC representing *On* and values below 2VDC representing *Off*.

2.8 Siemens PLC

The S7 PLC's are different in many aspects including function, speed and memory capacity. The configuration of the PLC is depending on the application. A simple process such as conveyor belt systems could settle with a simpler S7 PLC's. For more sophisticated systems such as turbines and paper machines, several powerful S7 PLC's could be needed working together as a cluster or separate

CPU module(s) consists of a CPU, and a memory module. The CPU module holds a DP interface and a combined DP/MPI interface. The MPI is used by programmer to program CPU modules flash card via an expansion card in a PC. Typically, the memory card is programmed through the CP modules Ethernet connection (that is via a network)

2.9 Siemens PLC Program Editor

Basically, there are more than 5 type of programming language that offered by Siemens PLC. For this project, I will use two types of PLC programming language. The first one is Ladder Diagram (LAD) and the second language is S7- Graph. For each of the language, it has own advantages.

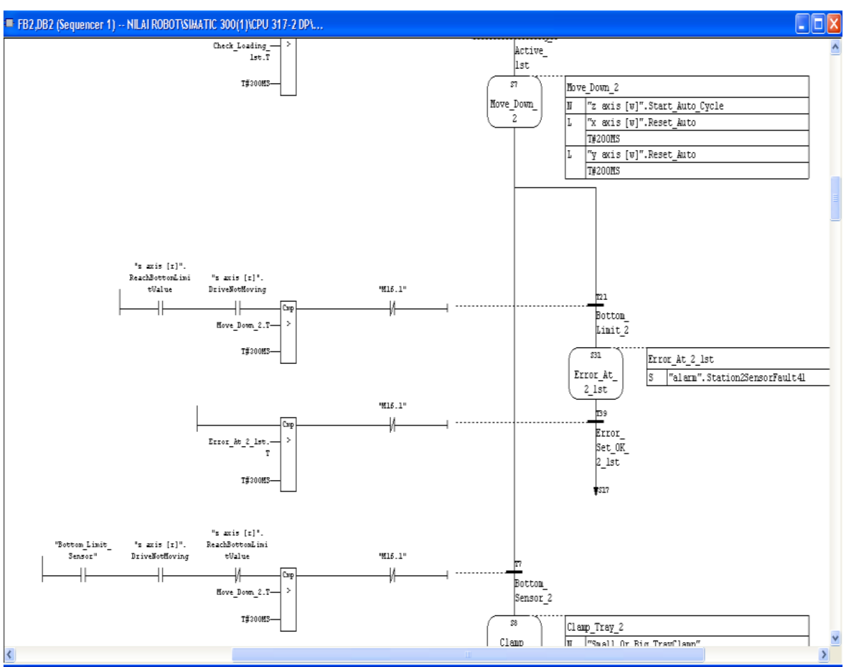


Figure 3: Example of Graph-7 Program

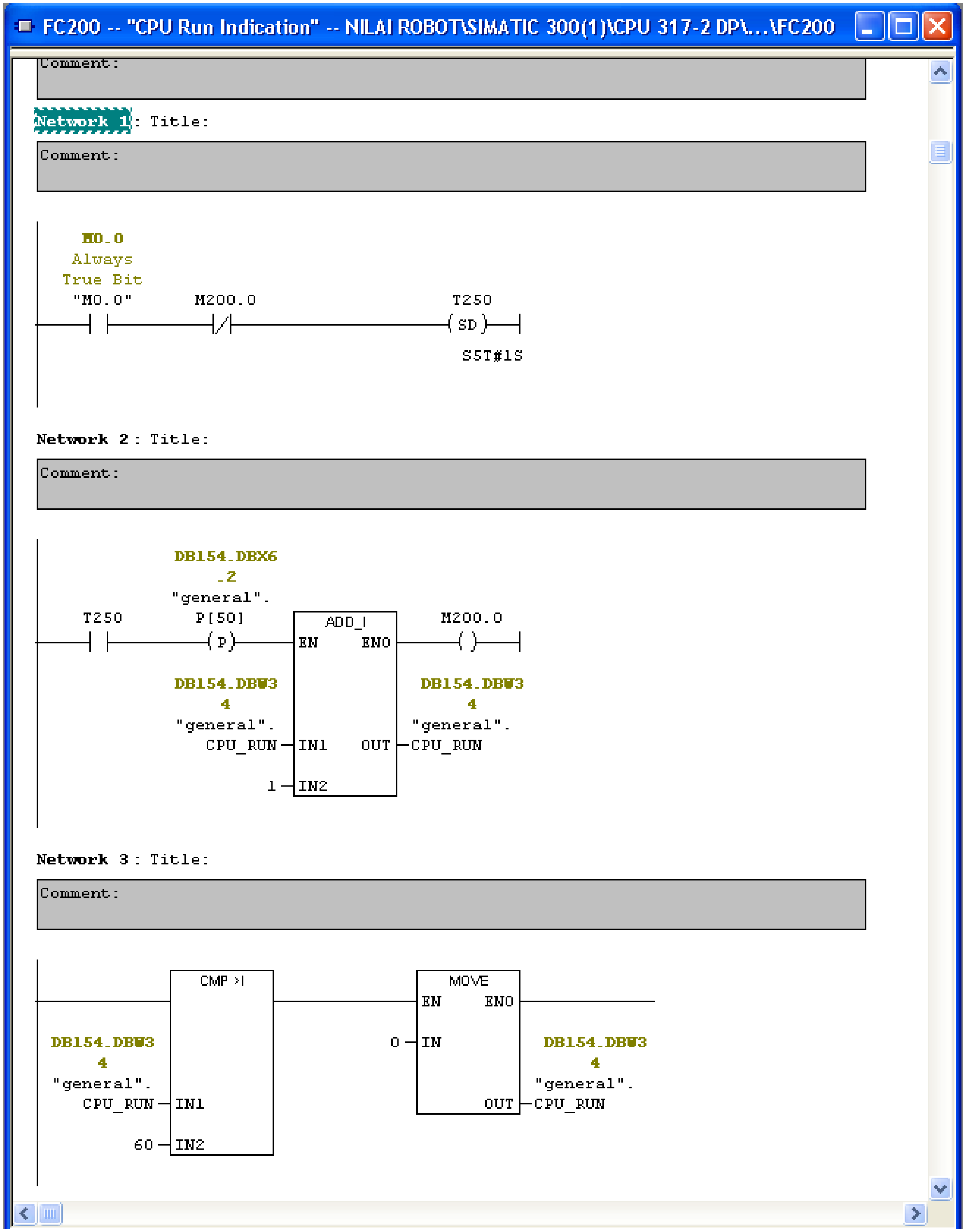


Figure 4: Example of Ladder Diagram Editor

2.10 Siemens Touch Screen

Basically, in industries, the Siemens touch screens used as the interface for a particular machine or plant. All the information regarding the process will be put on the screen for the workers to monitor.

For my project, I will be using this touch screen as a simulator. In order to simulate at the touch screen, I need to develop a program using WinCC Flexible software.

Figure 5: Siemens Touch Screen

2.11 Passive Infra-Red (PIR) Sensor

The most important part in this project is sensor. Basically, in this project the PIR sensor is used to detect human present in a particular lecture hall. A Passive Infrared sensor (PIR sensor) is a device which measures the infrared light emitted from an object in its field of view. PIR sensors do not radiate energy themselves and that is the reason they are called 'passive'. When there is a heat created the infrared energy is release. PIR sensors detect this infrared energy and measure it against a standard level. By this manner, we can monitor the changes in surrounding area.

The Passive Infrared sensors (PIR sensor) have a lot of edge as compare to other sensors. This sensor is very economic and highly reliable. They are no such as perfect motion detection system but the PIR sensors is the best option available in market

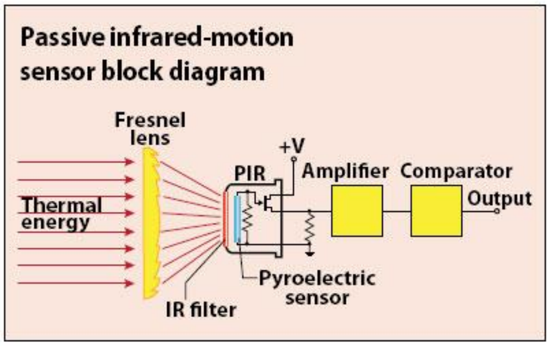


Figure 6: Passive Infrared-Motion Sensor Block Diagram

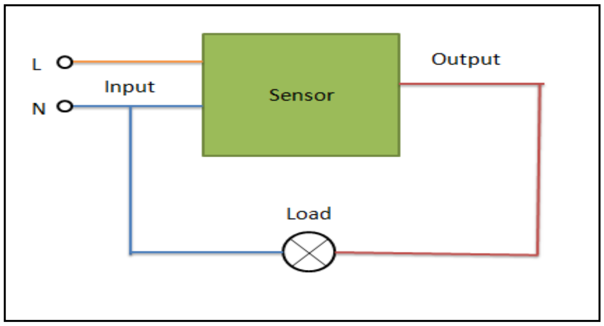


Figure 7: Connection wire of motion sensor

2.12 Photoelectric Sensor

A photoelectric sensor is one of many type of position sensing device. Photoelectric sensors basically used a ray of light to identify whether there is an object presence or not. The sensor consists of an emitter (the light source), receiver to detect the light that emitted and related electronics that measures and amplify the signal. This action will cause the photoelectric sensor to produce an output to change state. On the other hand, we are familiar with the simple photoelectric sensor application such as to detect the presence of a customer in a store.

Scan Techniques

For the project, I like to use a photoelectric sensor with a thru-beam sensor. It has independent emitter and receiver. As you can see from the figure (8), the emitter and receiver are separate. The emitter and receiver are aligned in very precise manner so that the greatest possible amount of beam from transmitter reaches receiver. The principle of photoelectric is very simple as its only need an object to block the path of light beam to receiver causing the receiver's output to change state. When there is no object that blocks the light path from emitter to receiver, the output return to original state. Thru-beam has a limitation as its only can detect rigid and opaque object. The thru-beam is not suitable to detect transparent object. The sensing range is differ from one company to another company but its maximum sensing range is 300 feet

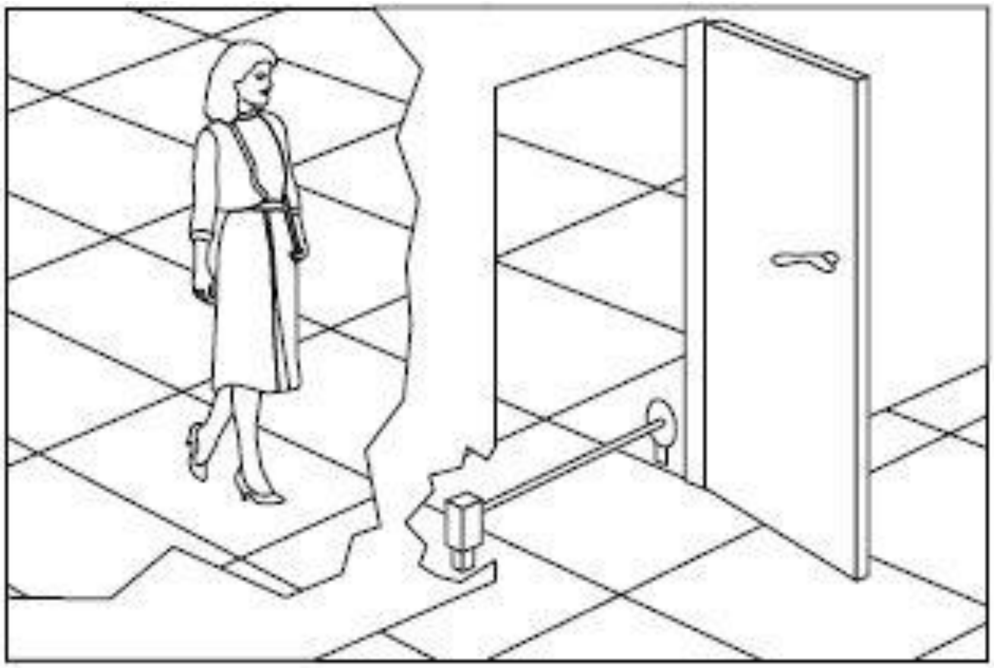


Figure 8: Photoelectric sensor application

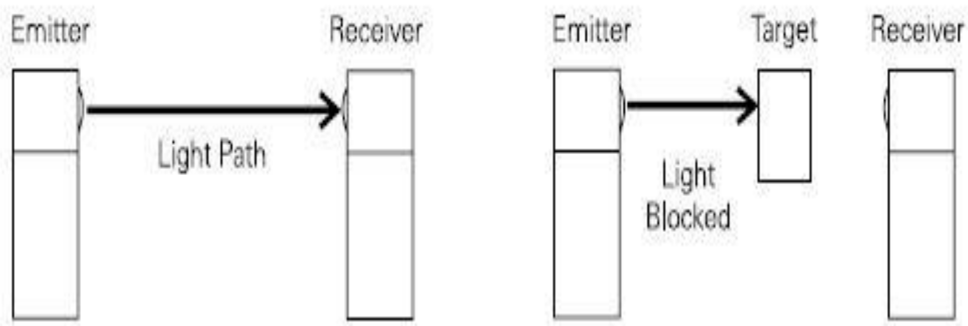


Figure 9: Transmitter and Receiver

2.13 Constant Lux Controller

This constant lux controller measures the luminance available in a particular area using detachable daylight sensor. It also determines the compensation needed to achieve the total target lux. The amount is then is converted into an output signal to the 1-10v dimmable ballast, which then produces the needed compensation of artificial light to keep the target area at the target lux level.

