

JHARSUGUDA ENGINEERING SCHOOL

JHARSUGUDA



**DEPARTMENT OF ELECTRONICS AND
TELECOMMUNICATION ENGINEERING**

**PLC & AUTOMATION
LAB MANUAL**

Year & Semester-3rd year & 6th sem

Subject Code/Name: PR-4, PLC & AUTOMATION LAB

**Prepared by:
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(Lect. In ETC Dept.)**

VISION OF THE DEPARTMENT-

To contribute in the nation development in the field of Electronics and Telecommunication by imparting quality education, promoting academic achievement to produce internationally accepted high quality human & technology resource for the country.

MISSION OF THE DEPARTMENT -

- 1) To prepare students for a brilliant career/entrepreneurship along with the development of the knowledge, skills, attitude & teamwork through the designed program me.
- 2) To impart quality teaching-learning experience with state-of-the-art curriculum.
- 3) To undertake collaborative projects which offer opportunities for long term interaction with academia & industry. Sustained interaction with the alumni, students, parents, faculty & other stake holders.
- 4) To develop human potential to its fullest extent so that intellectually capable & imaginative gifted leaders can emerge in a range of professions.

PROGRAM EDUCATIONAL OBJECTIVE-

- 1) To impart analytical & thinking skills to develop initiatives & innovative ideas for R&D, industry & societal requirements.
- 2) To understand the facets of advanced technologies, processes & materials necessary in the engineering field.
- 3) To provide sound theoretical & practical knowledge of E&C Engineering, managerial & entrepreneurial skills to enable students to contribute to sustenance of society with a global outlook.
- 4) To inculcate qualities of teamwork, good social, interpersonal & leadership skills & an ability to adapt to evolving professional environment in the domains of engineering & technology.
- 5) To appreciate the significance of collaborations in designing, planning, & implementing solutions for practical problems & facilitate the networking with national research & academic organization.

PROGRAM SPECIFIC OUTCOME-

- 1) Use techniques and skills to design, analyze, synthesize and simulate electronics components and systems.
- 2) Architect, partition and select appropriate technology for implementation of a specified communication system.

PRECAUTIONS:

- Properly connect the microprocessor and microcontroller kit with power supply terminals.
- Switch on the power supply after checking connections
- Handle the Trainer kit carefully.
- If you smell anything burning, immediately disconnect the power.
- Keep your work area dry.

COURSE OUTCOME

After the completion of the course the students will be able to:

C01-Design PLC ladder logic program.

C02-Interface the PLC trainer with the PC and application trainer kit with the PLC trainer.

C03-Simulate the PLC programming and observe the output.

C04-Install network card, wireless node, internal modem and switches.

C05-Write and explain the procedure of the experiments conducted.

LIST OF EXPERIMENTS

S.NO.	NAME OF EXPERIMENTS	PAGE NO.
1	Introduction to PLC trainer & its installation with PC	
2	Write and implement a simple ladder logic program using digital inputs and outputs for PLC.	
3	Write and implementation of simple ladder logic program using timer 1) On delay timer 2) Off delay timer 3) Retentive timer	
4	Write and implementation of simple ladder logic program using counter. 1) UP counter 2) Down counter	
5	Write program on MOVE, control statement, math function, data manipulation technique on PLC.	
6	To study about conveyor control system using PLC	
7	Write and implement ladder logic program to on-off the DC motor using PLC	
8	To study the traffic light controller system by using PLC	
9	Interface SCADA with PLC and associate tags with memory and I/O and operate the PLC inputs through the switch symbol from the computer screen and view the status of the outputs using lamp and motor graphics symbols in the screen.	

Programming and Logic Control (PLC)

AIM OF THE EXPERIMENT:

Introduction /Familiarization PLC trainer & its instruction with PC.

APPARATUS REQUIRED:

Sl. no.	Name of Equipment
1	Programmable Logic Controller (PLC) trainer kit
2	Personal Computer

THEORY:

What is PLC?

A programmable logic controller (PLC) is an industrial computer control system that continuously monitors the state of input device and makes decisions based upon a custom program to control the state of output devices.

What is inside a PLC?

- The central processing unit, the CPU, contains an internal program that tells the PLC how to perform the following functions.
- The CPU combines a microprocessor, an integrated power supply, input and output circuits, built in PROFINET, high speed motion control I/O, and on-board analog input in a compact housing to create a powerful controller.
- After you download your program, the CPU contains the logic required to monitor and control the devices in your application.
- **The CPU monitors the input and changes the outputs according to the logic of your user program**, which can include Boolean logic, counting, timing, complex math operations and communication with other intelligent devices.
- To communicate with a programming device, the CPU provides a built in PROFINET port.
- With the PROFINET network, the CPU can communicate with HMI panels or another CPU.
- To provide security for your application, every S7-1200 CPU provides password protection that allows you to configure access to the CPU functions.

- The CPU supports only a preformatted SIMATIC memory card. To insert a memory card, open the top CPU door and insert the memory card in the slot.
- Use the optional SIMATIC memory card either as a program card or as a transfer card.
- Digital inputs in the controller are 14 and voltage is 24. Digital outputs in the controller are 10 and voltage is 24.
- Back panel is available to connect extra I/O modules and communication modules.
- Analog input in the controller is two.
- Input power supply to the controller is 120/240 VAC.
- Three communication modules and eight I/O expansion modules can be used.
- Modbus communication board, output board and analog input board can be used.

PLC Languages:

The function of all programming languages is to allow the user to communicate with the programmable controller via a programming device. They all convey to the system, by means of instructions, a basic control plan.

- The most common types of languages encountered in programmable controller system design is;
 - a) Ladder Diagram (LD)
 - b) Function Block Diagram (FBD)

LADDER DIAGRAM (LD)

Traditional ladder logic is graphical programming language. Initially programmed with simple contacts that simulated the opening and closing relays, counters, timers, shift registers etc.

FUNCTION BLOCK DIAGRAM (FBD)

Useful for expressing the interconnection of control system algorithms and logic.

HARDWARE/SOFTWARE REQUIREMENT:

Processor type - Intel Pentium i3, 2.5 GHZ or similar

RAM - 4GB

Available hard disk space - 10 GB on system drive C:\

Operating systems- windows XP professional SP3, windows 2003 server R2 SP2, windows 7 (professional, enterprise, ultimate) SP1, windows 10 pro

Graphics card - 32MB RAM 24-bit color depth

Screen resolution - 1024 x 768

Network – 20 M bit/s Ethernet or faster

Optical drive- DVD-ROM

PROCEDURE: (PLC SETUP)

1. First select **TIA portal 14.0** and double click on it.
2. Double click on **“Create new project”** then select the **“Project name”** and select the location path to save project and then click **“Create”**.
3. Double click on **“Configure a device”**.
4. Click **“Add new device”**. After device is added click **“Controller”** and then click on **“SIMATIC S71200”**.
5. Click on **“CPU”** and **“CPU 1214 DC/DC/DC”**, then select the required **“MLFB”** number and click **“Add”**.
6. Now select the signal module **AQ1x12 BIT** and Add to the CPU and save the project by pressing **CTRL+S** key.
7. The select respective expansion module 3 no’s of **DI 16/DQ 16x24VDC**, 1 no. of **DI 8/DQ8 x 24 VDC** and 1 no. of **AI 4 x 13 BIT/AQ 2 x 14 BIT** from the hardware catalogue.
8. Double click on the **“RJ 45”** symbol in the controller, now **“Properties”** of the controller will be open and Ethernet configuration also open, if it is not opened just click on the Ethernet address and change IP address and change IP address as required then save the project.
9. Then go to **“Downloading the program”** setting for click on the **“Compile”** icon and then click on the **“Download”** icon.
10. Then automatically the **“Extended to download device”** window open. Select the **“PN/IE”** into the type of the **“PG/PC”** interface and also select the **“Show all compatible devices”**. Finally click the **“Start search”** option and then click the **“Load”** button.
11. In software synchronization before loading to a device window in opens and then clicks the **“Continue without synchronization”** option below.

12. **“Stop modules”**, **“Stop all”** option and then **“Load”** option and then load option and also goes to **“Load results”** window tick the **“Start all”** and click the **“Finish”** option.

PROGRAMMING METHOD IN PLC:

1. Click **“PLC-1”** in the project tree then click **“Program block”** and click **“main OB1”**.
Now OB1 is created (object block1).
2. Now select the network and double click on **“normally open”** icon (-|+).
3. Now normally open is added. Now add the **“output coil”** (- () -) in the network. Then double click on the both NO contact and output coil to enter their addresses simultaneously.
4. After it click on the **“Compile”** icon then **“Download to device”** icon.
5. For make an online process goes to click the **“Monitoring on/off”** icon. Then the window shows the online mode of the PLC.

RESULT:

We studied introduction of PLC, its installation with PC, hardware components, building various blocks and determine no. of digital inputs/outputs & analog inputs/outputs.

Write and implement a simple ladder logic program to study and verify and gate using digital inputs and outputs for PLC.

AND-GATE OPERATION

AIM OF THE EXPERIMENT:

Test the truth table of AND gate using PLC software.

APPARATUS REQUIRED:

Sl. no.	Apparatus Name
1.	PLC trainer kit
2.	Personal computer installed with PLC software
3.	Ethernet cable
4.	Patch chords

THEORY:

- 1) In AND_GATE operation is used to make the multiple operations of 2 inputs. Now using A&B are 2 inputs and C is the output.
- 2) Now generating the following formula to create the AND gate operation is given below.

$$A.B = C$$

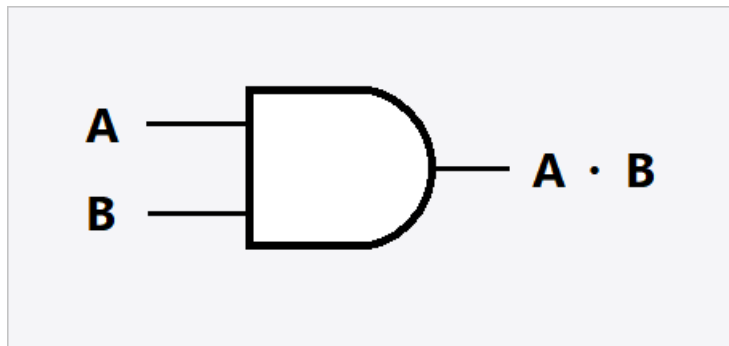
Programming:-



Truth table & Symbol of AND gate:

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

0-LOW ; 1-HIGH



PROCEDURE:

1. Click “**PLC-1**” in the project tree then click “**Program block**” and click “**Main OB1**”. Now **OB1** is created (object block1).
2. Now write an **AND_GATE** operation for make a 2 inputs like A and B. It is created by using two normally open contacts. And their addresses are **A(I0.0)** and **B(I0.1)**.
3. And the only one output can be used in this program that is C and their address is **(Q0.0)**.
4. After saved the program go to online mode to click **GO Online** icon directly.
5. After click the online mode goes to select the **Monitoring ON/OFF** icon.
6. Finally the two inputs [(10.0),(10.1)]are goes to HIGH the output[Q0.0]will goes to HIGH.

CONCLUSION:

Thus, the **AND_GATE** operation was studied successfully through **PLC Software**.

OR-GATE OPERATION

AIM OF THE EXPERIMENT:

Test the truth table of OR gate using PLC software.