The detachable daylight sensor will turn off the power supply automatically when the natural daylight is above than the target lux value, and turn on again when the natural daylight is below the target lux value. With the above feature, this sensor is perfect for automatic lighting management system in offices, meeting rooms and classrooms.

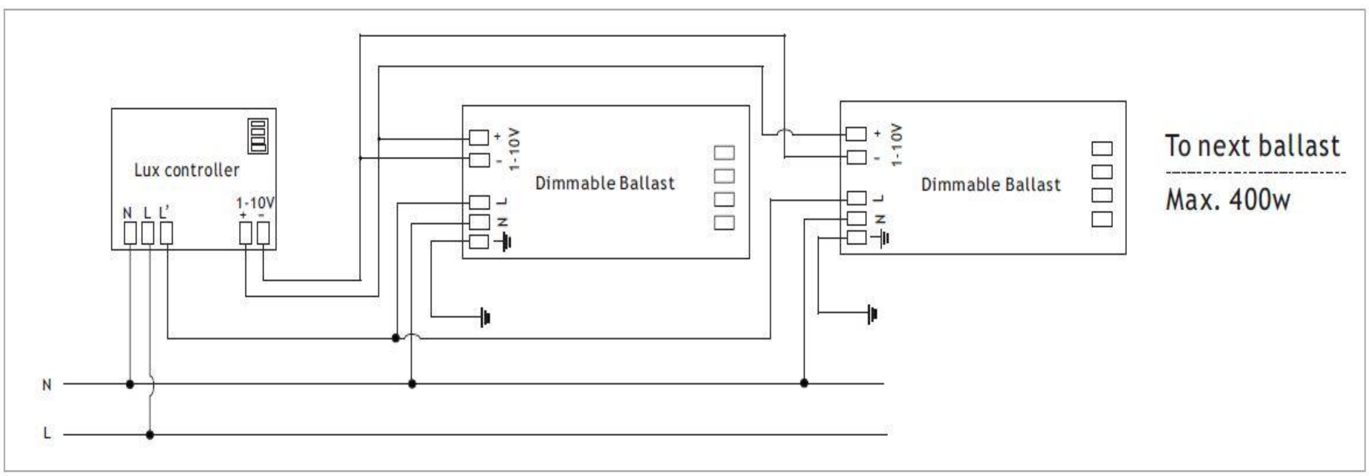


Figure 10: Schematic Drawing of Constant Lux Controller

CHAPTER 3: METHADOLOGY

This project is divided into three parts. The first part is to determine how many inputs and outputs that I will use for the whole project

3.1 Project Activities Flow Chart

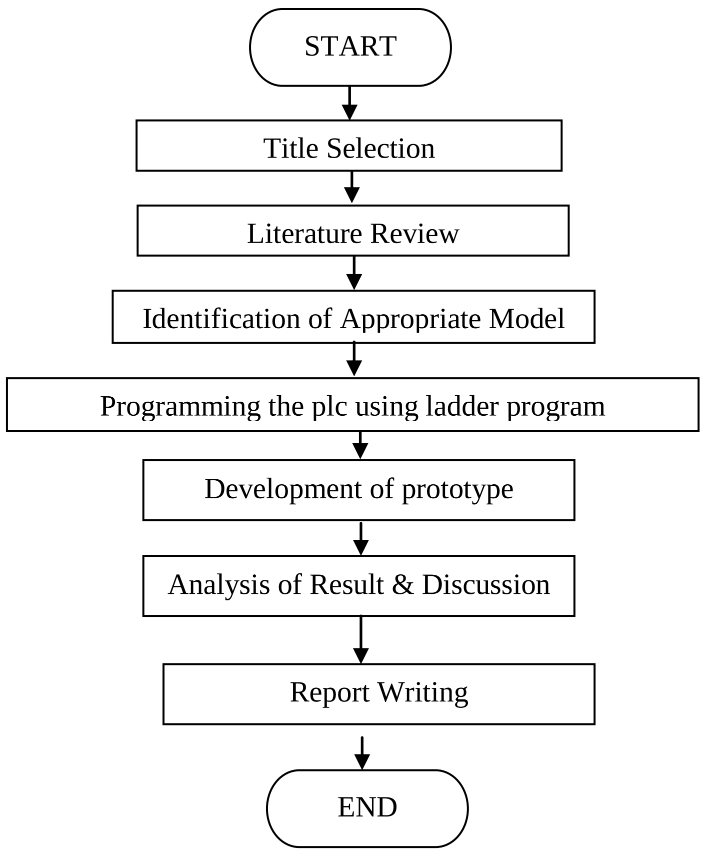
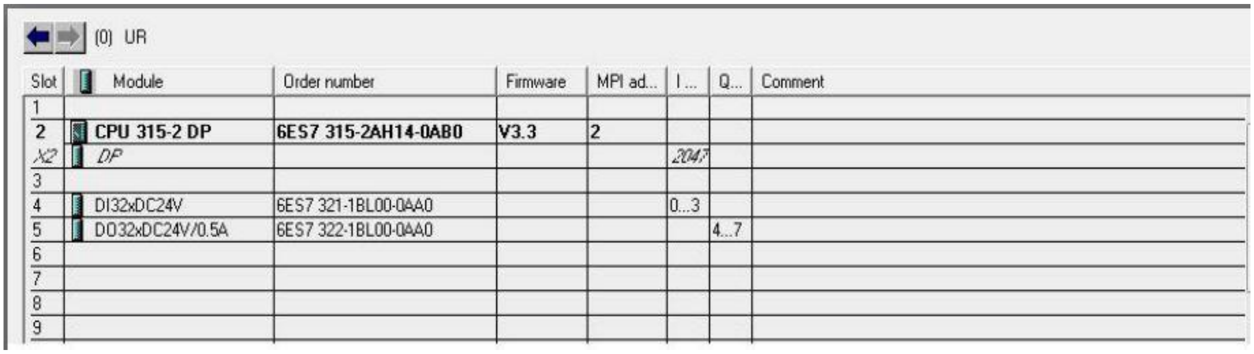


Figure 11: Project Activities Flow Chart

3.2 Siemens PLC Hardware Configuration

The hardware configuration editor is done in SIMATIC manager. This is where I need to set up the entire hardware network, including the type of PLC, the type of media that connects the nodes and where the OS and ES stations should be connected in the automatic control system network. Siemens PLC do not have auto hardware configuration



Slot	Module	Order number	Firmware	MPI ad...	I ...	Q...	Comment
1							
2	CPU 315-2 DP	6ES7 315-2AH14-0AB0	V3.3	2			
X2	DP				2047		
3							
4	DI32xDC24V	6ES7 321-1BL00-0AA0			0...3		
5	DO32xDC24V/0.5A	6ES7 322-1BL00-0AA0				4...7	
6							
7							
8							
9							

Figure 12 : PLC Hardware Configuration

3.3 Siemens Network Configuration

For connecting between Siemens HMI touch panel MP277 10" and Siemens S7 PLC, I have to configure the connection using NetPro Configuration tools .Through this software, I had interconnect between HMI and PLC. Figure 13 show the NetPro configuration that used for this project.

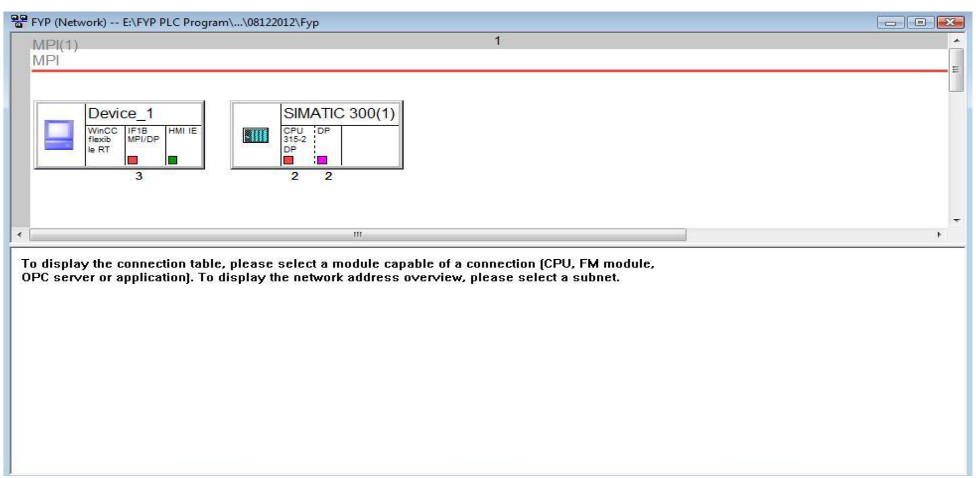


Figure 13 : PLC Network Configuration

3.4 Siemens Human Machine Interface (HMI)

For this project I'm using Siemens MP 277 10" Touch panel that need to programmed using WinCC flexible 2008.Figure 4.8 show WinCC Flexible 2008 editor software

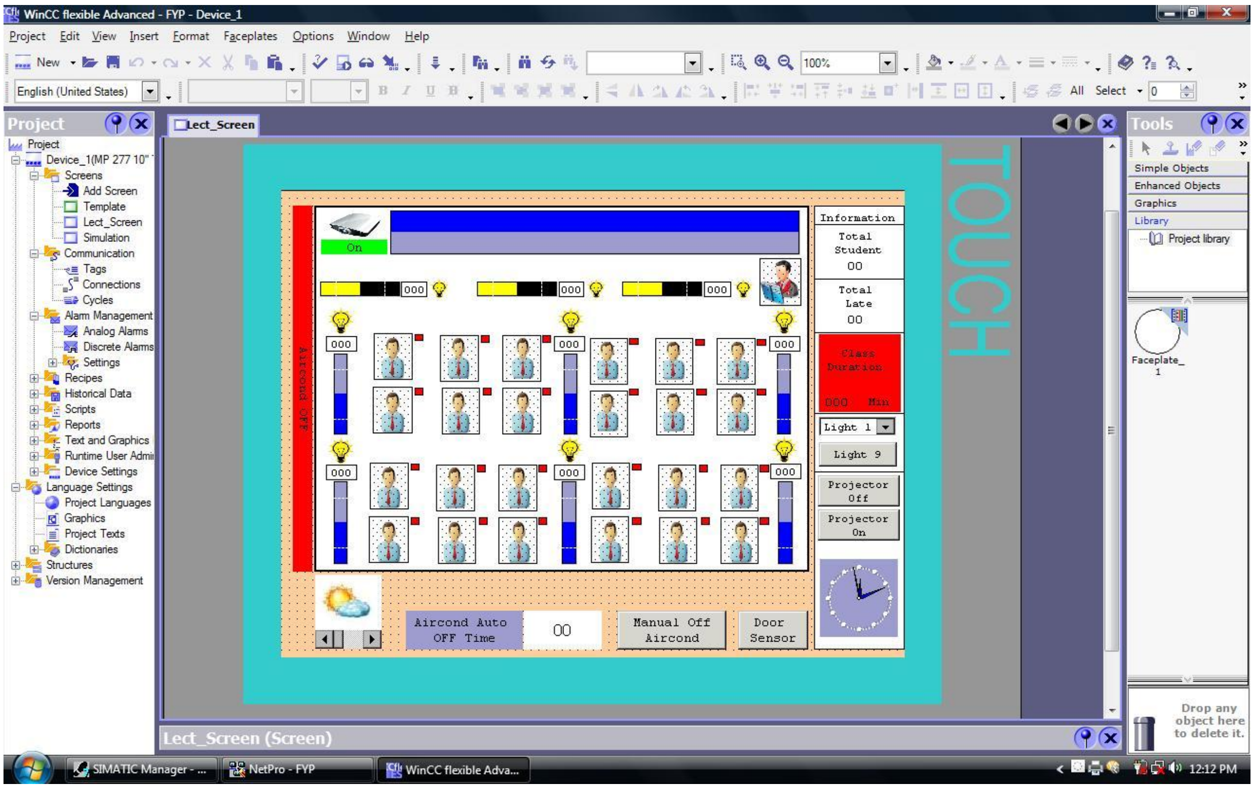


Figure 14: Siemens Human Machine Interface (HMI)