APPARATUS REQUIRED:

Sl. no.	Apparatus Name
1.	PLC trainer kit
2.	Personal computer installed with PLC software
3.	Ethernet cable
4.	Patch chords

THEORY:

- In OR_GATE operation is used to make the addition operation of 2 inputs. Now using A&B are 2 inputs and C is the output.
- Now generating the following formula to create the AND_GATE operation is given below.

$$A + B = C$$

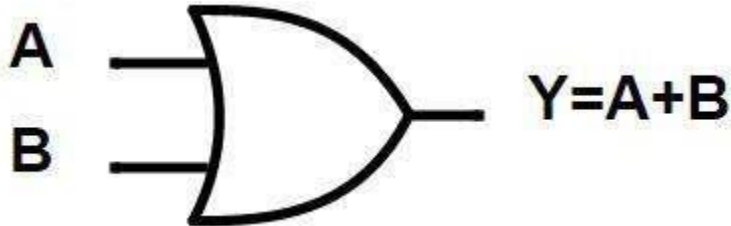
Programming: -



TRUTH TABLE & SYMBOL OF OR GATE:

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

0-LOW ; 1-HIGH



PROCEDURE:

1. Click PLC-1 in the project tree then click **program block** and then click **main OB1**.
2. Now the (object block 1) **OB1** is created.
3. Now write an **OR_GATE** operation for make 2 inputs like A and B.
4. It is created by using two normally open contacts parallel connection. And their addresses are A (**I0.0**) and B (**I0.1**).
5. And the only one output can be used in this program that is C and their address is (**Q0.0**).
6. Then save the program to press (CTRL+S) function it will be saved.
7. After saved the program go to online mode to click **GO Online** icon directly.
8. After click the online mode goes to select the **Monitoring ON/OFF** icon.
9. Finally, the inputs [(I0.0), (I0.1)] are goes to **HIGH** the output [Q0.0] will goes to **HIGH**. It can be represented in **Green** color indication.

CONCLUSION:

Thus, the **OR_GATE** operation was studied successfully through **PLC Software**.

EX OR-GATE

AIM OF THE EXPERIMENT:

Test the truth table of EX- OR gate using PLC software.

APPARATUS REQUIRED:

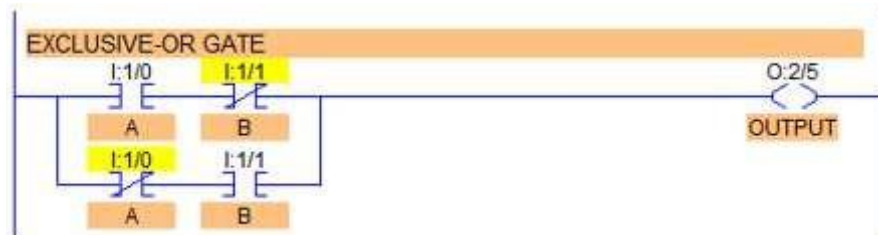
Sl. no.	Apparatus Name
1.	PLC trainer kit
2.	Personal computer installed with PLC software
3.	Ethernet cable
4.	Patch chords

THEORY:

- In **EX-OR_GATE** operation is used to make the operation of inequality functions of inputs. Now using A, B and C is the output.
- Now generating the following formula to create the **EX-OR_GATE** operation is given below.

$$\bar{A}B + A\bar{B} = C$$

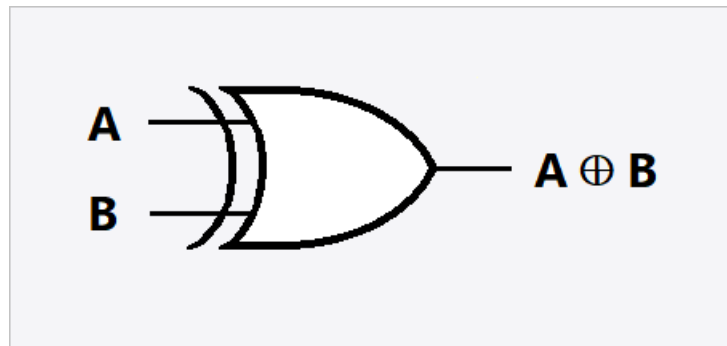
PROGRAMMING: -



TRUTH TABLE & SYMBOL OF EX-OR GATE:

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

0-LOW ; 1-HIGH



PROCEDURE:

1. Click **PLC-1** in the project tree then click **program block** and then click **main OB1**.
2. Now the (object block 1) **OB1** is created.
3. Now write an **EX-OR_GATE** operation for make a 2 inputs like A and B.
4. Then save the program and go to **download** into PLC.
5. After saved the program go to online mode to click **GO Online** icon directly.
6. Finally **monitoring** all the values of the inputs and outputs.
7. All the inputs are **LOW** at that time the output is **LOW**. The inequality functions of Inputs are **HIGH** the Output is **HIGH**.
8. Thus, the all input values are **HIGH** at that time the Output is **HIGH**.

CONCLUSION:

Thus, the **EX-OR_GATE** operation was studied successfully through **PLC Software**.

EX NOR-GATE

AIM OF EXPERIMENT:

Test the truth table of EX- OR gate using PLC software.

APPARATUS REQUIRED:

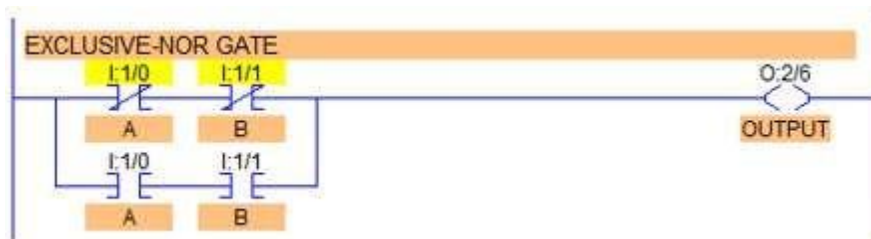
Sl. no.	Apparatus Name
1.	PLC trainer kit
2.	Personal computer installed with PLC software
3.	Ethernet cable
4.	Patch chords

THEORY:

- In **EXNOR_GATE** operation is used to make the inverse operation of the **EXNOR_GATE** values. Now using A,B and C is the output.
- Now generating the following formula to create the **EXNOR_GATE** operation is given below.

$$\bar{A}\bar{B} + A.B = C$$

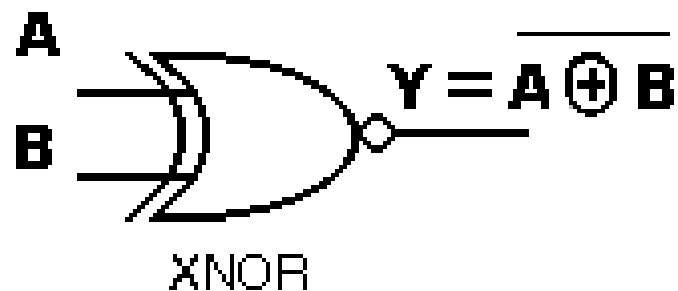
Programming: -



TRUTH TABLE & SYMBOL OF EXNOR GATE:

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

0-LOW 1-HIGH



PROCEDURE:

1. Click **PLC-1** in the project tree then click **program block** and then click **main OB1**.
2. Now the (object block 1) **OB1** is created.
3. Now write an **EXNOR_GATE** operation for make 2 inputs like A and B.
4. Then save the program and go to **download** into PLC.
5. After saved the program go to online mode to click **GO Online** icon directly.
6. Finally **monitoring** all the values of the inputs and outputs.
7. All the inputs are **LOW** at that time the output is **HIGH**. The inequality functions of Inputs are **HIGH** the Output is **HIGH**.
 - Thus, the all input values are **HIGH** at that time the Output is **HIGH**.

CONCLUSION:

Thus, the **EX-NOR_GATE** operation was studied successfully through **PLC Software**.

Write and implementation of simple ladder logic program using timer

ON DELAY TIMER

AIM OF THE EXPERIMENT:

To study the ON Delay Timer operation using PLC Software.

APPARATUS REQUIRED:

- PLC Trainer kit
- Personal Computer Installed with PLC Software
- Ethernet cable
- Patch chords

THEORY:

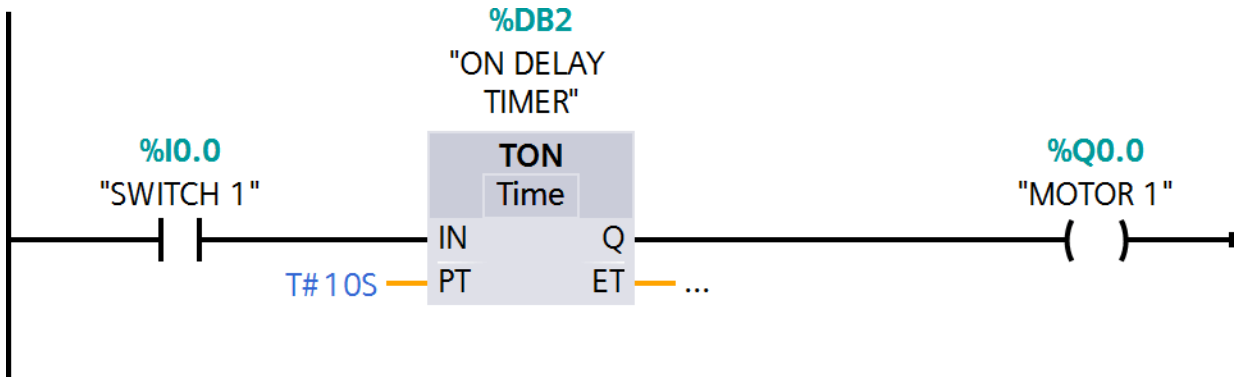
- ❖ ON Delay Timer is used to make the Delay operation in processes.
- ❖ It can control the inputs and outputs of the field instruments.

PROCEDURE:

1. Click PLC-1 in the project tree "1" then click program block "2" and click main OB1 "3" as shown in the below image.
2. Now the (Object Block1) OB1 is created.
3. Now select the On-Delay Timer goes to instructions tab and click the Basic Instructions and select the Timer operations tab and then double click the TON block.
4. Now the call options block is displayed. Then change the data block name. And click the automatic option finally select the ok button.
5. Now the Timer block is created in network is shown below the diagram. And also, that one input and one output coil is created in same network for testing the timer block.
6. The input can be connected with IN of the Timer block. Then output coil connected with Q of the Timer block.
7. Then given the addresses for input and outputs. And finally given the preset time for the Timer goes to double click the PT in timer block and write the values in sec.
8. Then save the program and download after that goes to online mode. And monitoring the program can be displayed in following images.
9. Then given the addresses for input and outputs. And finally given the preset time for the Timer goes to double click the PT in timer block and write the values in sec.
10. Then save the program and download after that goes to online mode and monitor the program.

11. When the status of the SWITCH 1(I0.0) changes from 0 to 1 the timer instruction will be executed and it will activate the MOTOR 1(Q0.0) after 10s delay.

LADDER LOGIC PROGRAM: -



CONCLUSION:

Thus, the ladder logic program of ON Timer was written and implemented successfully using PLC Software.

OFF DELAY TIMER

AIM OF THE EXPERIMENT:

To study the OFF-Delay Timer operation using PLC Software.