3.5 System Design

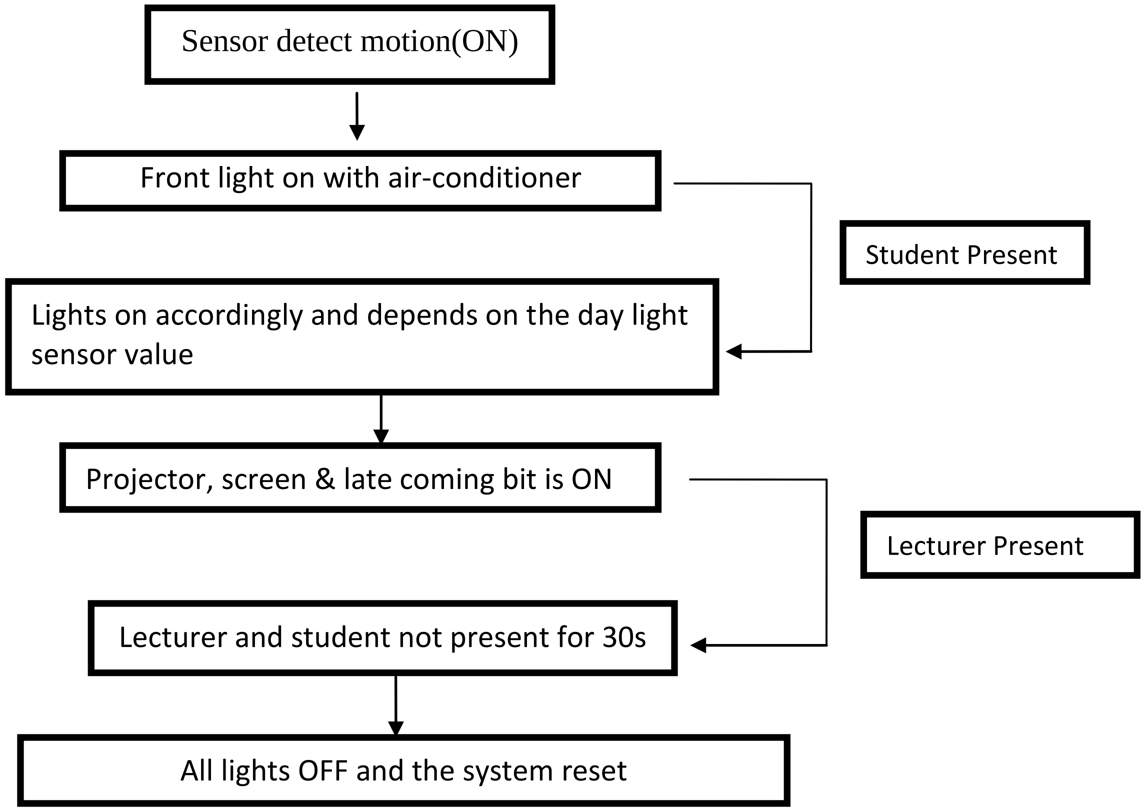


Figure 15: System Design

Figure 15 illustrates the system flowchart. When the sensor at the door ON, only the front light and the air-conditioner is turn ON. Once the student seats, the light will adjust accordingly depends on the day light value and the number of student in the group. When the lecturer is present, projector and screen is ON. Students who came after lecturer are considered late. Once there is no presence of people in the class, all light off and the system reset .The air-conditioner is maintained at 25 Celsius and not turn off. This is due to when each time compressor cut-in to run, the power consumption is about 6 times higher than it running current. The air-conditioner will only turned OFF after 5 p.m because most of the classes finished by 5 p.m

3.6 LUX Distribution

	Grp 1(no.of student)	Grp 2(no.of student)	Light 1(lx)	Light 2(lx)	Light 3(lx)
Sunny day (160lx)	<3	<3	140	140	260
	<3	>3	140	240	210
	>3	<3	240	140	210
	>3	>3	240	240	160
	0	>3	0	240	240
	0	<3	0	140	140
	>3	0	240	0	240
	<3	0	140	0	240

Table 2: Lux distribution on a sunny day

	Grp 1(no.of student)	Grp 2(no.of student)	Light 1(lx)	Light 2(lx)	Light 3(lx)
Cloudy day (40lx)	<3	<3	260	260	140
	<3	>3	260	360	130
	>3	<3	360	260	130
	>3	>3	360	360	100
	0	>3	0	360	360
	0	<3	0	260	260
	>3	0	360	0	360
	<3	0	260	0	260

Table 3: Lux distribution on a cloudy day

	Grp 1(no.of student)	Grp 2(no.of student)	Light 1(lx)	Light 2(lx)	Light 3(lx)
Night (0lx)	<3	<3	300	300	110
	<3	>3	300	370	120
	>3	<3	370	300	120
	>3	>3	370	370	100
	0	>3	0	400	400
	0	<3	0	300	300
	>3	0	300	0	300
	<3	0	400	0	400

Table 4: Lux distribution on a night

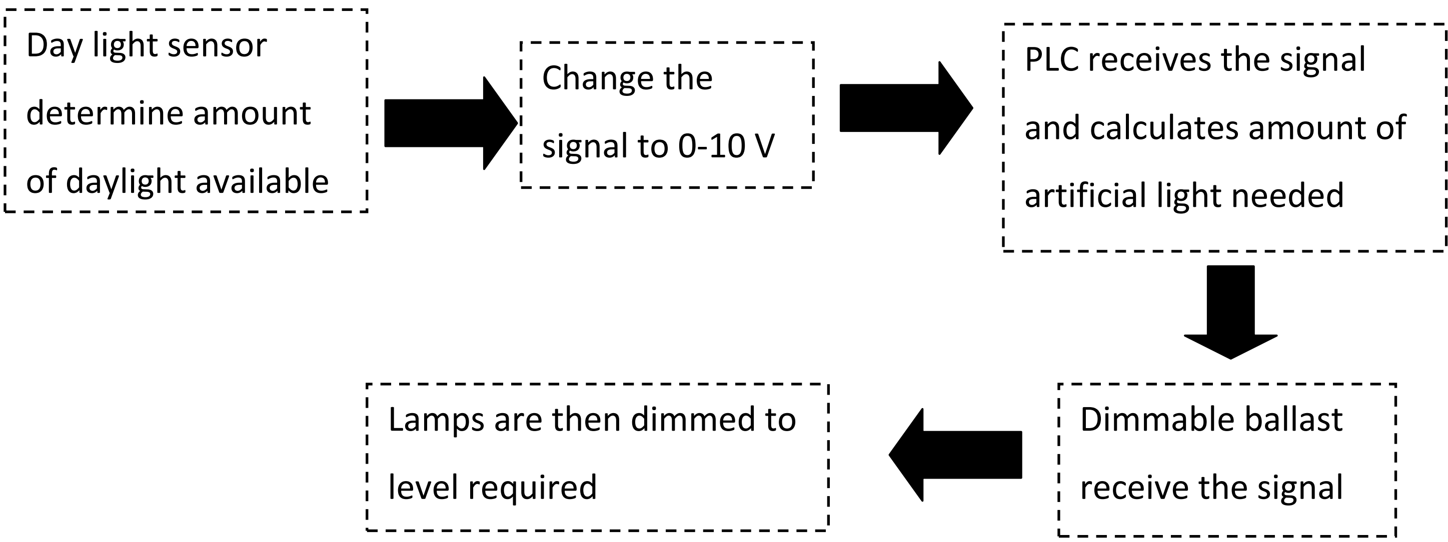


Figure 16: System Implementation

Figure 16 shows the system implementation in real situation. The daylight sensor will determine the amount of daylight available in surrounding. Then, it will convert to analog signal. The PLC receives the signal and determines amount of artificial light needed. Dimmable ballast will receive the signal and lamps are dimmed to the level required

3.7 Proposed Simulation Design

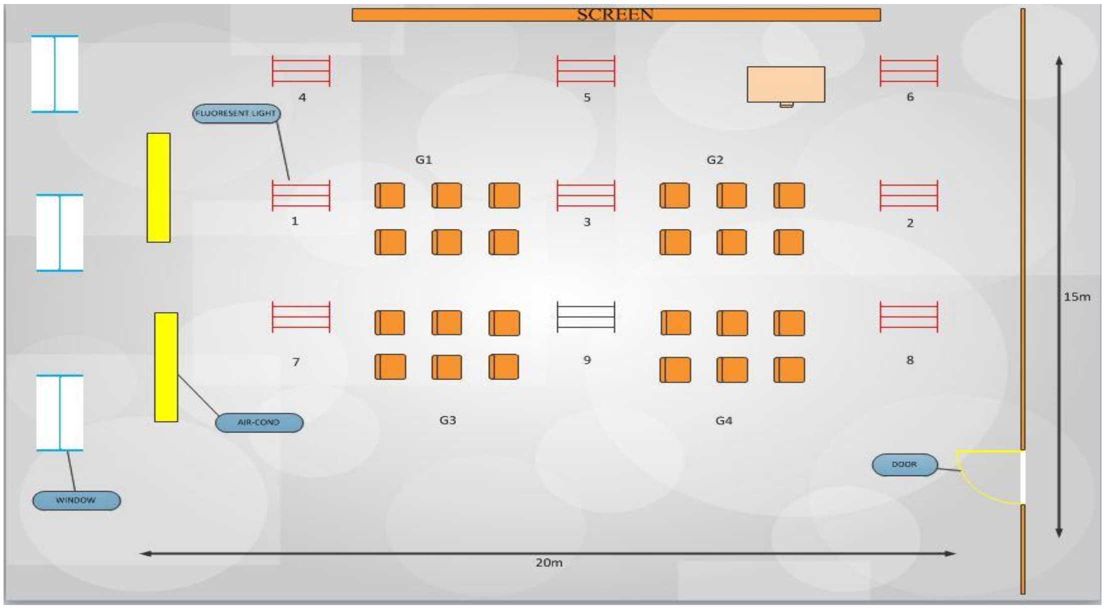


Figure 17: Classroom Layout

The several lighting control strategies available to manage lighting energy use in buildings are scheduling, occupancy, daylighting and luminance control. An appropriate electric lighting control concept for a daylight-building consists of a group of components coherent and integrated in a certain sequence. The two main components are the integrated lighting control zones and the control strategy for each zone. The students are divided into a group of six and the maximum number of students in the class is restricted to 24. The integrated lighting control in the lecture room also depends on the availability of daylight and the actual occupancy of persons in each group.

The main strategies of the design are:

1) to subdivide the classroom in two different zones with different uses (i.e teacher zone and students zone)
2) to schedule the general switching ON/OFF of the lighting and air-conditioning system
3) to integrate the artificial lights with available daylighting in the room
4) to cut off the lights according to real occupancy of the different group
5) to manually override the system in order to activate by manual push buttons (i.e. screen, projector and lights)

The classroom used for the reference is the Lecture Room 15 at Block N in Universiti Teknologi Petronas, Malaysia. The author divided the classroom into 4 groups. Each group consists of 6 students. For a start, only 24 students in the class are considered. This is to ensure an efficient division system respective to the lighting control. Figure 1 illustrates the layout of the lecture room. Lecture room 15 is a squared room of 20m × 15m with three large windows and one external door. The capacity of students is about 60. The classroom installed with 27 × 36 Watt lights and two air- conditioner. For this paper, the number of lights is reduced to 18× 36 Watt since only 24 students will occupied the class

3.8 Tools Required

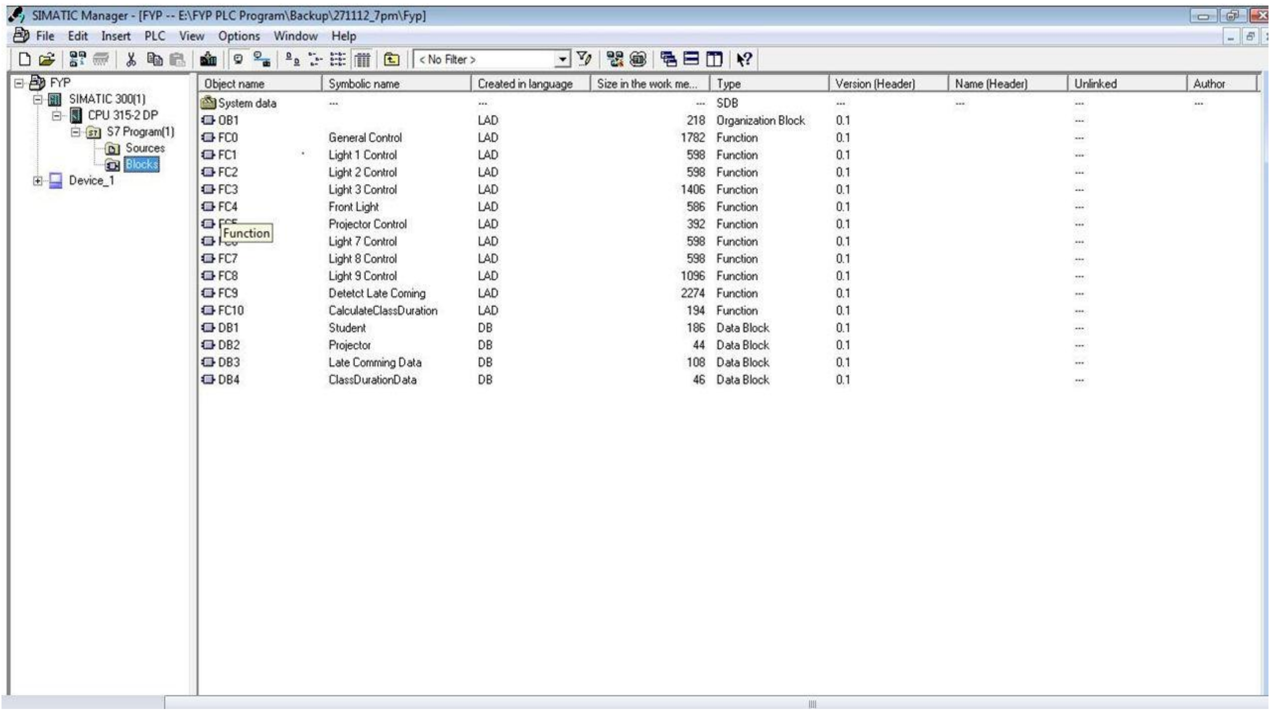
Hardware	Software
Siemens S7300 series cpu Siemens touch screen Network cable MPI cable 24 DC 32 Bit Digital Input and Output 24DC Push Buttons and Trigger Switch 24 DC Lights	Siemens Simatic Manager WinCC Flexible Microsoft Visio

Table 5: Tools Required

Chapter 4: RESULT AND DISCUSSION

Below shows some corresponding result obtain using the touch screen and the program written in Siemens S7