APPARATUS REQUIRED:

- PLC Trainer kit
- Personal Computer Installed with PLC Software
- Ethernet cable
- Patch chords

THEORY:

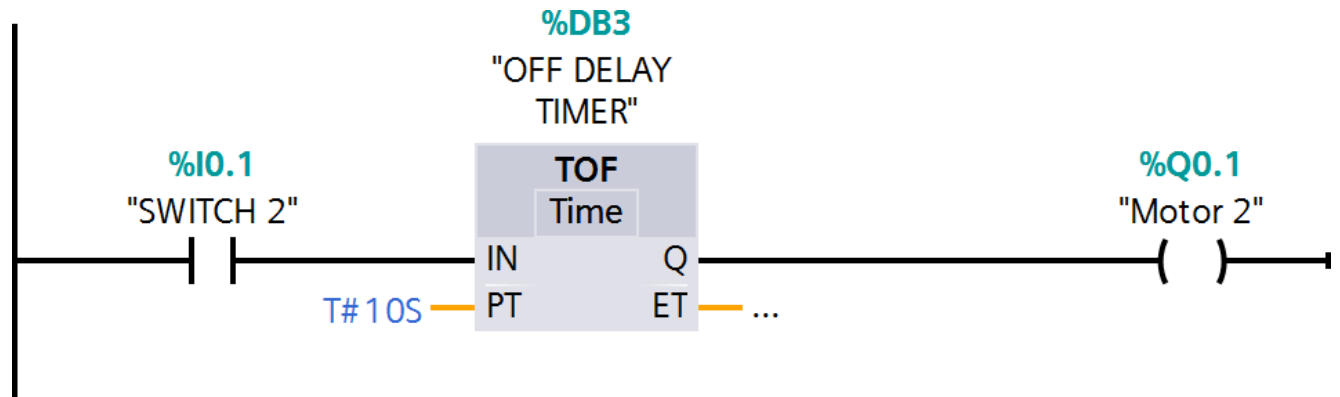
- ❖ OFF Delay Timer is used to make the Delay operation in processes.
- ❖ It can be controlling the inputs and outputs of the field instruments.

PROCEDURE:

1. Click PLC-1 in the project tree "1" then click program block "2" and click main OB1 "3" as shown in the below image
2. Now the below image shows (Object Block1) OB1 is created.
3. Now select the OFF-Delay Timer goes to instructions tab and click the Basic Instructions and select the Timer operations tab and then double click the TOF block.
4. Now the call options block is displayed. Then change the data block name. And click the automatic option finally select the ok button.
5. Now the Timer block is created in network. And also that one input and one output coil is created in same network for testing the timer block.
6. The input can be connected with IN of the Timer block. Then output coil is connected with Q of the Timer block.
7. Then given the addresses for input and outputs. And finally given the preset time for the Timer goes to double click the PT in timer block and write the values in seconds.
8. Then save the program and download after that goes to online mode and monitor the program.
9. When the status of the SWITCH 2(I0.1) changes from 0 to 1 the timer instruction will be executed and it will activate the MOTOR 2(Q0.1) immediately.

10. When the SWITCH 2(I0.1) status changes back to 0 then programmed time (PT) will start and after time MOTOR 2(Q0.1) will be OFF.

LADDER LOGIC PROGRAM:



CONCLUSION:

Thus, the ladder logic program of OFF Timer was written and implemented successfully using PLC Software.

RETENTIVE TIMER

AIM OF THE EXPERIMENT:

Write and implement a simple ladder logic program using Retentive timer.

APPARATUS REQUIRED:

- PLC Trainer kit
- Personal Computer Installed with PLC Software
- Ethernet cable
- Patch chords

THEORY:

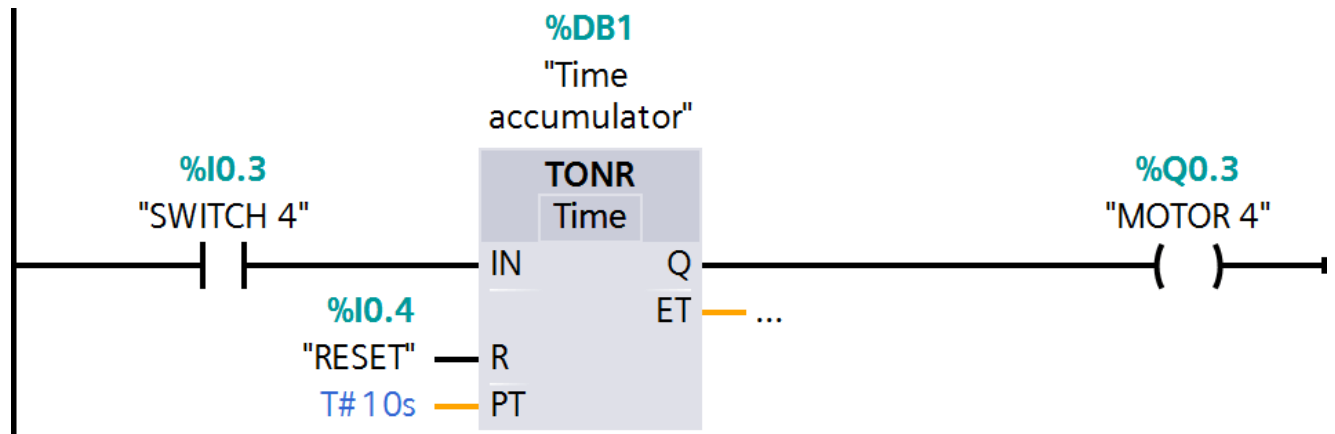
- Counts time base intervals when the instruction is true and retains the accumulated value when the instruction goes false or when power cycle occurs.
- The Retentive Timer instruction is a retentive instruction that begins to count time base intervals when rung conditions become true.
- The Retentive Timer instruction retains its accumulated value when any of the following occurs:
 - Rung conditions become false.
 - The processor loses power while battery backup is still maintained. And a fault occurs.

PROCEDURE:

1. Click PLC-1 in the project tree "1" then click program block "2" and click main OB1 "3" as shown in the below image
2. Now the below image shows (Object Block1) OB1 is created.
3. Now select the Accumulator timer goes to instructions tab and click the Basic Instructions and select the Timer operations tab and then double click the TONR block.
4. Now the call options block is displayed. Then change the data block name. And click the automatic option finally select the ok button.
5. Now the Timer block is created in network. And also that one input and one output coil is created in same network for testing the timer block.
6. The input can be connected with IN of the Timer block. Then output coil is connected with Q of the Timer block.
7. Then given the addresses for input and outputs. And finally given the preset time for the Timer goes to double click the PT in timer block and write the values in seconds.
8. Then save the program and download after that goes to online mode and monitor the program.

9. When the status of the SWITCH 4(I0.3) changes from 0 to 1 the timer instruction will be executed and MOTOR 4(Q0.3) will start after 10s.
10. The MOTOR 4(Q0.2) will remain ON, even when the input status changes back to 0. The Reset (I0.4) is necessary to reset the timer or accumulated time.

LADDER LOGIC PROGRAM-



CONCLUSION:

Thus the ladder logic program of Accumulator Timer was written and implemented successfully using PLC software.

Write and implementation of simple ladder logic program using counter

UP COUNTER

AIM OF THE EXPERIMENT:

To study about the UP-Counter operation using PLC Software.

APPARATUS REQUIRED:

- PLC Trainer kit
- Personal Computer Installed with PLC Software
- Ethernet cable
- Patch chords

THEORY:

The counters are mainly used for counting the values from the field equipment. The UP counters can be used to counting the values in upward manner. It can be performing the incremental purpose.

PROCEDURE:

1. Click **PLC-1** in the project tree "1" then click **program block "2"** and click **main OB1 "3"**.
2. Now the below image shows (Object Block1) OB1 is created.
3. To select the UP-Counter block in plc goes to **Instructions** Tab and click the **Basic Instructions** then select the **CTU** block for UP Counter operation.
4. Now the UP-Counter call options block can be opened. Then change the **data block** name in that Name block. And then click the **ok** button.
5. The following details can be entered into the UP-Counter block is given below.

CU - Make the counter Input

Q- Counter Output

R - Reset input

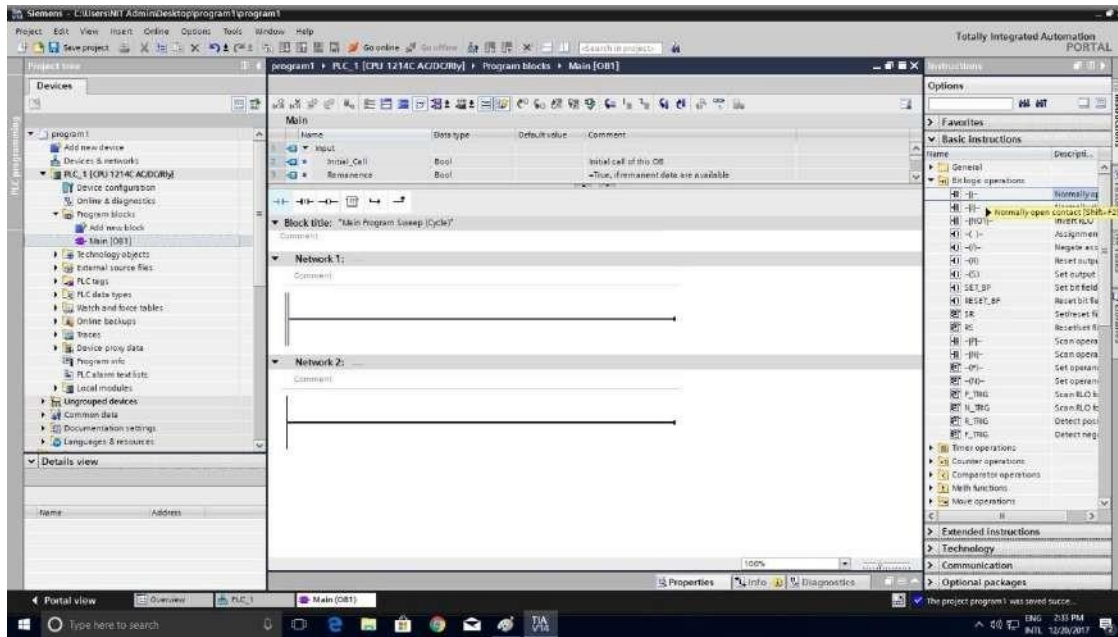
CV - Count Value

PV - Preset value (Set Value)

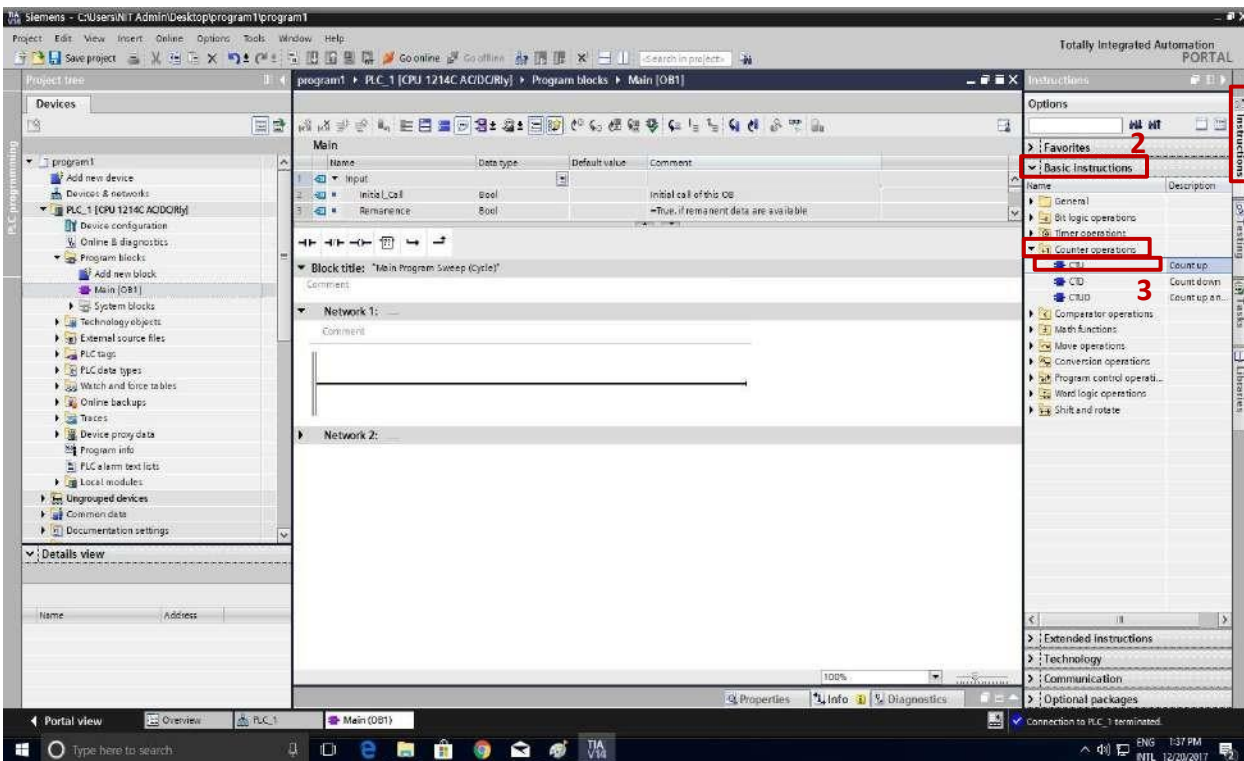
6. Then save the program and goes to online mode and monitoring the counter values before and after enabling the counter block.

LADDER LOGIC PROGRAM: -

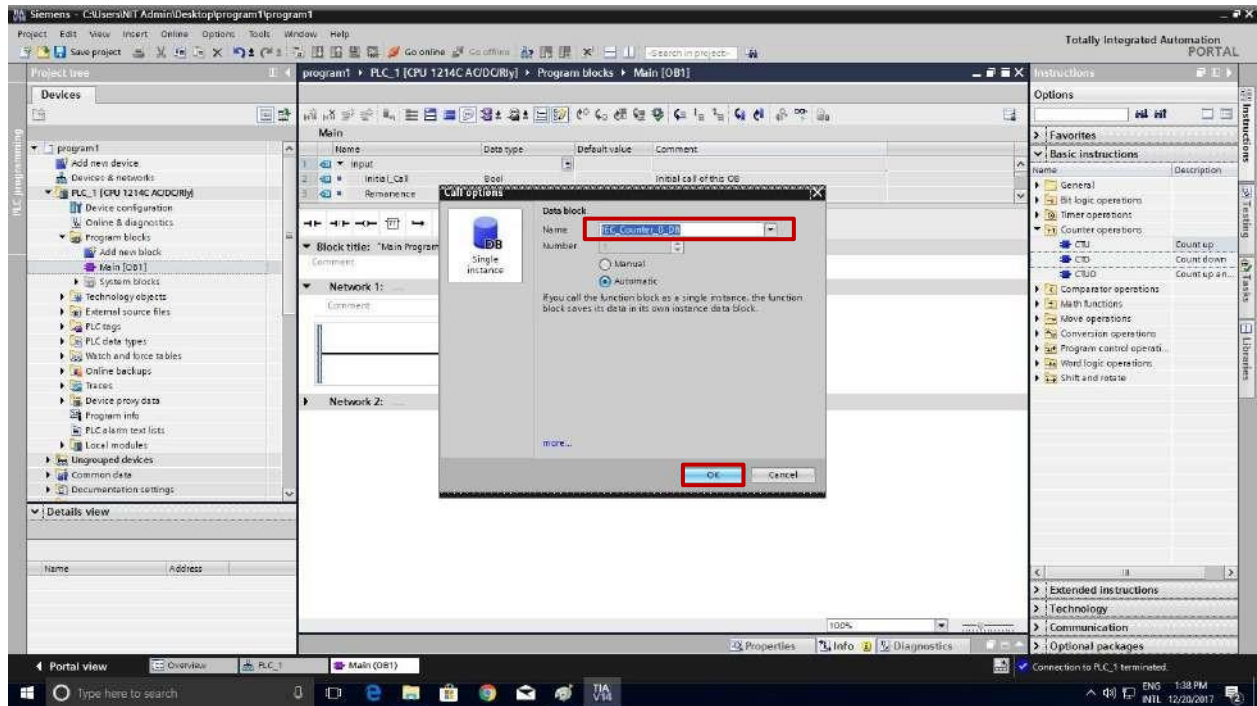
1.



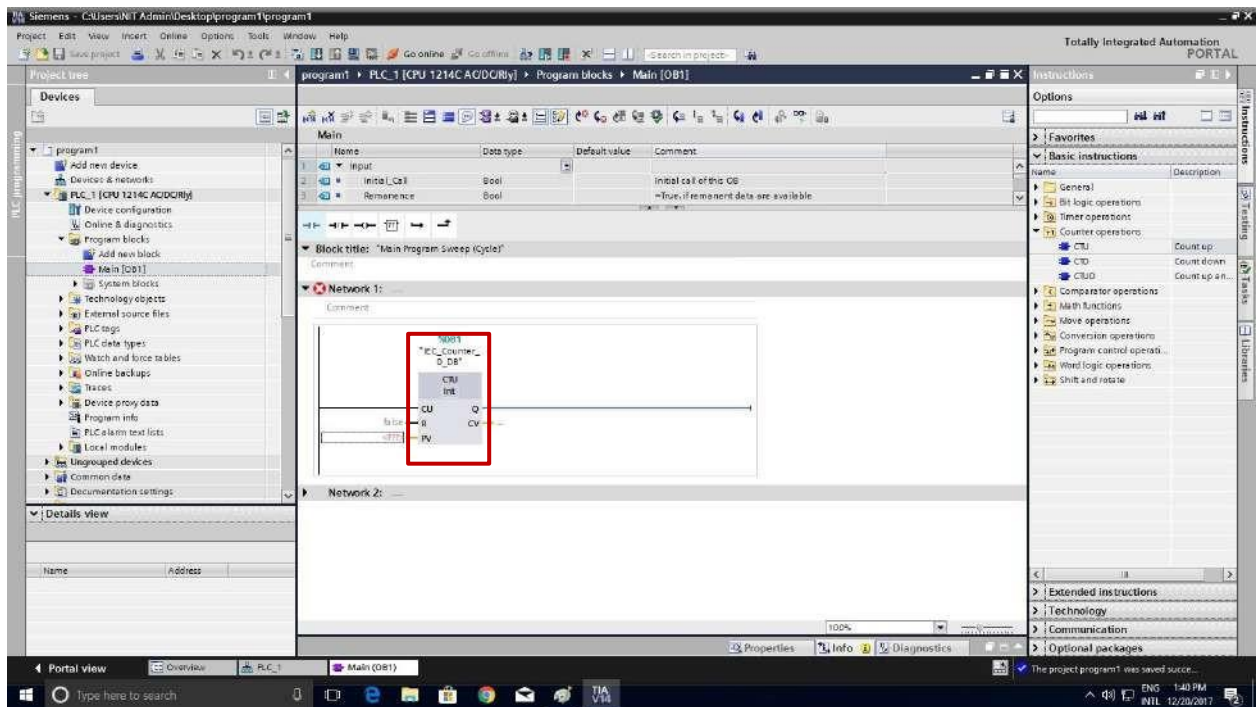
2.



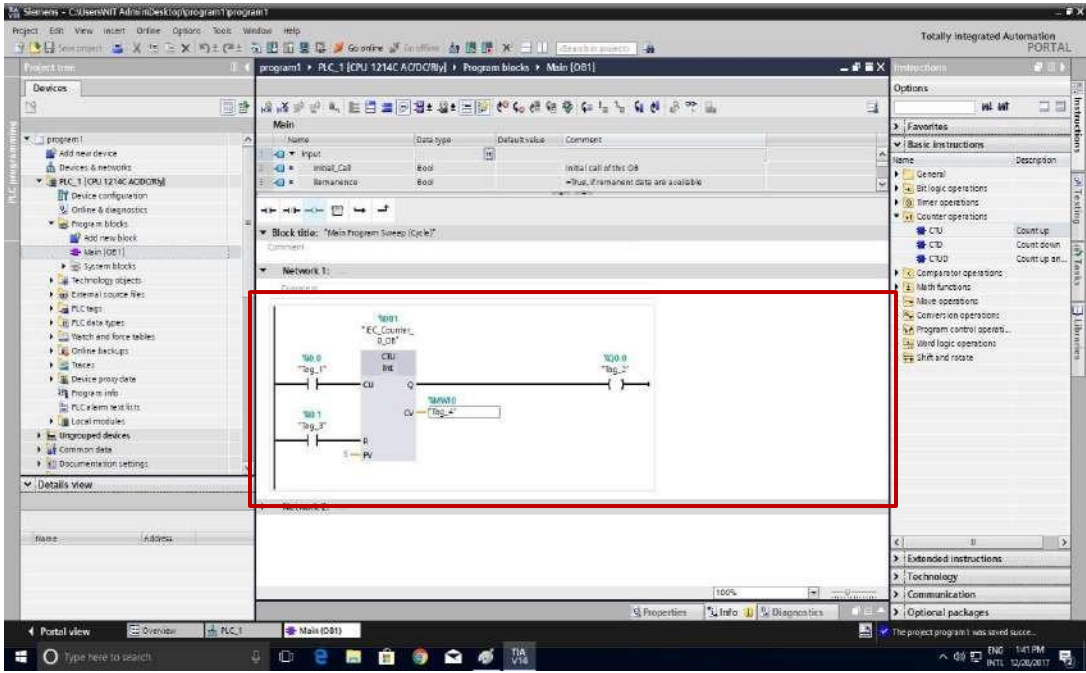
3.



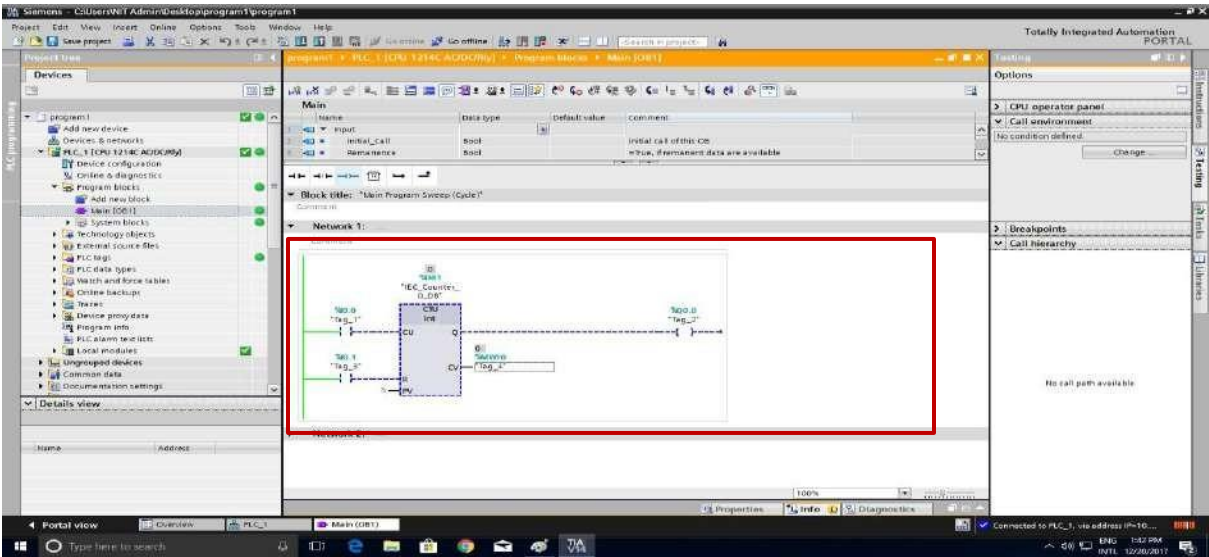
4. Now the UP-Counter block is created in network is shown below the image.