4.1 Total Program



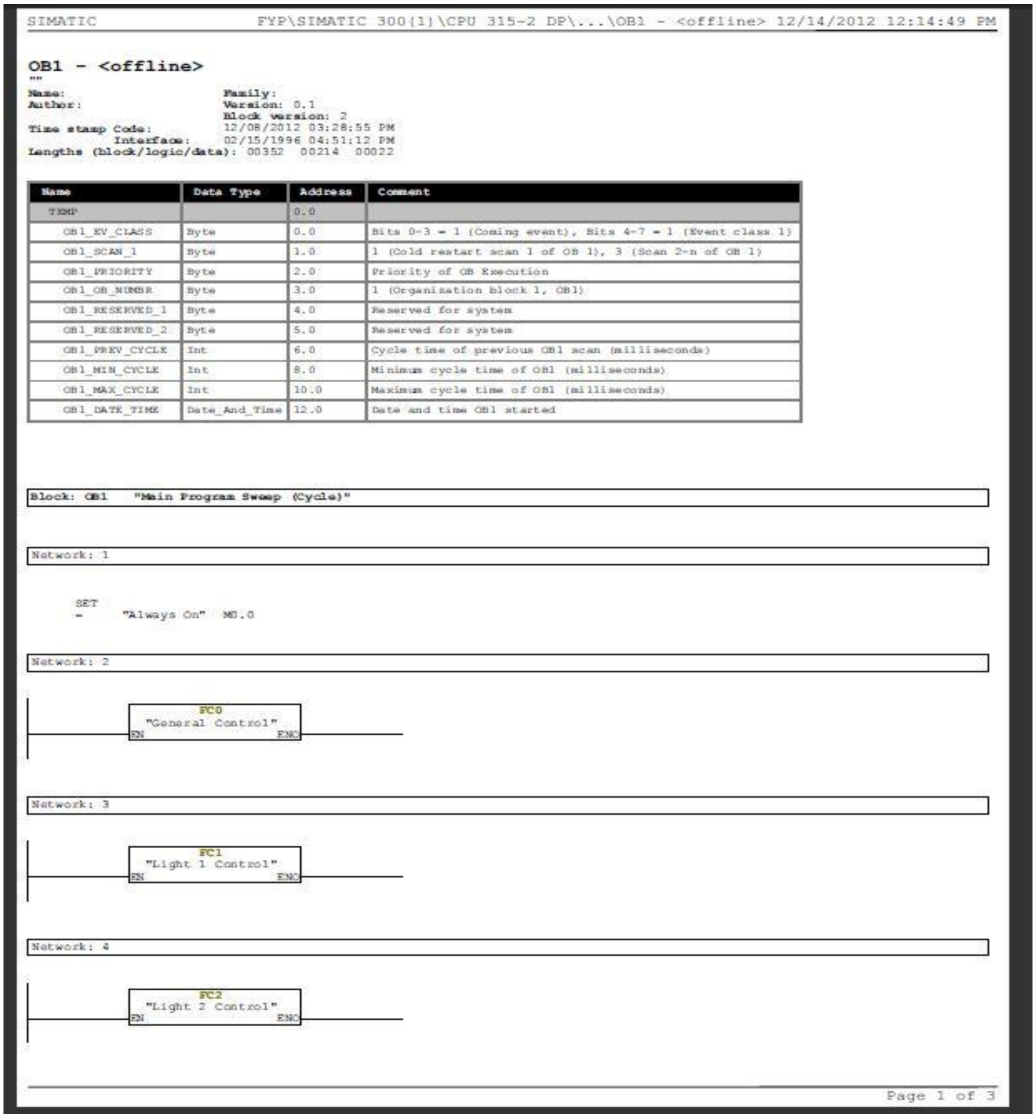
Object name	Symbolic name	Created in language	Size in the work me...	Type	Version (Header)	Name (Header)	Unlinked	Author
System data	---	---	---	SDB	---	---	---	---
OB1		LAD	218	Organization Block	0.1		---	
FC0	General Control	LAD	1782	Function	0.1		---	
FC1	Light 1 Control	LAD	598	Function	0.1		---	
FC2	Light 2 Control	LAD	598	Function	0.1		---	
FC3	Light 3 Control	LAD	1406	Function	0.1		---	
FC4	Front Light	LAD	586	Function	0.1		---	
FC5	Projector Control	LAD	392	Function	0.1		---	
FC6	Light 7 Control	LAD	598	Function	0.1		---	
FC7	Light 8 Control	LAD	598	Function	0.1		---	
FC8	Light 9 Control	LAD	1096	Function	0.1		---	
FC9	Detetct Late Coming	LAD	2274	Function	0.1		---	
FC10	CalculateClassDuration	LAD	194	Function	0.1		---	
DB1	Student	DB	186	Data Block	0.1		---	
DB2	Projector	DB	44	Data Block	0.1		---	
DB3	Late Comming Data	DB	108	Data Block	0.1		---	
DB4	ClassDurationData	DB	46	Data Block	0.1		---	

Figure 18:The total program

The program is arranged from FC1 to FC10. FC stands for function block. The program is always written in the function block. The data block or DB is used to reduce the ladder used for repeating logics

4.2 Program

OB1



SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\OB1 - <offline> 12/14/2012 12:14:49 PM

OB1 - <offline>

""

Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 12/08/2012 03:28:55 PM
Interface: 02/15/1996 04:51:12 PM
Lengths (block/logic/data): 00352 00214 00022

Name	Data Type	Address	Comment
TEMP		0.0	
OB1_EV_CLASS	Byte	0.0	Bits 0-3 = 1 (Coming event), Bits 4-7 = 1 (Event class 1)
OB1_SCAN_1	Byte	1.0	1 (Cold restart scan 1 of OB 1), 3 (Scan 2-n of OB 1)
OB1_PRIORITY	Byte	2.0	Priority of OB Execution
OB1_OB_NUMBR	Byte	3.0	1 (Organization block 1, OB1)
OB1_RESERVED_1	Byte	4.0	Reserved for system
OB1_RESERVED_2	Byte	5.0	Reserved for system
OB1_PREV_CYCLE	Int	6.0	Cycle time of previous OB1 scan (milliseconds)
OB1_MIN_CYCLE	Int	8.0	Minimum cycle time of OB1 (milliseconds)
OB1_MAX_CYCLE	Int	10.0	Maximum cycle time of OB1 (milliseconds)
OB1_DATE_TIME	Date_And_Time	12.0	Date and time OB1 started

Block: OB1 "Main Program Sweep (Cycle)"

Network: 1

SET
= "Always On" M0.0

Network: 2

Network: 3

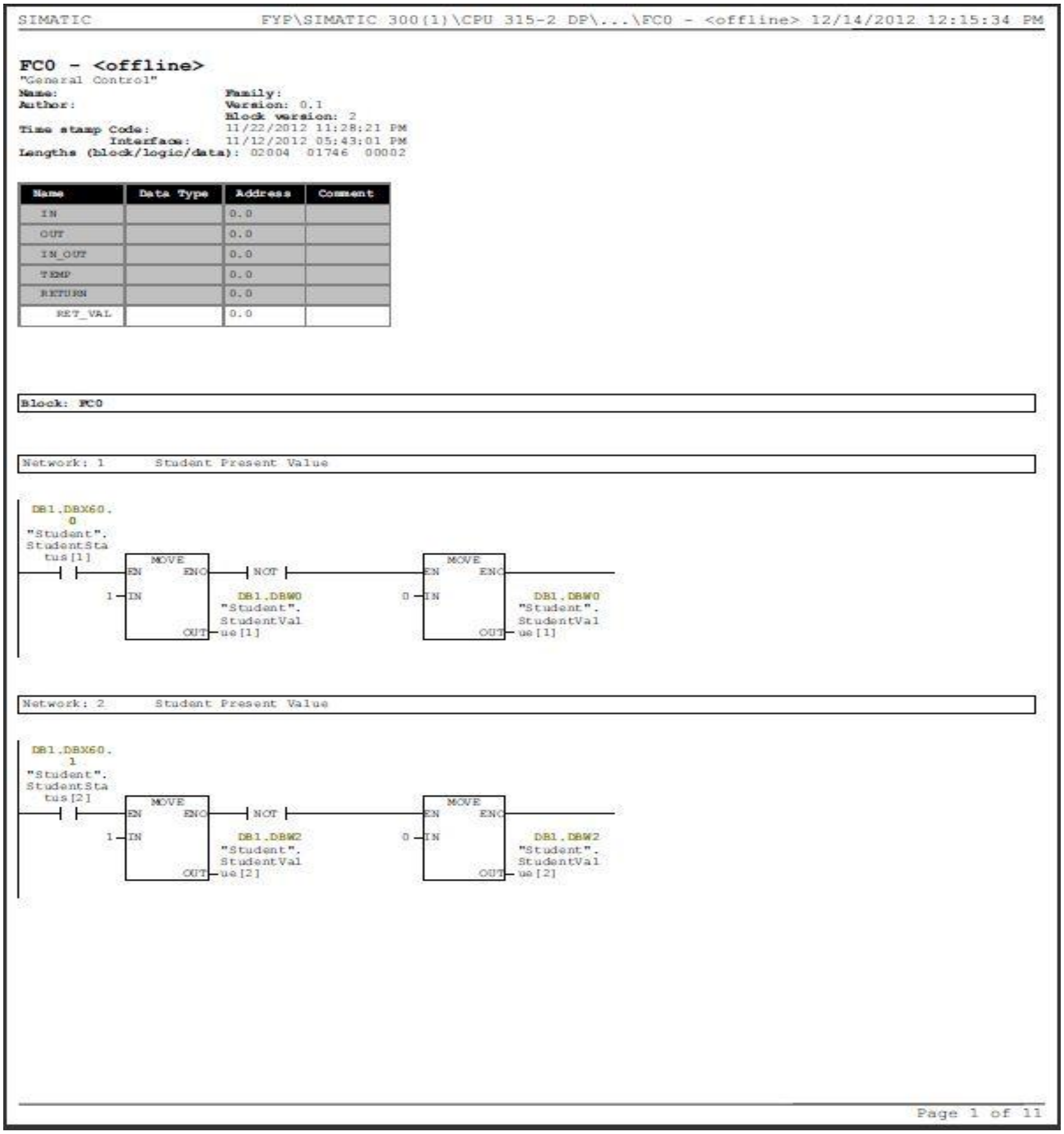
Network: 4

Page 1 of 3

Figure 19: OB1

In this block called OB1, usually programmer will use this as a general block. It means all the function block will be transferred to OB1 before upload it to PLC. This is to ensure the programming is organized and not messy. For my project, all my function block (FC) is transferred to OB1 .

FC0



SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC0 - <offline> 12/14/2012 12:15:34 PM

FC0 - <offline>
"General Control"
Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 11/22/2012 11:28:21 PM
Interface: 11/12/2012 05:43:01 PM
Lengths (block/logic/data): 02004 01746 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC0

Network: 1 Student Present Value

Network: 2 Student Present Value

Page 1 of 11

Figure 20: FC0

FC refer to function block. In this block, I create a program to detect student present in the class. I used both ladder and STL language

FC1

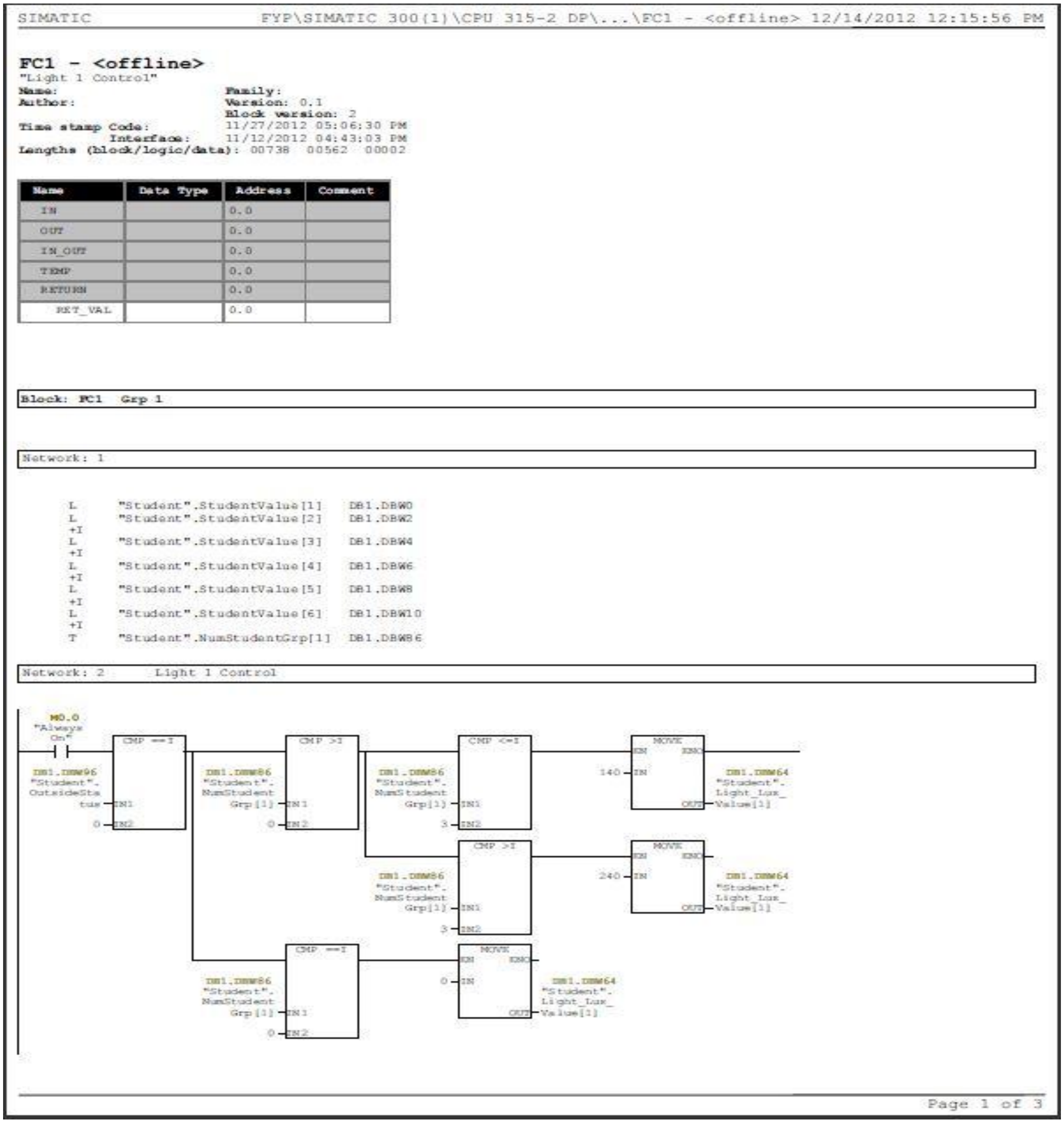


Figure 21: FC1

In this block, I create a program to control the amount of luminance in light 1 based on the density of student in group 1 and the amount of daylight available whether sunny day (160 lux), cloudy day (40 lux) and night (lux)