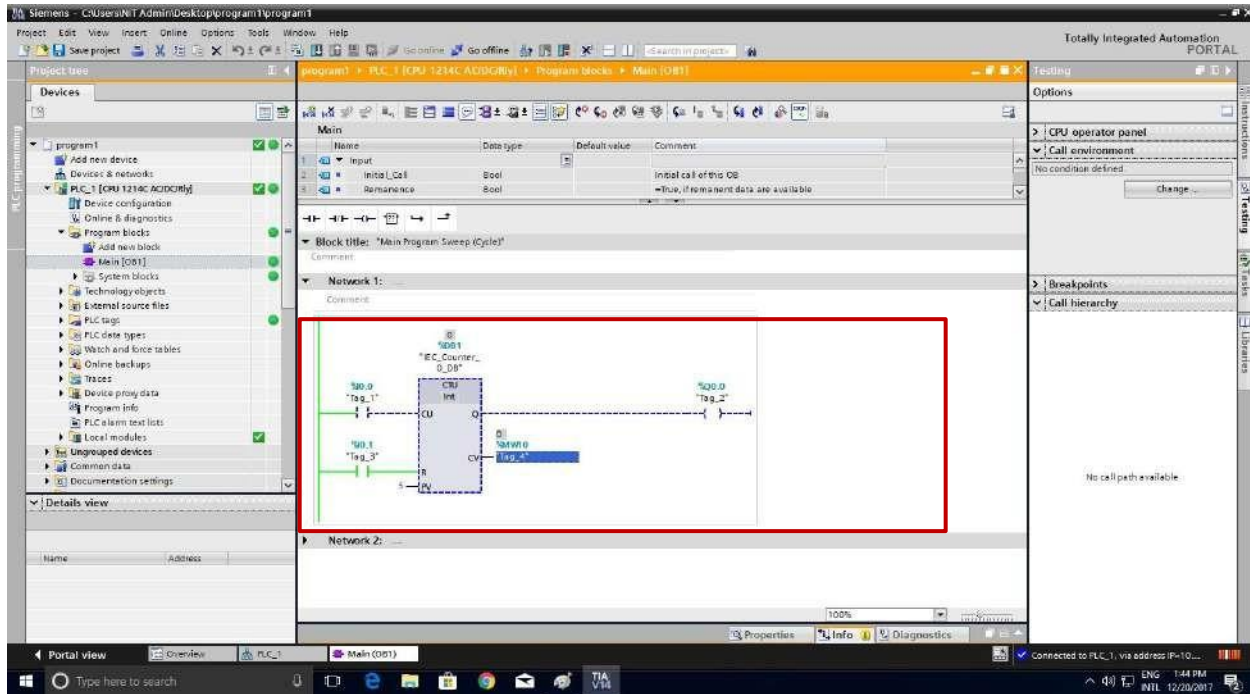
5. Before Enabling the Counter Block



6. After Enabling the Counter Block



7. After Resetting the Counter Block



CONCLUSION:

Thus, the UP-Counter operation was successfully performed using PLC software.

DOWN COUNTER

AIM OF THE EXPERIMENT:

To study about the Down Counter operation using PLC Software.

APPARATUS REQUIRED:

- PLC Trainer kit
- Personal Computer Installed with PLC Software
- Ethernet cable
- Patch chords

THEORY:

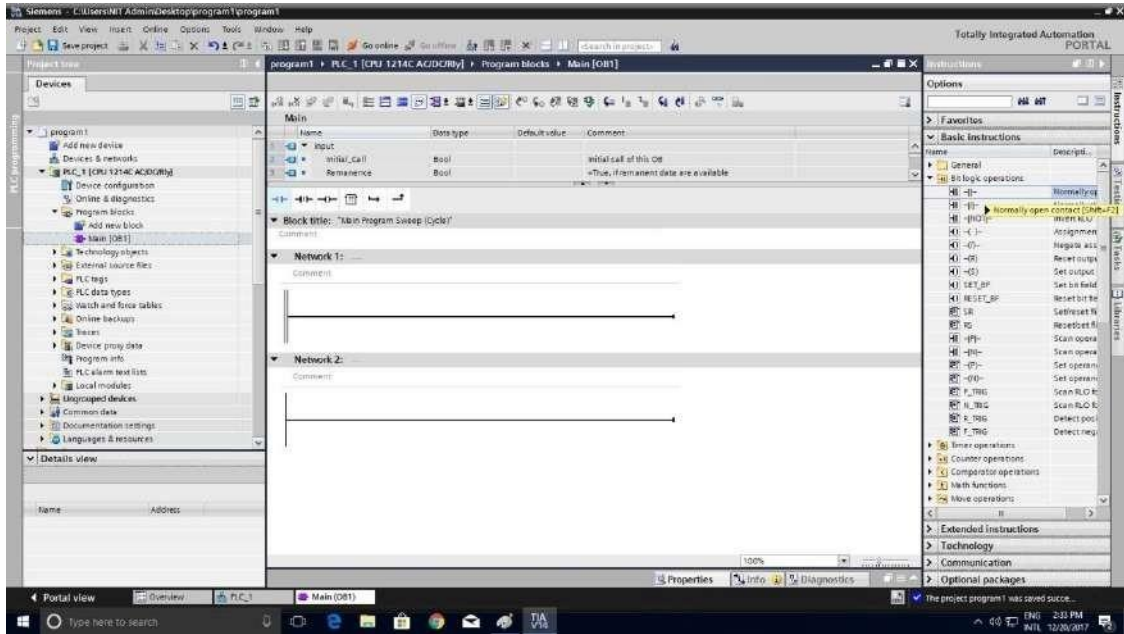
The counters are mainly used for counting the values from the field equipment. The DOWN Counters can be used to counting the values in down ward manner. It can be performing the decremental purpose.

PROCEDURE:

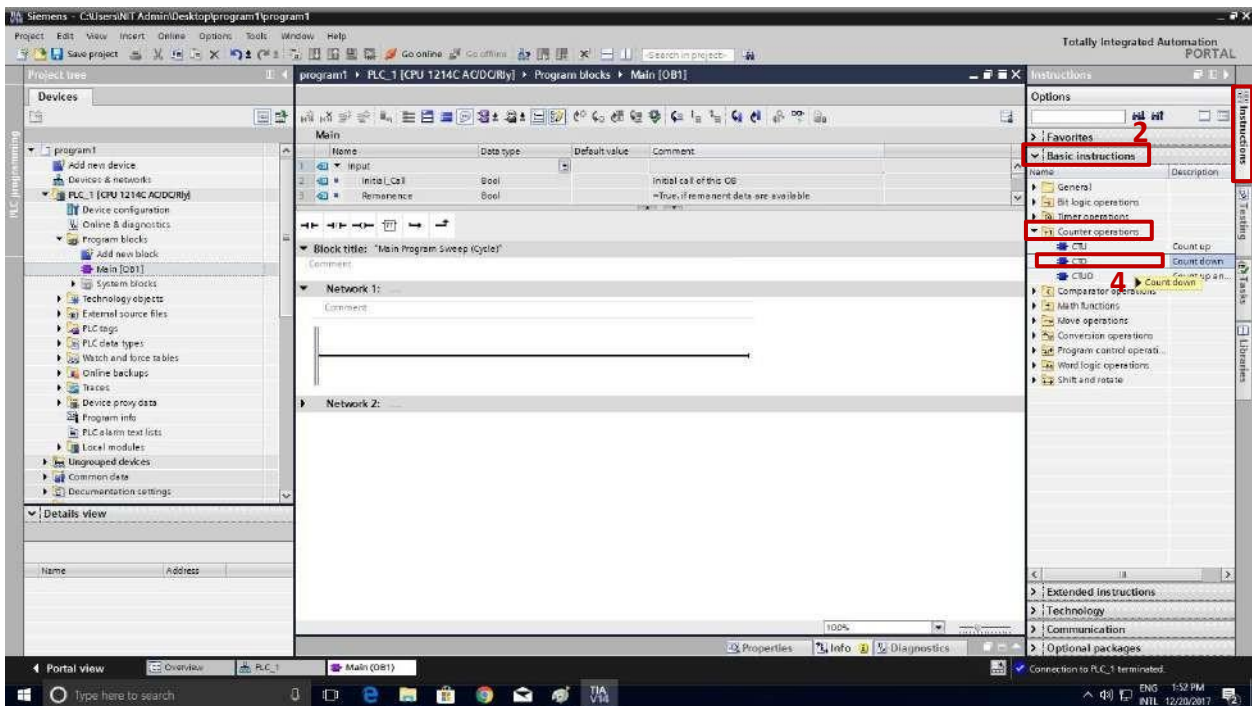
1. Click **PLC-1** in the project tree "1" then click **program block "2"** and click **main OB1 "3"**.
2. Now the below image shows (Object Block1) OB1 is created.
3. To select the DOWN Counter block in plc goes to **Instructions** Tab and click the **Basic Instructions** then select the **CTD** block for DOWN Counter operation.
4. Now the DOWN Counter call options block can be opened. Then change the **data block** name in that Name block. And then click the **ok** button.
5. Now the **DOWN** Counter block is created in network.
6. The following details can be entered into the UP-Counter block is given below.
CD - Make the counter Input
Q- Counter Output
LD - load Preset value (After reach the value of 0)
CV - Count Value
PV - Preset value (Set Value)
7. Then save the program and goes to online mode and monitoring the counter values before and after enabling the counter block.

LADDER LOGIC PROGRAM: -

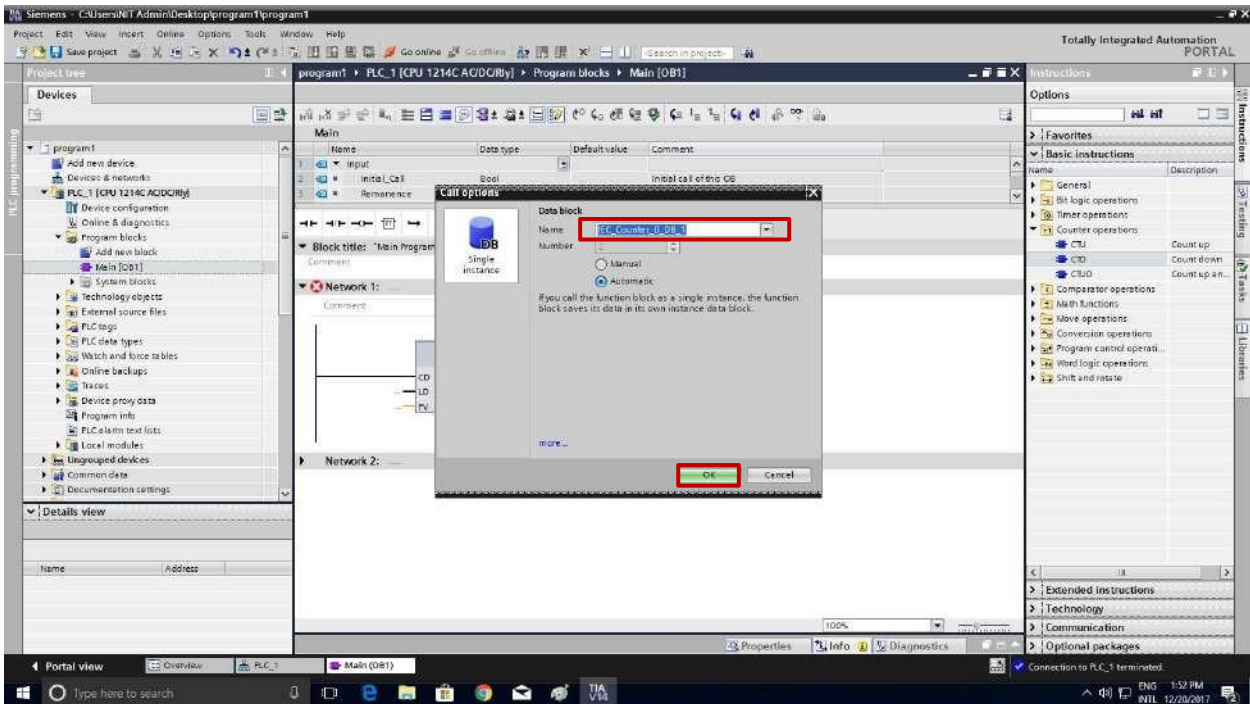
1.