FC2

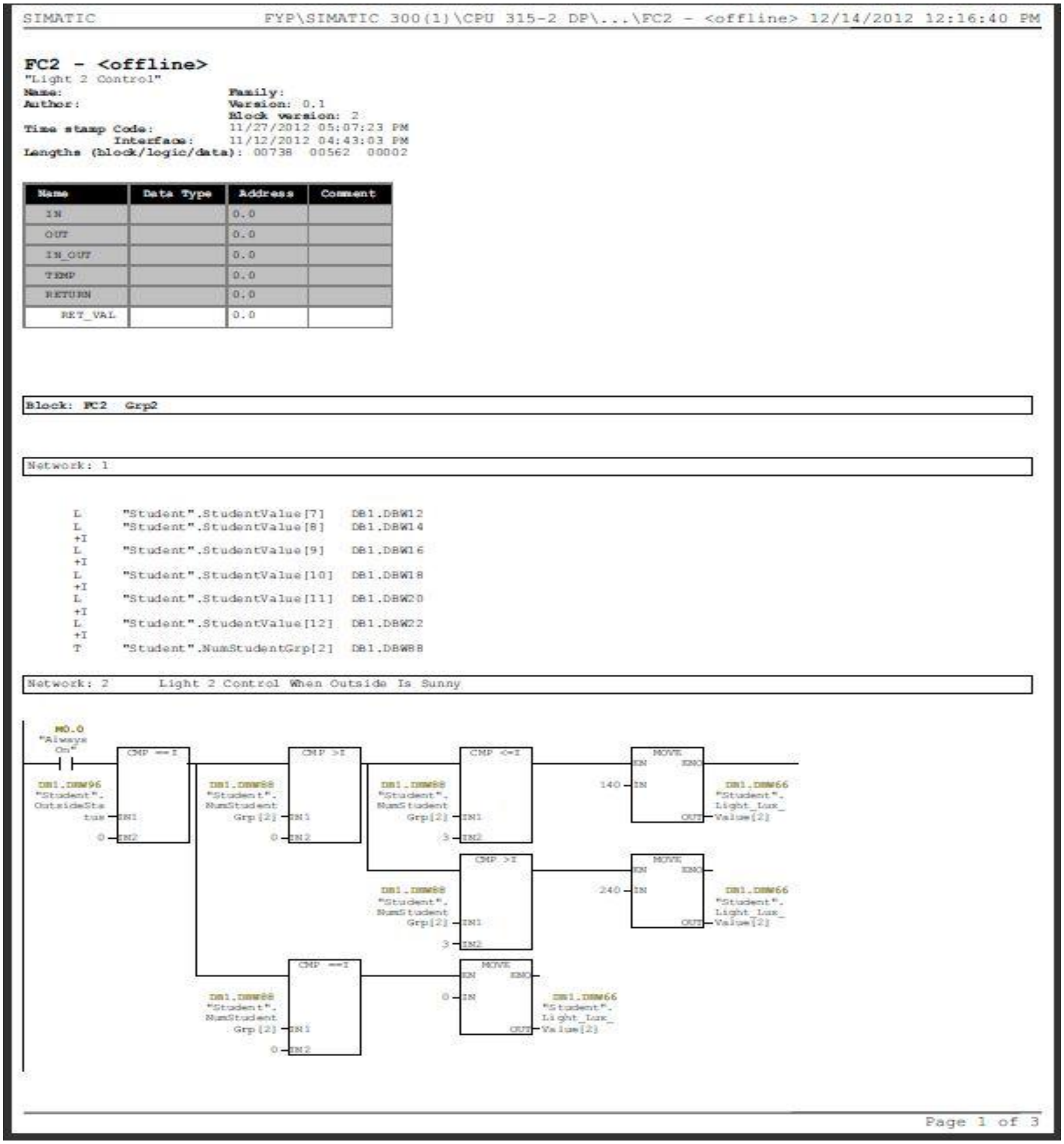


Figure 22: FC2

In this block, I create a program to control the amount of luminance in light 2 based on the density of student in group 2 and the amount of daylight available whether sunny day (160 lux), cloudy day (40 lux) and night (lux)

FC3

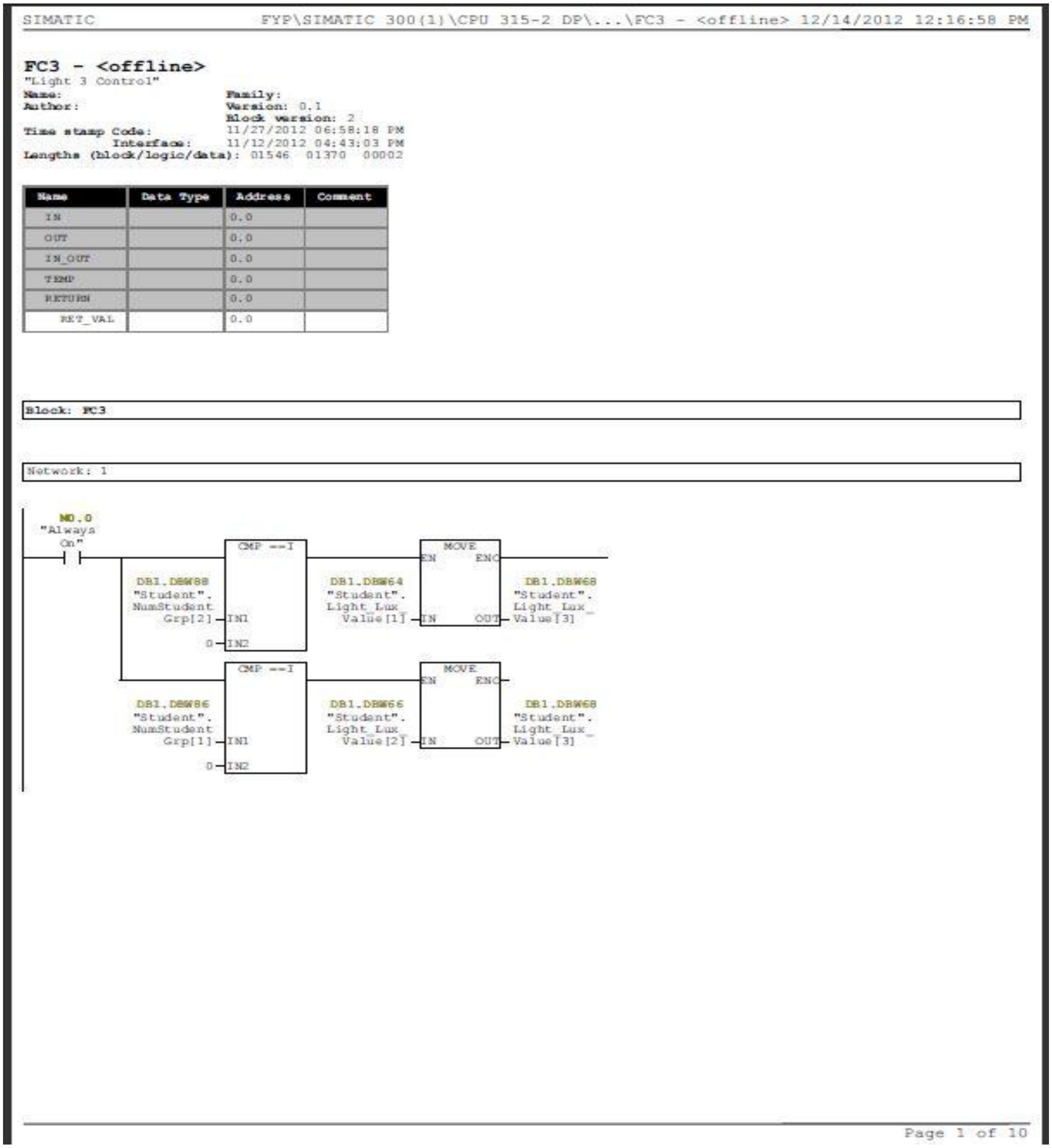


Figure 23: FC3

FC3 is programmed to control the luminance of light 3 which is between group 1 and group 2.Certain combination is considered in order to get as accurate as possible the luminance of the light 3.

FC4

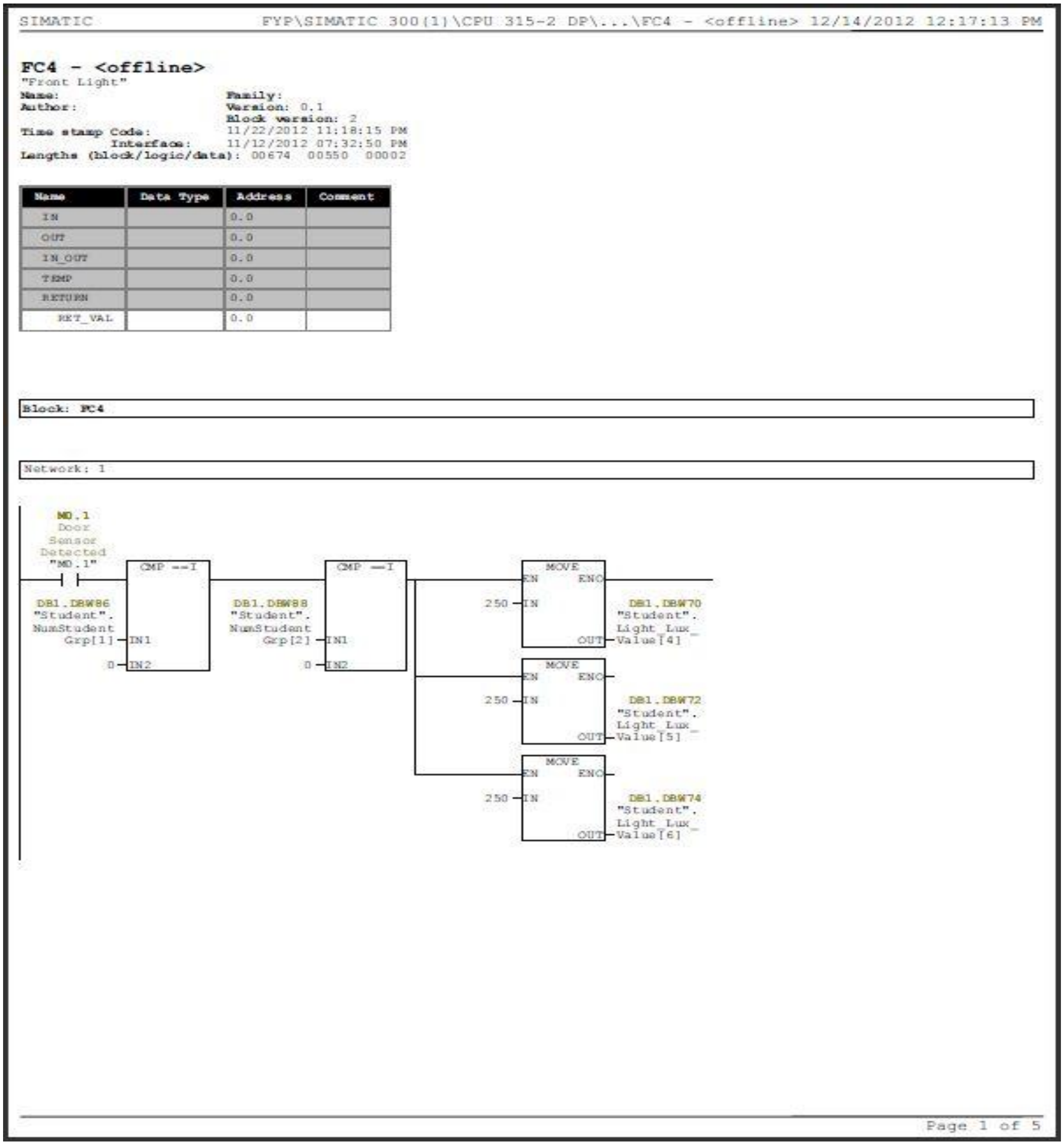
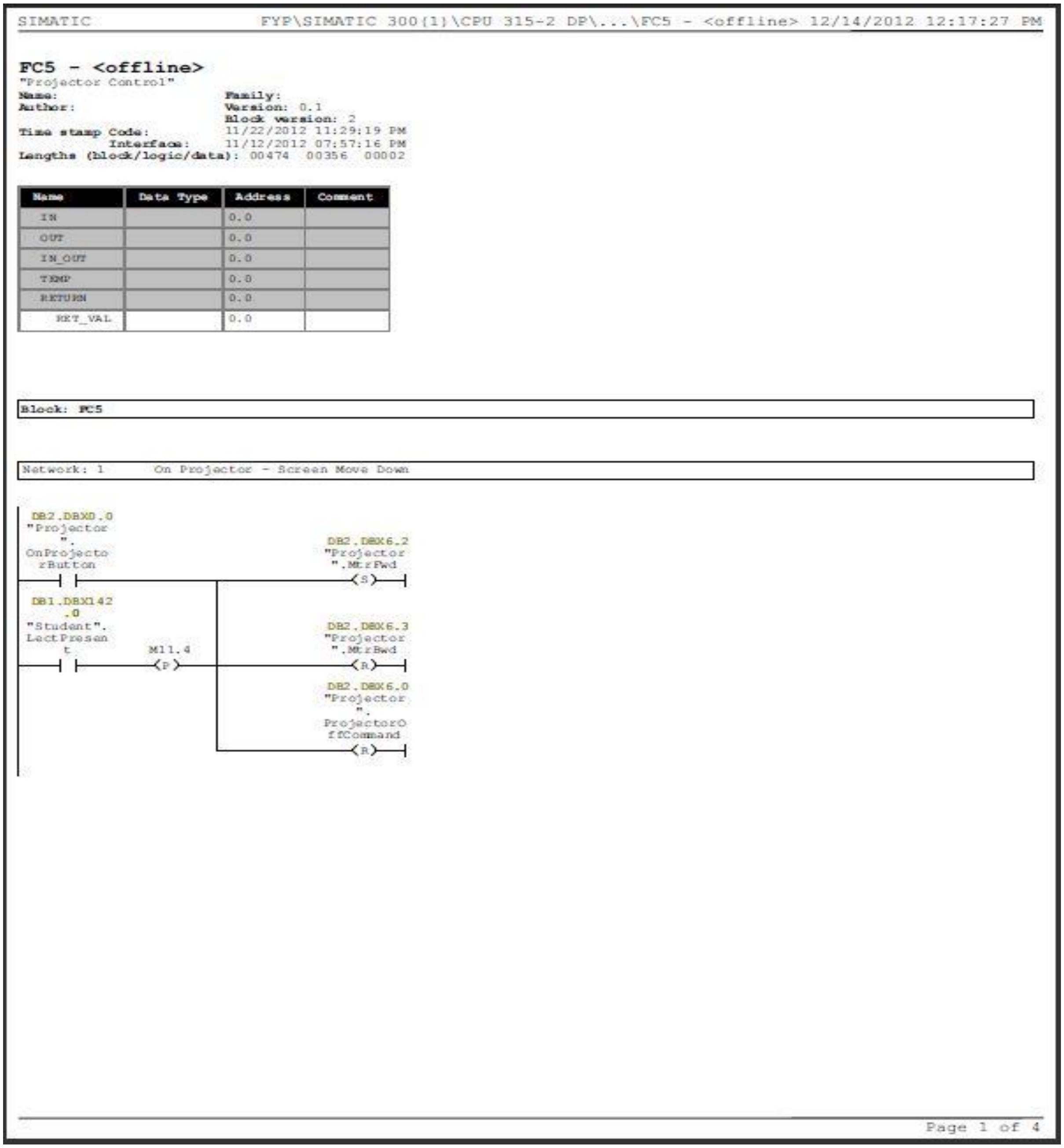