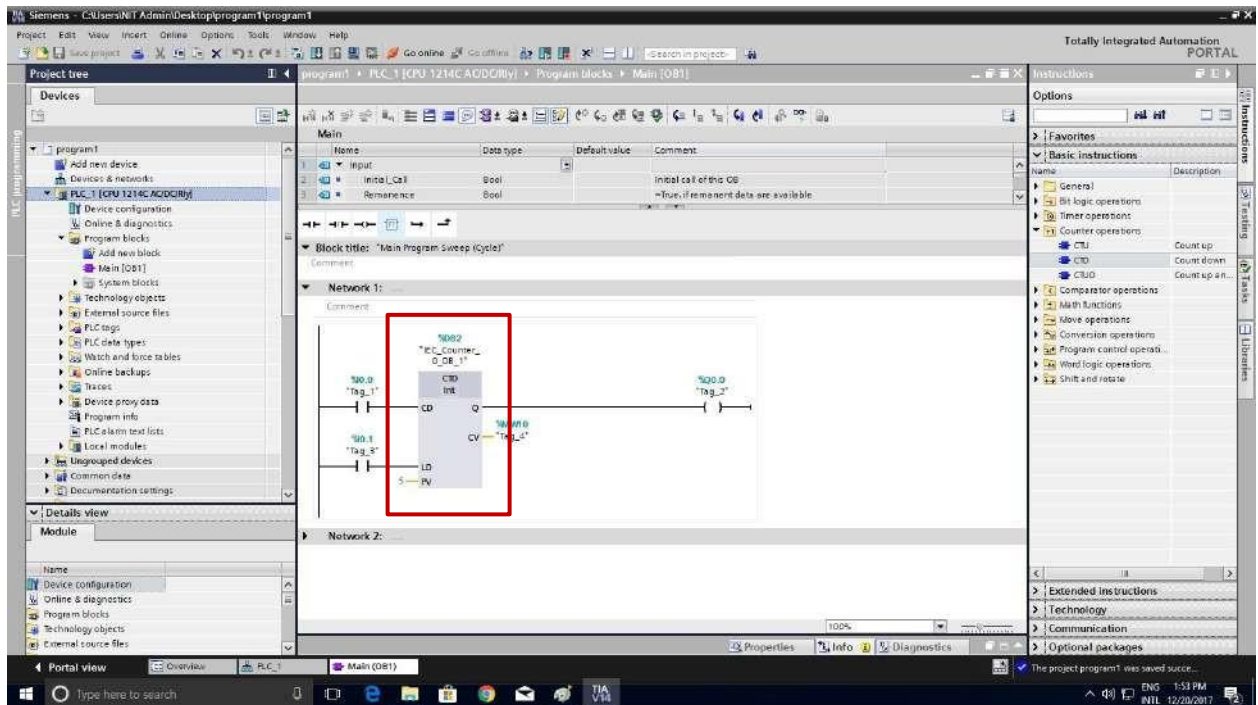
2.



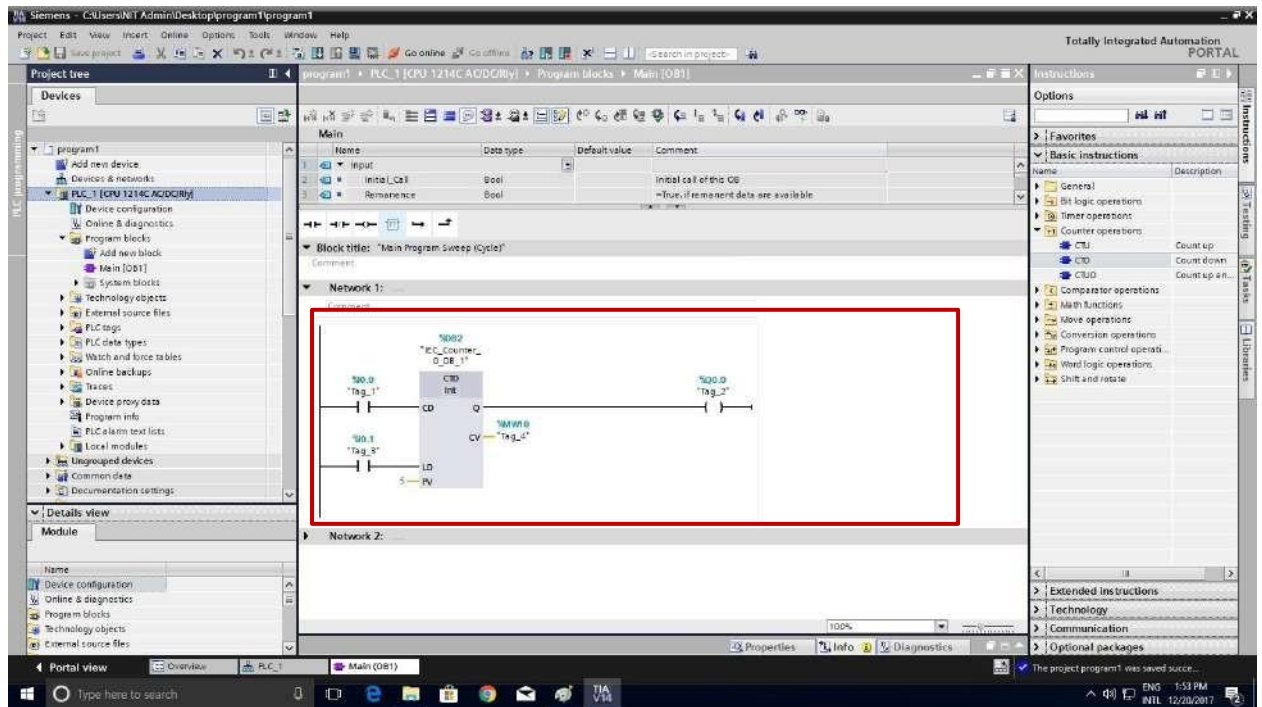
3.



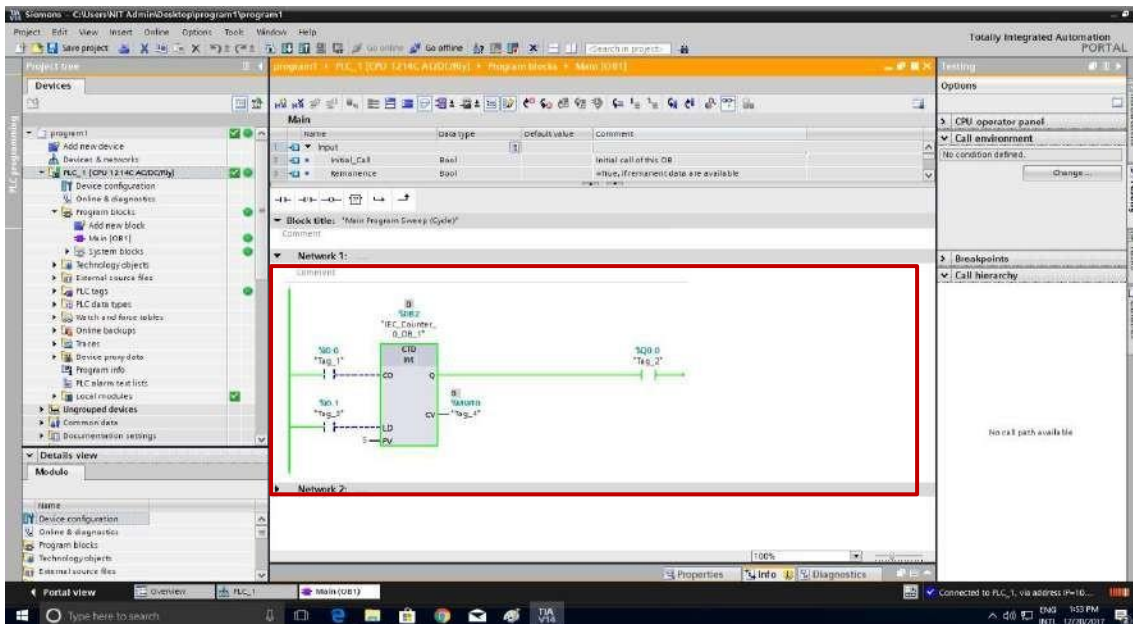
4.



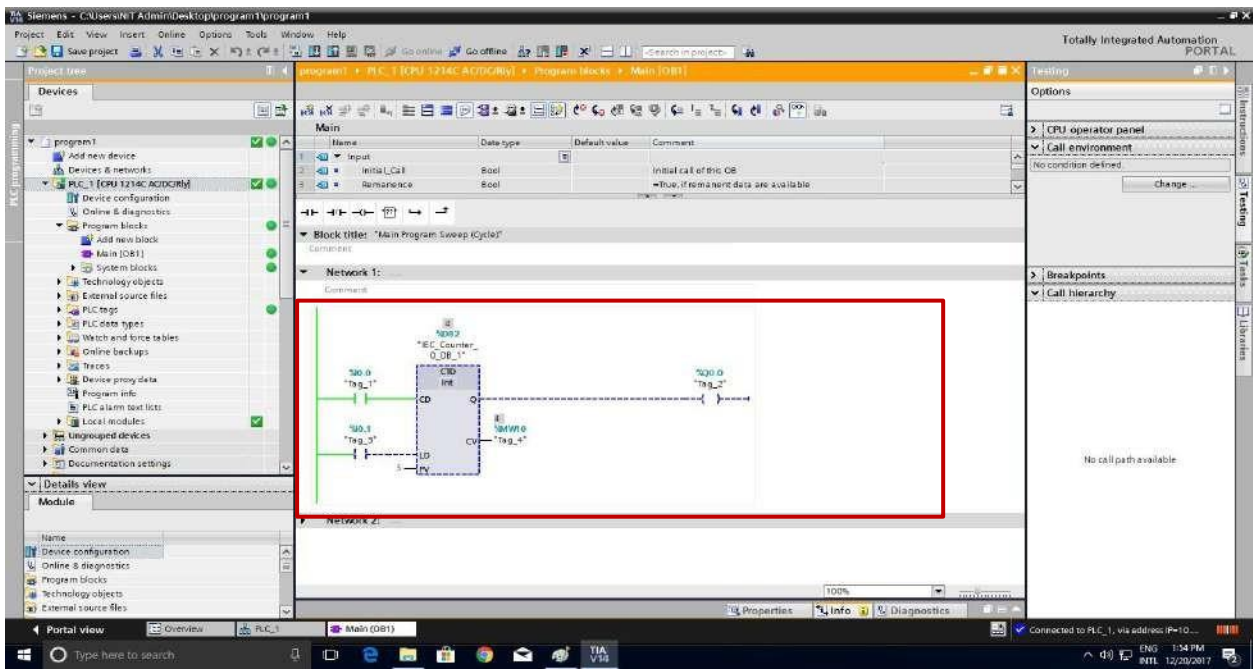
5. Before Enabling the Counter Block.



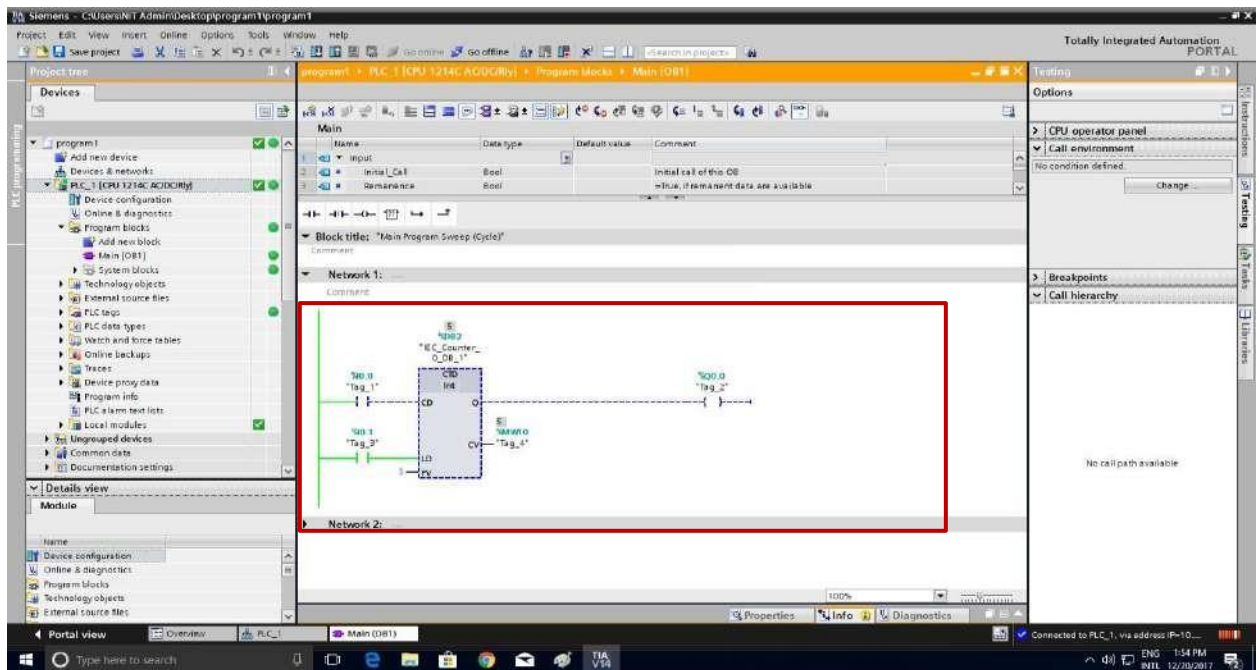
6. After Enabling the Counter Block



7. After Load Presetting the Counter Block



8.



CONCLUSION:

Thus, the DOWN Counter operation was performed successfully using PLC software.

Write program on MOVE, Control statement, math function, data manipulation technique on PLC

MOVE

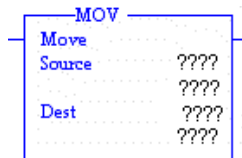
AIM OF THE EXPERIMENT:

Write a simple ladder logic program using MOVE instruction.

EQUIPMENTS REQUIRED:

- PLC software
- Desktop Computer

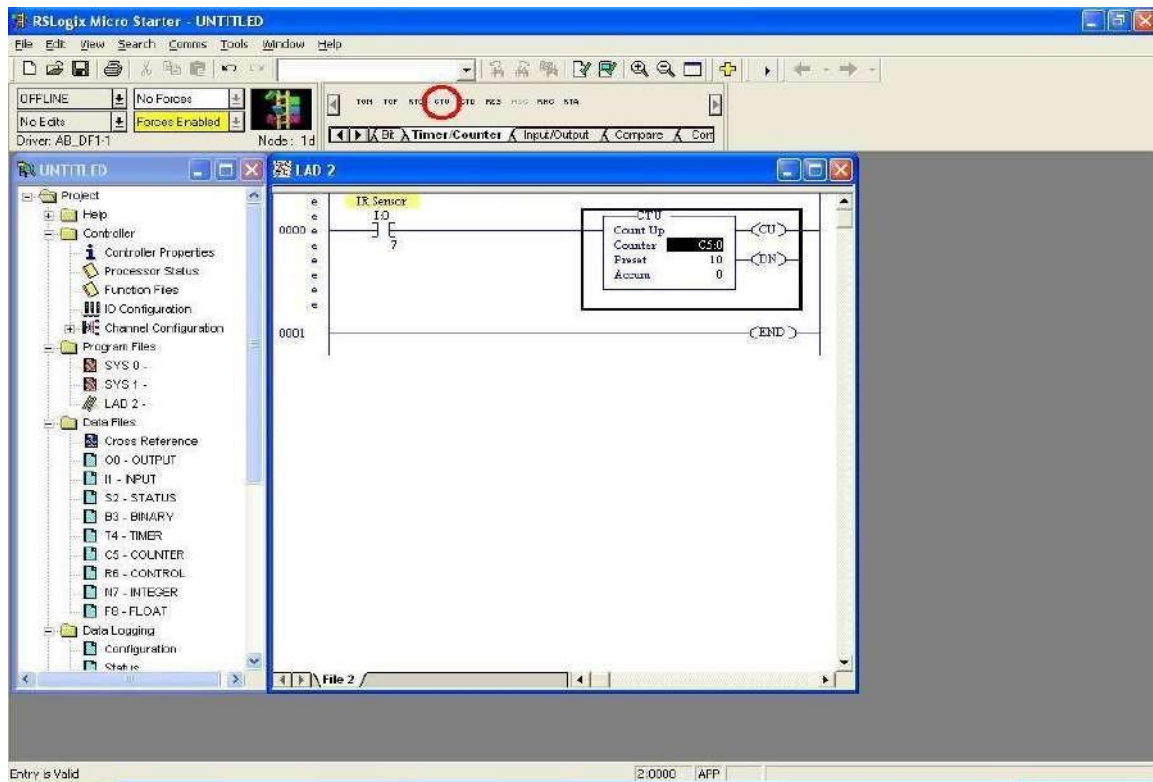
THEORY:



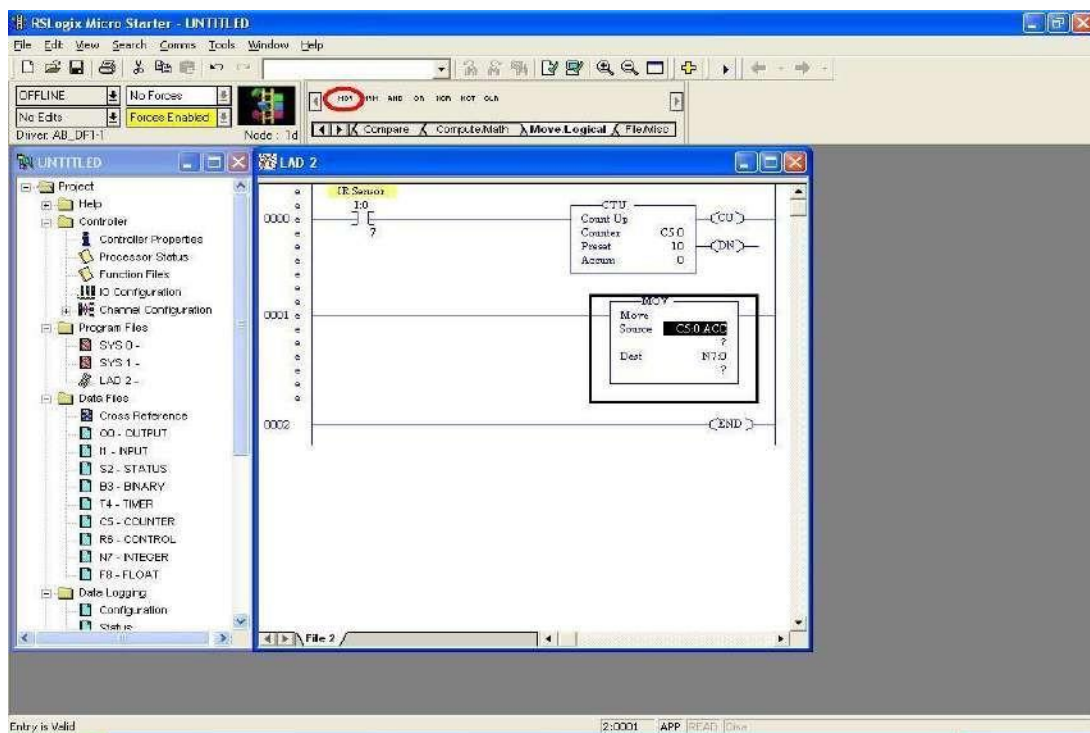
When rung conditions preceding this instruction are true, the MOV instruction moves copy of the source to the destination each scan. The original value remains intact and unchanged in its Source location.

PROCEDURE AND LADDER LOGIC PROGRAM:

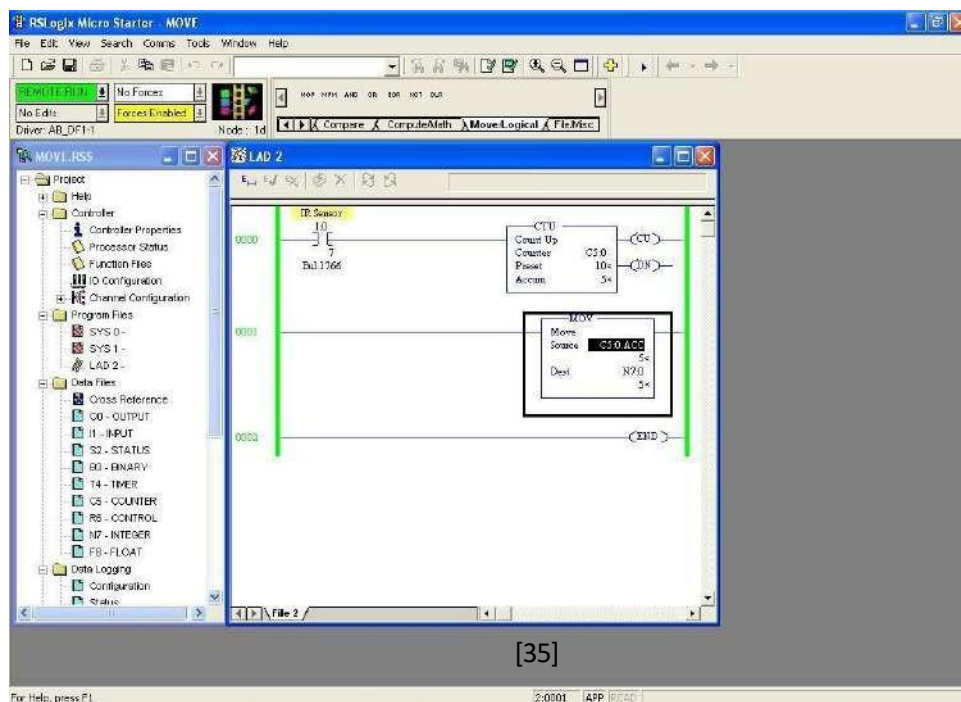
- Take one NO bit and assign address I:0/7 and comment to IR Sensor and take Counter and assign Counter to C5:0 and Preset to 10 is shown below.