Figure 24: FC4

In this block, I programmed so that when the sensor at the door is on, the front light 4, 5, 6 will on automatically. But when there is no student present in the class, it will off automatically in 30s

FC5



SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC5 - <offline> 12/14/2012 12:17:27 PM

FC5 - <offline>

"Projector Control"

Name: **Family:**

Author: **Version:** 0.1

Block version: 2

Time stamp Code: 11/22/2012 11:29:19 PM

Interface: 11/12/2012 07:57:16 PM

Lengths (block/logic/data): 00474 00356 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC5

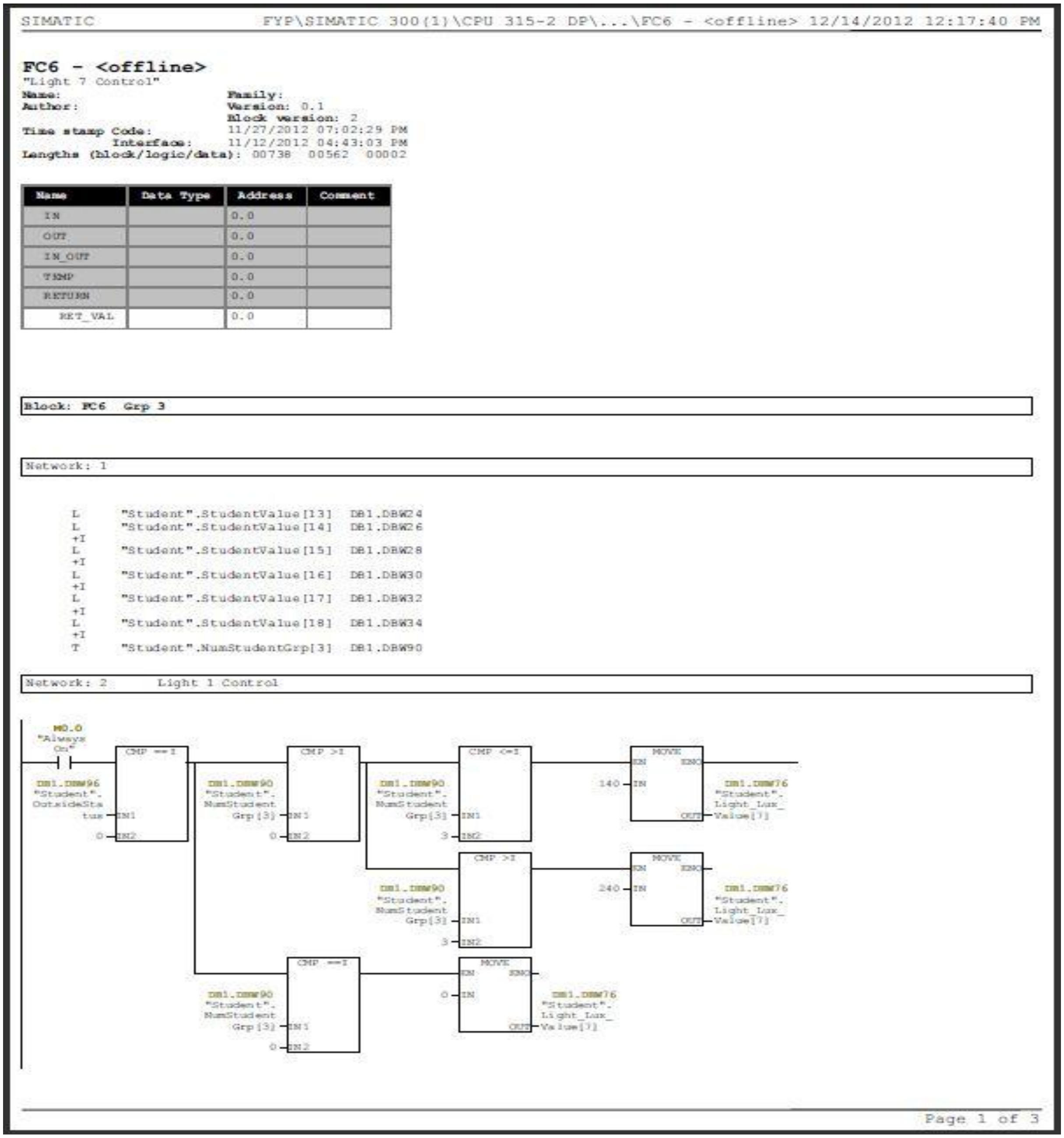
Network: 1 On Projector - Screen Move Down

Page 1 of 4

Figure 25: FC5

In FC5, it will control the projector whether on or off. Once the lecturer present, the projector will on and the screen will slide down automatically. When the lecturer not present, the screen will slide up and projector will turn off automatically.

FC 6


SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC6 - <offline> 12/14/2012 12:17:40 PM

FC6 - <offline>

"Light 7 Control"

Name: **Family:**

Author: **Version:** 0.1

Block version: 2

Time stamp Code: 11/27/2012 07:02:29 PM

Interface: 11/12/2012 04:43:03 PM

Lengths (block/logic/data): 00738 00562 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC6 Grp 3

Network: 1

```
L    "Student".StudentValue[13]   DB1.DBW24
L    "Student".StudentValue[14]   DB1.DBW26
+I
L    "Student".StudentValue[15]   DB1.DBW28
+I
L    "Student".StudentValue[16]   DB1.DBW30
+I
L    "Student".StudentValue[17]   DB1.DBW32
+I
L    "Student".StudentValue[18]   DB1.DBW34
+I
T    "Student".NumStudentGrp[3]   DB1.DBW90
```

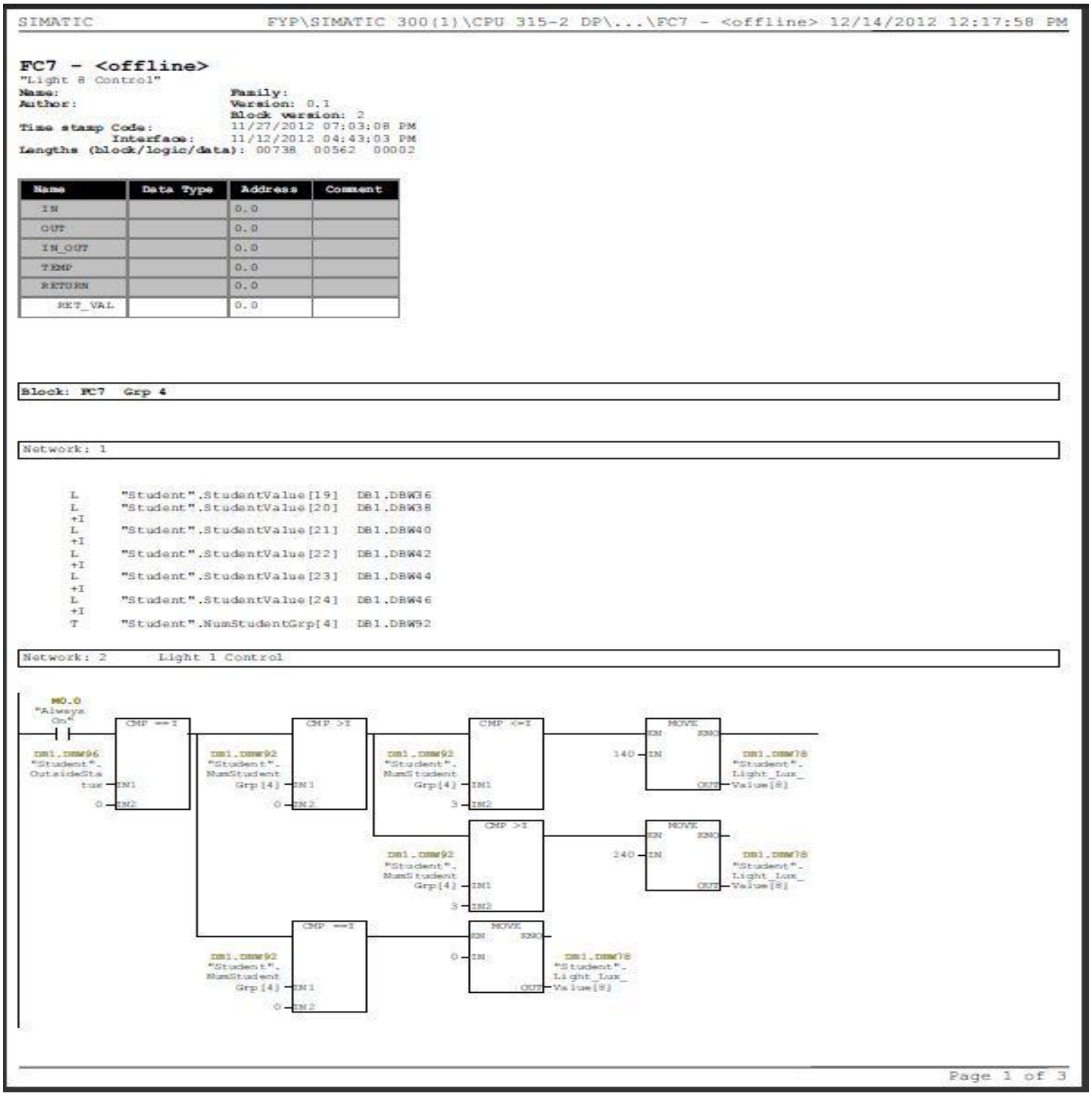
Network: 2 Light 1 Control

Page 1 of 3

Figure 26: FC6

In this block, I create a program to control the amount of luminance in light 7 based on the density of student in group 3 and the amount of daylight available whether sunny day (160 lux), cloudy day (40 lux) and night (lux)

FC7


SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC7 - <offline> 12/14/2012 12:17:58 PM

FC7 - <offline>
"Light 8 Control"
Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 11/27/2012 07:03:08 PM
Interface: 11/12/2012 04:43:03 PM
Lengths (block/logic/data): 00738 00562 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC7 Grp 4

Network: 1

```
L    "Student".StudentValue[19]   DB1.DBW36
L    "Student".StudentValue[20]   DB1.DBW38
+I
L    "Student".StudentValue[21]   DB1.DBW40
+I
L    "Student".StudentValue[22]   DB1.DBW42
+I
L    "Student".StudentValue[23]   DB1.DBW44
+I
L    "Student".StudentValue[24]   DB1.DBW46
+I
T    "Student".NumStudentGrp[4]   DB1.DBW92
```

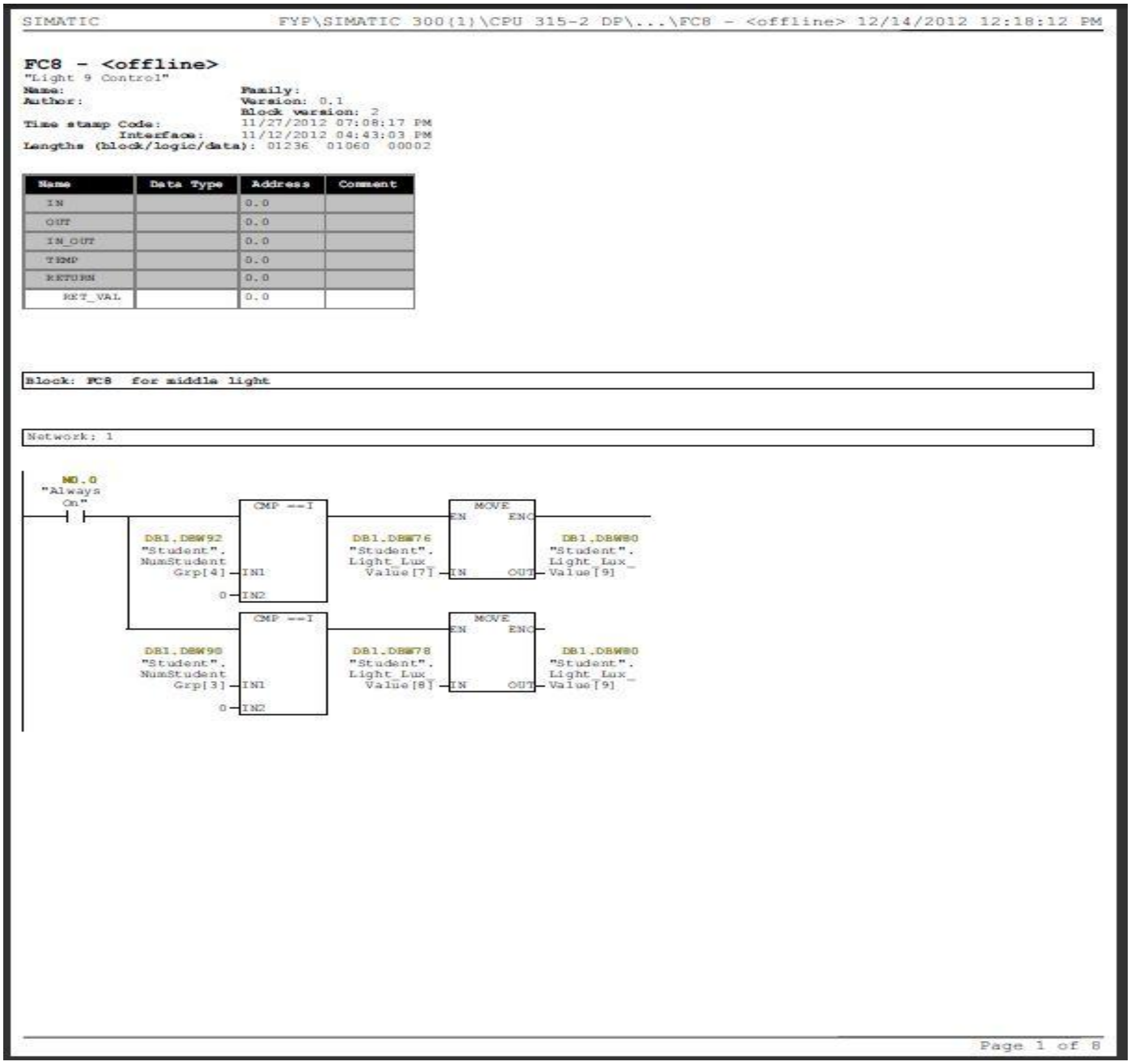
Network: 2 Light 1 Control

Page 1 of 3

Figure 27: FC7

In this block, I create a program to control the amount of luminance in light 8 based on the density of student in group 4 and the amount of daylight available whether sunny day (160 lux), cloudy day (40 lux) and night (lux)

FC8


SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC8 - <offline> 12/14/2012 12:18:12 PM

FC8 - <offline>

"Light 9 Control"

Name: **Family:**

Author: **Version:** 0.1

Block version: 2

Time stamp Code: 11/27/2012 07:08:17 PM

Interface: 11/12/2012 04:43:03 PM

Lengths (block/logic/data): 01236 01060 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC8 for middle light

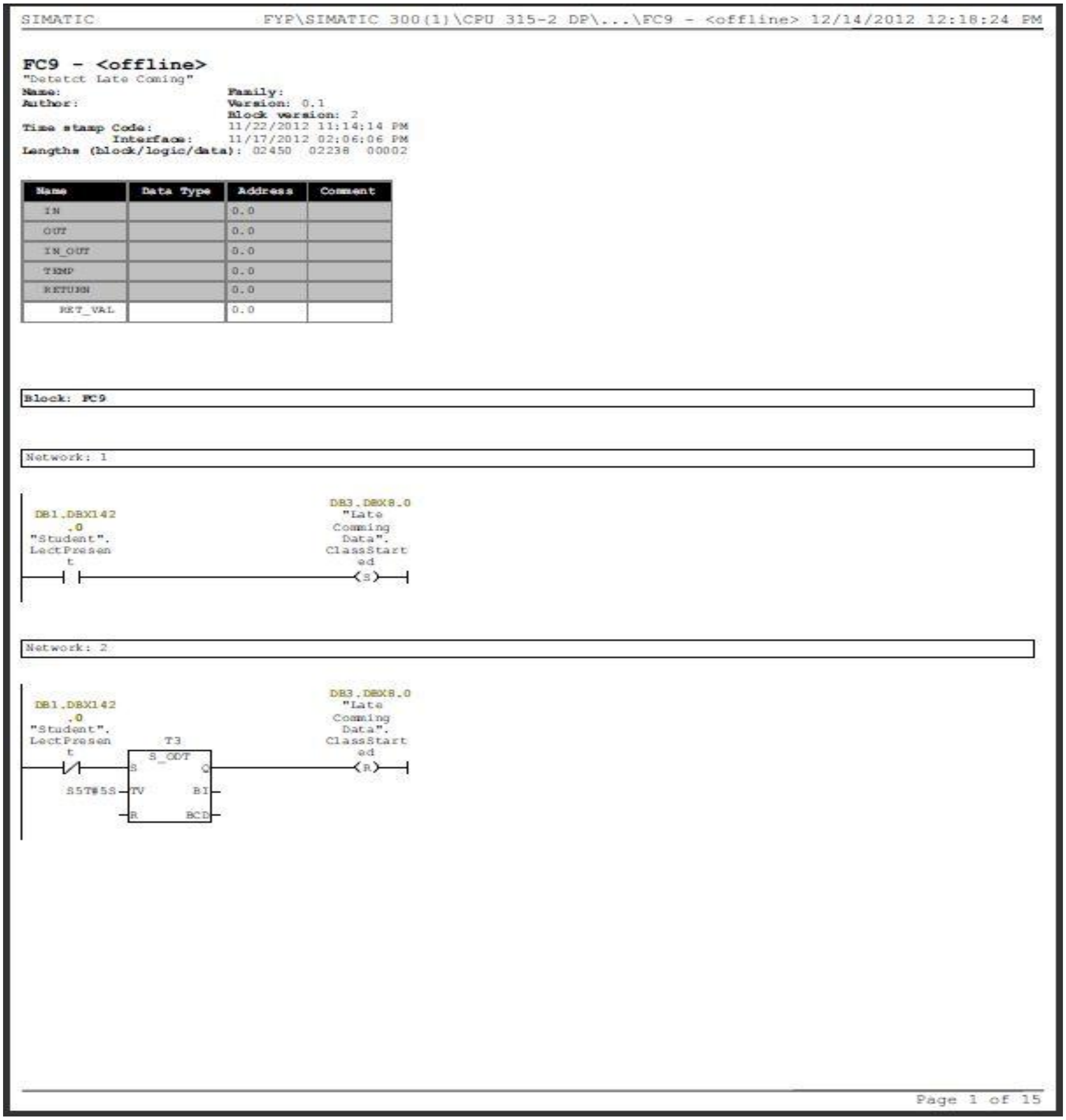
Network: 1

Page 1 of 8

Figure 28: FC8

In this block, I create a program to control the amount of luminance in light 8 based on the density of student in group 4 and the amount of daylight available whether sunny day (160 lux), cloudy day (40 lux) and night (lux)

FC9


SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC9 - <offline> 12/14/2012 12:18:24 PM

FC9 - <offline>
"Detetct Late Coming"
Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 11/22/2012 11:14:14 PM
Interface: 11/17/2012 02:06:06 PM
Lengths (block/logic/data): 02450 02238 00002

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC9

Network: 1

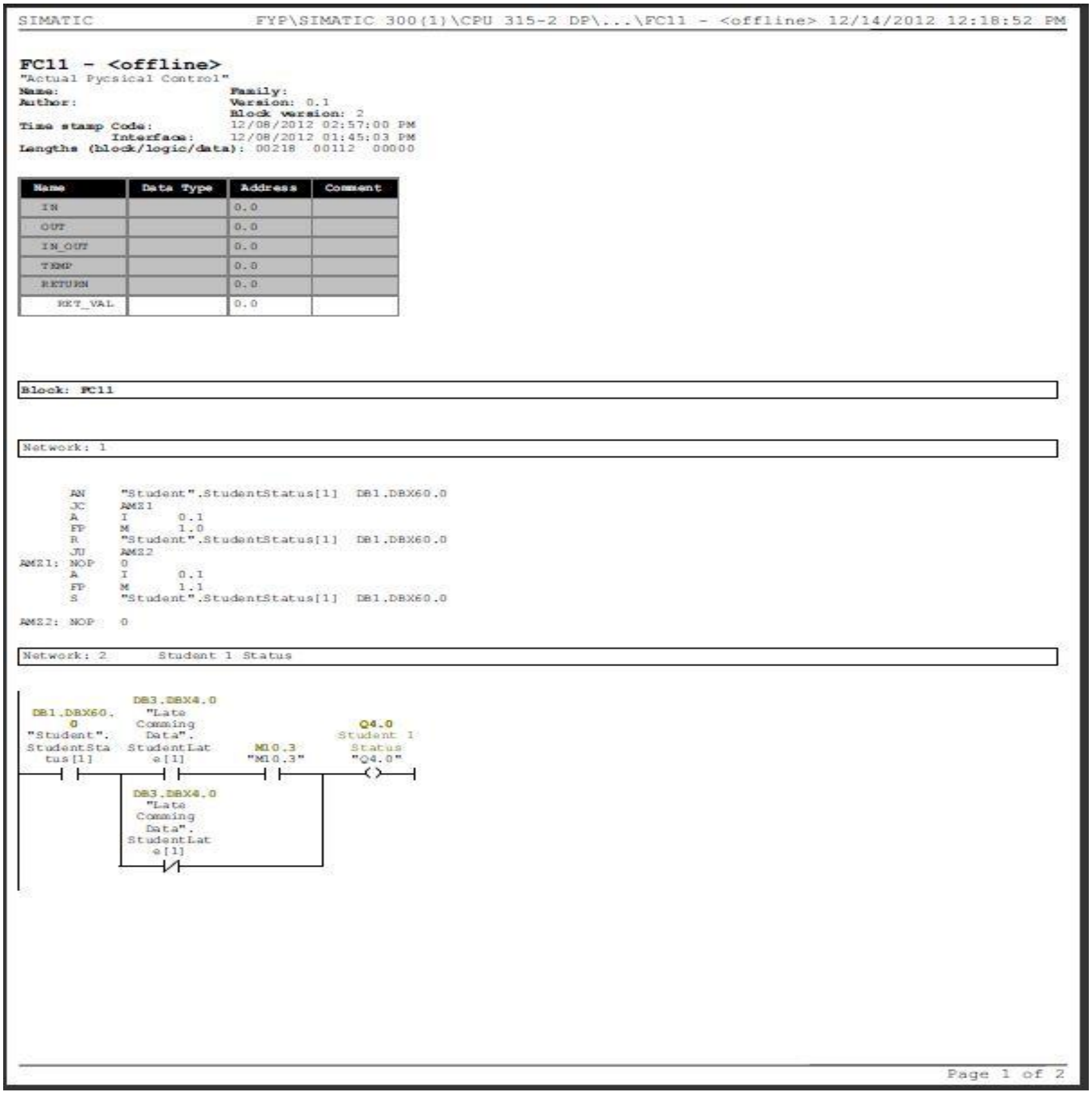
Network: 2

Page 1 of 15

Figure 29: FC9

For FC9, I programmed to detect the late coming student. I assume the lecturer will always come on time to class. Students who come after the lecturer are considered late. It will only reset when there are no people in the class.

FC11



SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC11 - <offline> 12/14/2012 12:18:52 PM

FC11 - <offline>

"Actual Pycsical Control"

Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 12/08/2012 02:57:00 PM
Interface: 12/08/2012 01:45:03 PM
Lengths (block/logic/data): 00218 00112 00000

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC11

Network: 1

```
      AN    "Student".StudentStatus[1]   DB1.DBX60.0
      JC    AMZ1
      A     I        0.1
      FP    M        1.0
      R     "Student".StudentStatus[1]   DB1.DBX60.0
      JU    AMZ2
AMZ1: NOP   0
      A     I        0.1
      FP    M        1.1
      S     "Student".StudentStatus[1]   DB1.DBX60.0

AMZ2: NOP   0
```

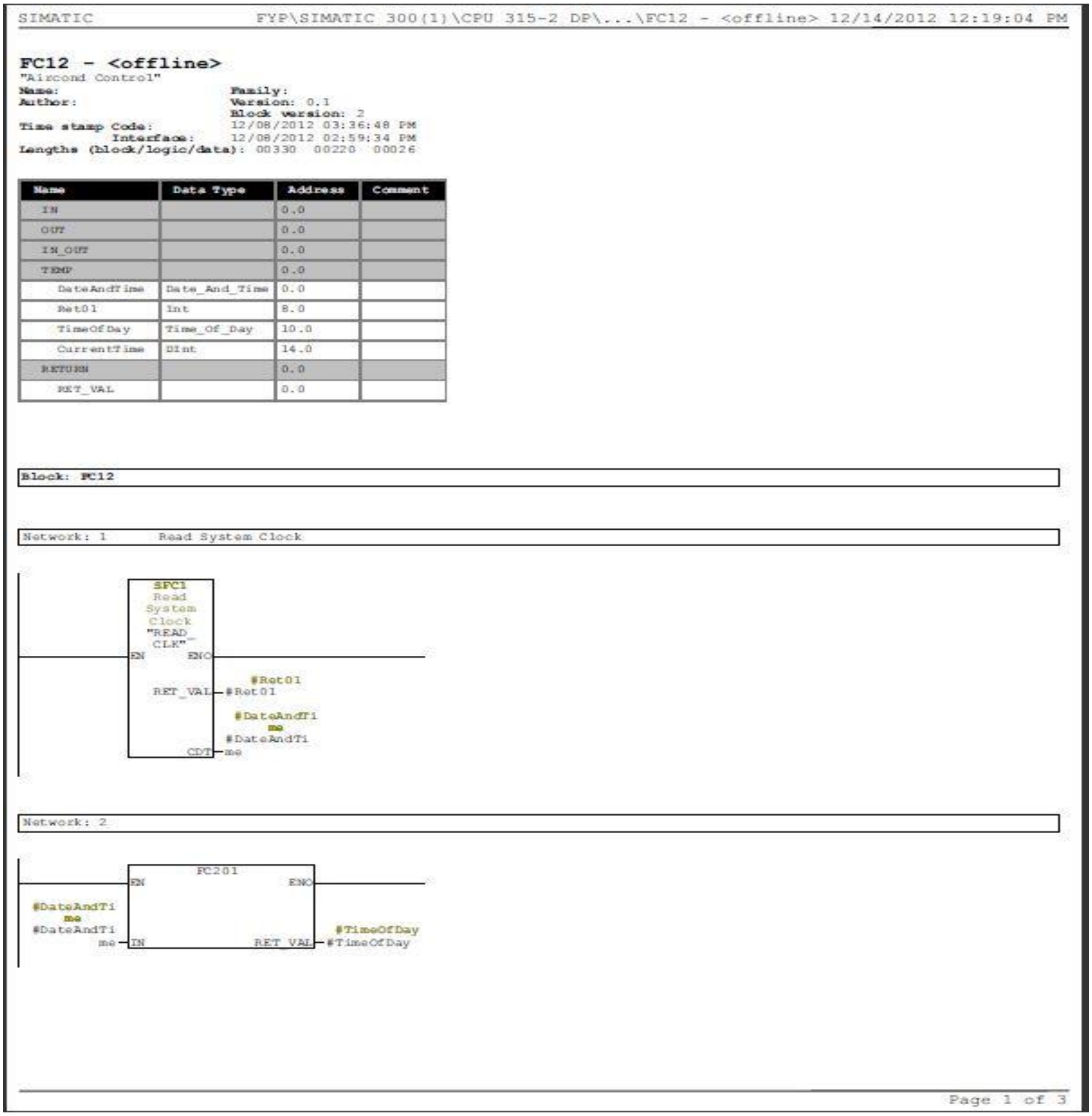
Network: 2 Student 1 Status

Page 1 of 2

Figure 30: FC11

In order to show the communication between PLC and other hardware (such as push buttons), I had to create this program. By this, I can communicate using 2 push buttons and 1 trigger button with 3 lights. The trigger button represents the lecturer present or not while one push buttons represent student present and another one represent the door sensor.

FC12



SIMATIC FYP\SIMATIC 300(1)\CPU 315-2 DP\...\FC12 - <offline> 12/14/2012 12:19:04 PM

FC12 - <offline>
"Aircond Control"
Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 12/08/2012 03:36:48 PM
Interface: 12/08/2012 02:59:34 PM
Lengths (block/logic/data): 00330 00220 00026

Name	Data Type	Address	Comment
IN		0.0	
OUT		0.0	
IN_OUT		0.0	
TEMP		0.0	
DateAndTime	Date_And_Time	0.0	
Ret01	Int	8.0	
TimeOfDay	Time_Of_Day	10.0	
CurrentTime	DInt	14.0	
RETURN		0.0	
RET_VAL		0.0	

Block: FC12

Network: 1 Read System Clock

Network: 2

Page 1 of 3

Figure 31: FC12

In FC12, I programmed to control the air - conditioner. The air –conditioner will ON once there is student present in the class. It will stay on until 5 P.M and automatically OFF after 5 P.M when there are no people present in the class. Lecturer also can key in the time when he or she want the air-conditioner to off automatically.

4.3 The Simulation

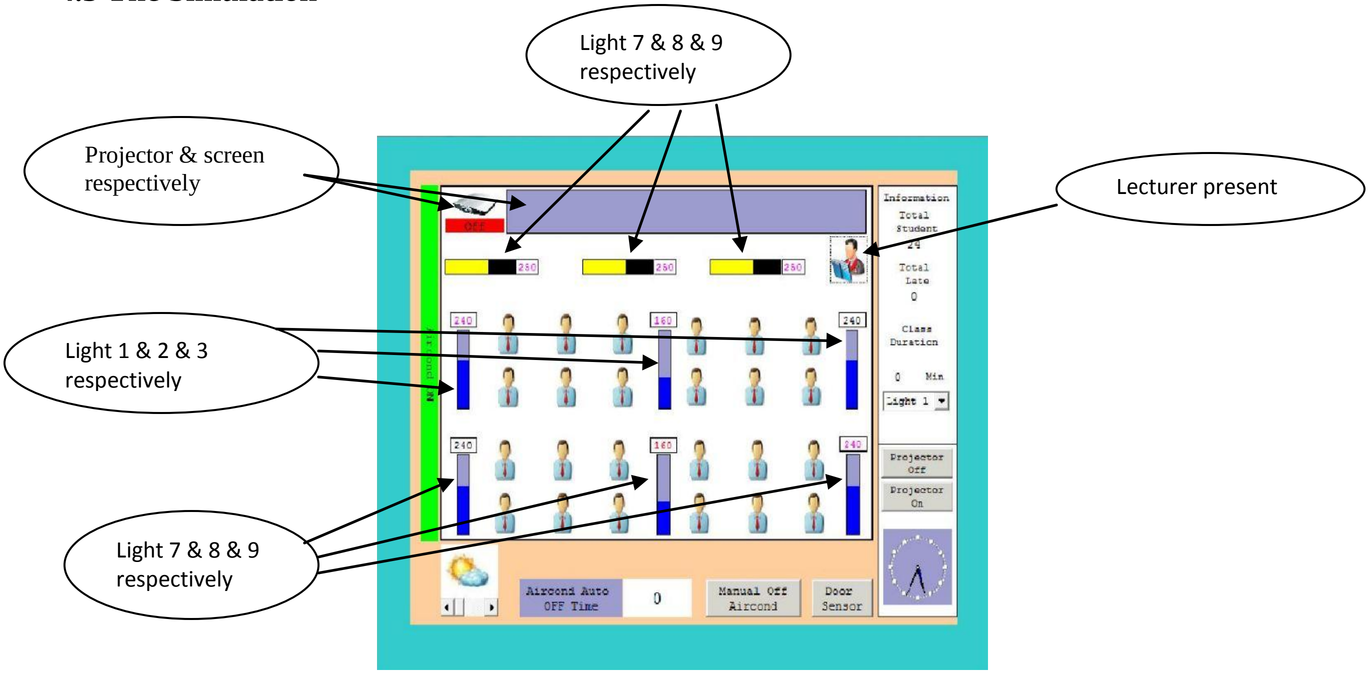


Figure 32: Layout 1

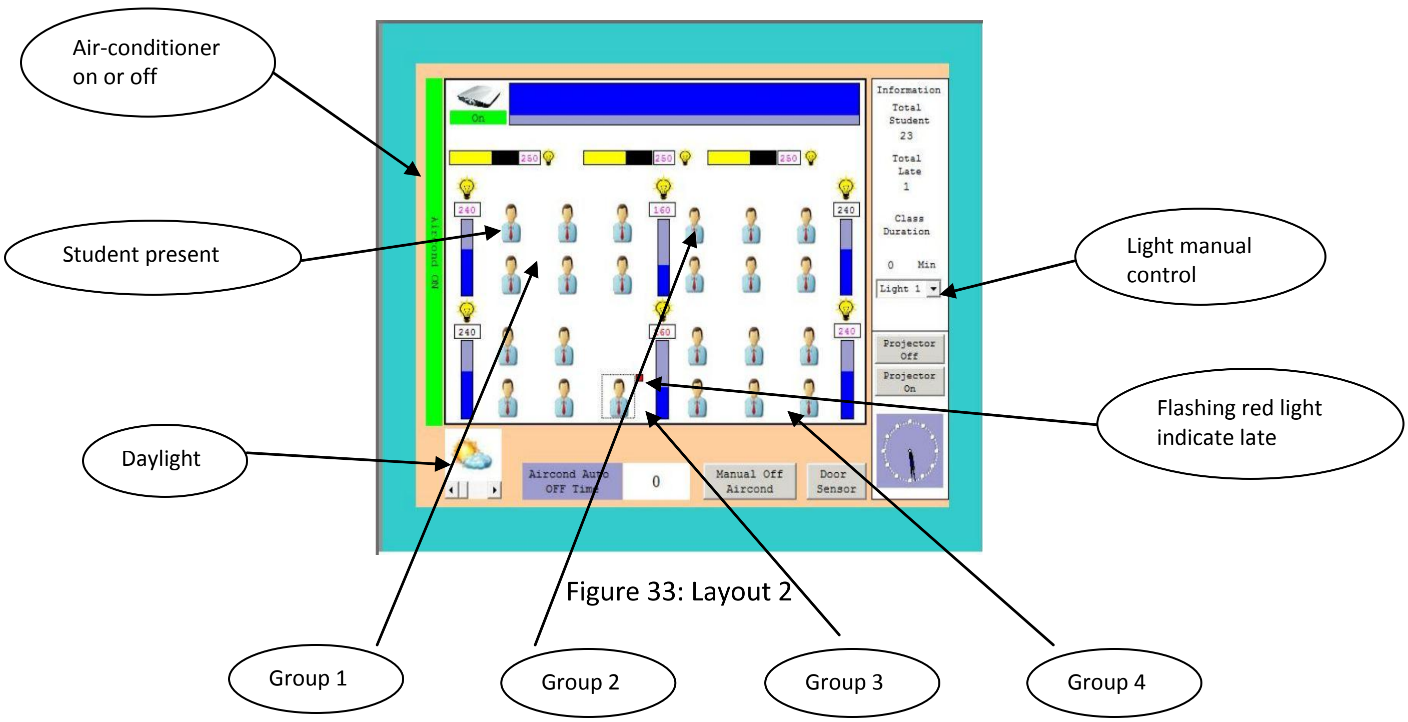


Figure 33: Layout 2

4.4 The simulation design

The simulation is done using Siemens touch screen. All the programming is interpreted into the display. Once the door sensor is ON, the front light will on with 250 lux. When student present for example in group 1, the light will on according the program I had wrote. It will check with the available of daylight. At the same moment the air-conditioner will also turn ON.

After lecturer is present in the class, the projector will ON and the screen will slide down automatically. Any students come after lecturer is considered late. A red light will flash indicates the student is late.

After the lecturer leaves the class, the projector will turn OFF and the screen will slide up automatically. When there are no students in the class, all the light will OFF and the system will reset but the air-conditioner remains ON. The air-conditioner will only OFF after 5 P.M and there are no people present in the class

4.5 Recommendation

Future work

1) When the projector is on, all the light must dimmed automatically. The recent program doesn’t include this feature.
2) The system can apply for classroom more than 24 students

Chapter 5: CONCLUSION AND REFERENCES

5.1 Conclusion

In conclusion, there are two objectives need to achieve by the end of this project which are to automatically control the switching of light and air-conditioner using PLC (Programmable Logic Controller) and to help lecturers to obtain an exact number of students in the class

The system that I will develop is energy efficient yet smart and can apply to every lecture rooms and halls in UTP. The system will be simulated in Siemens touch screen

5.2 References

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