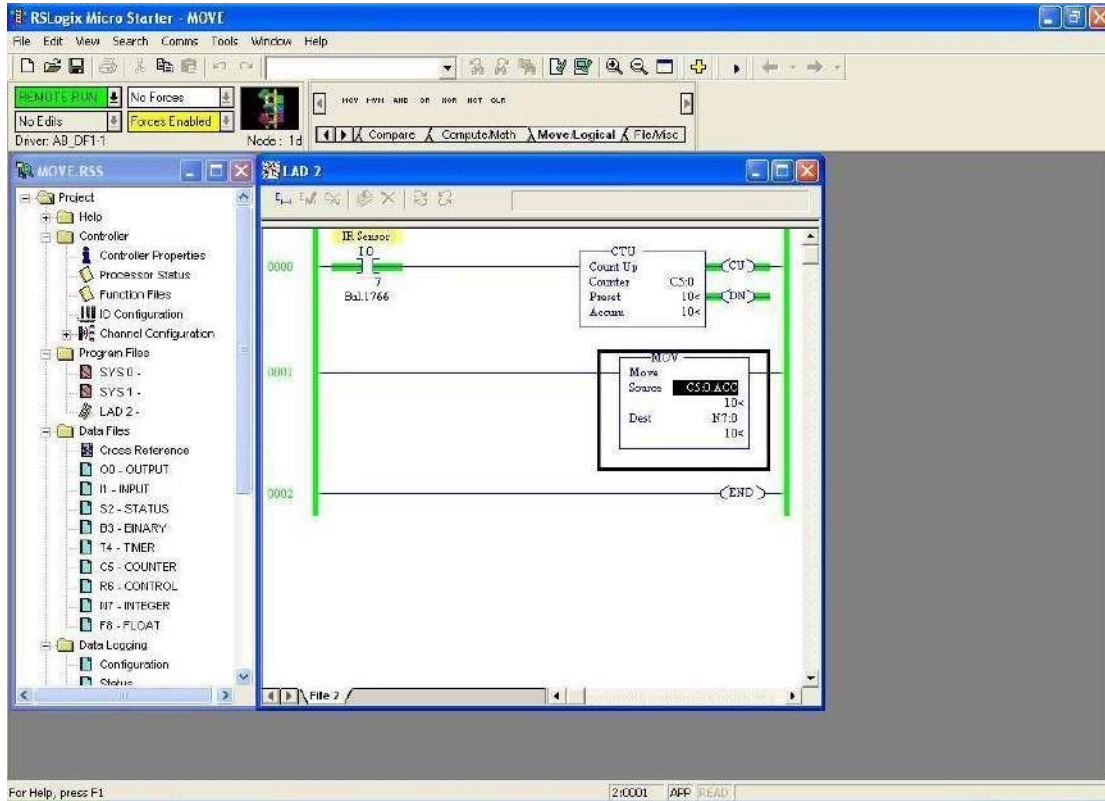
- Take Move instruction form Move/Logical Instruction and assign Source to C5:0 ACC and assign Dest. to N7:0 is shown below.



- Verify and download and run the program.
- When any obstacle in front of I:0/7 (IR Sensor) the n counter C5:0 will start counting. When counter Accumulator value is increase and move instruction Move the Counter accumulator value in Destination N7:0 is shown below.



- When any obstacle in front of I:0/7 (IR Sensor) the counter C5:0 will start counting. When counter Accumulator value is increase and move instruction Move the Counter accumulator value in Destination N7:0 is shown.



CONCLUSION:

Thus, the MOVE operation was studied and performed successfully using PLC software.

CONTROL STATEMENT

AIM OF THE EXPERIMENT:

Write a simple ladder logic program using Control statement (Jump & Label instruction).

EQUIPMENTS REQUIRED:

- PLC software
- Desktop Computer

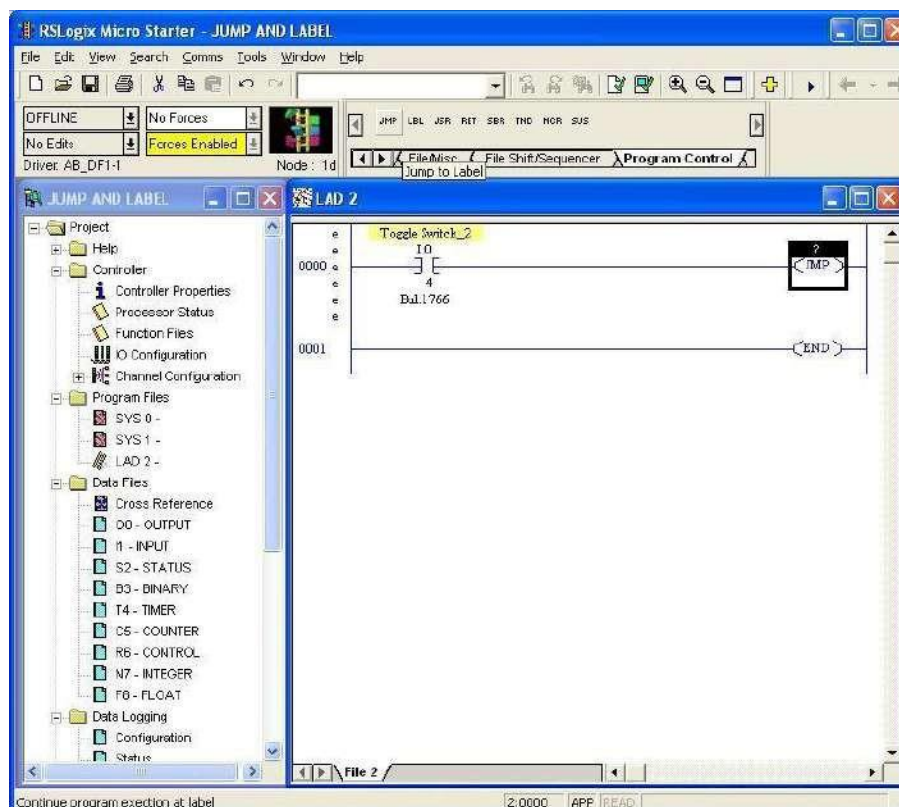
THEORY:

When the rung condition for this output instruction is true, the processor jumps forward or backward to the corresponding label instruction (LBL) and resumes program execution at the label. More than one JMP instruction can jump to the same label. Jumping forward to a label saves program scan time by omitting a program segment until needed. Jumping backward lets the controller execute program segments repeatedly.

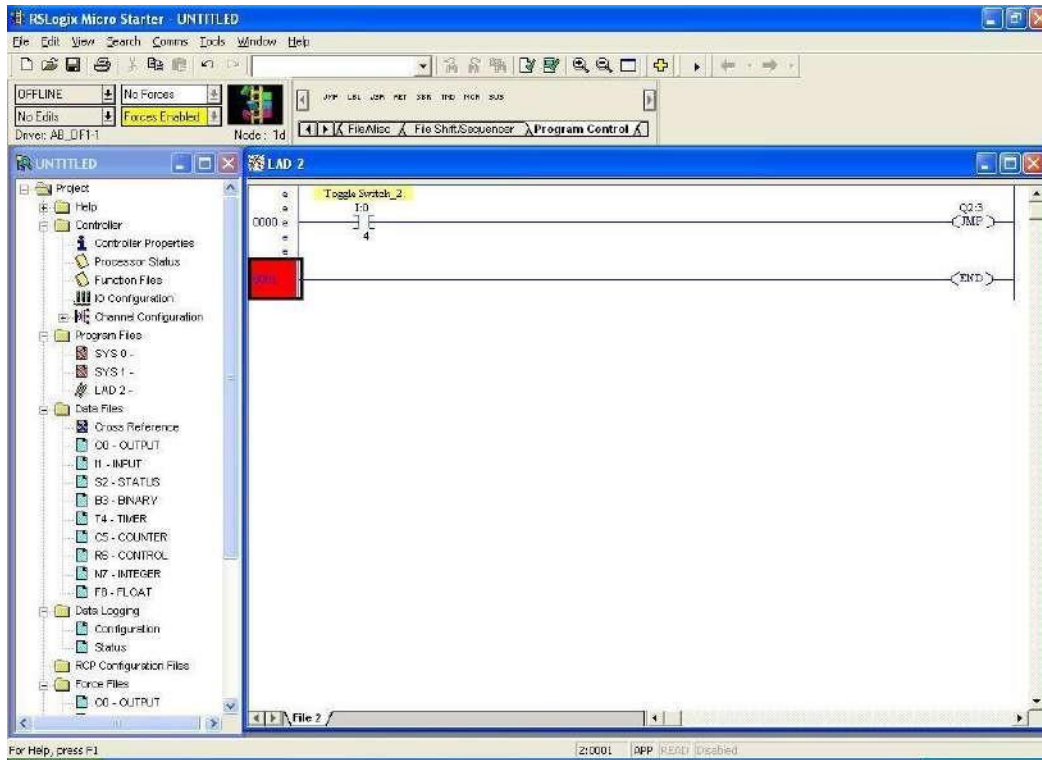


PROCEDURE AND LADDER LOGIC PROGRAM:

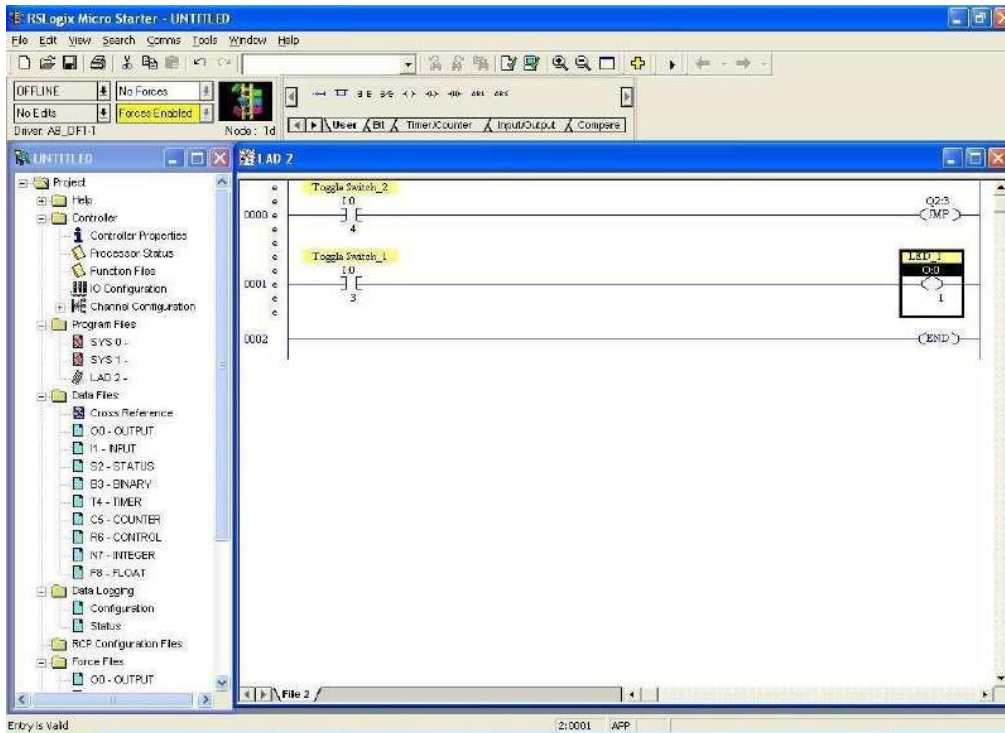
- Take NO Bit and assign address I0:0/4 and comment to ToggleSwitch_2 and take MP instruction from Program control instruction is shown below.



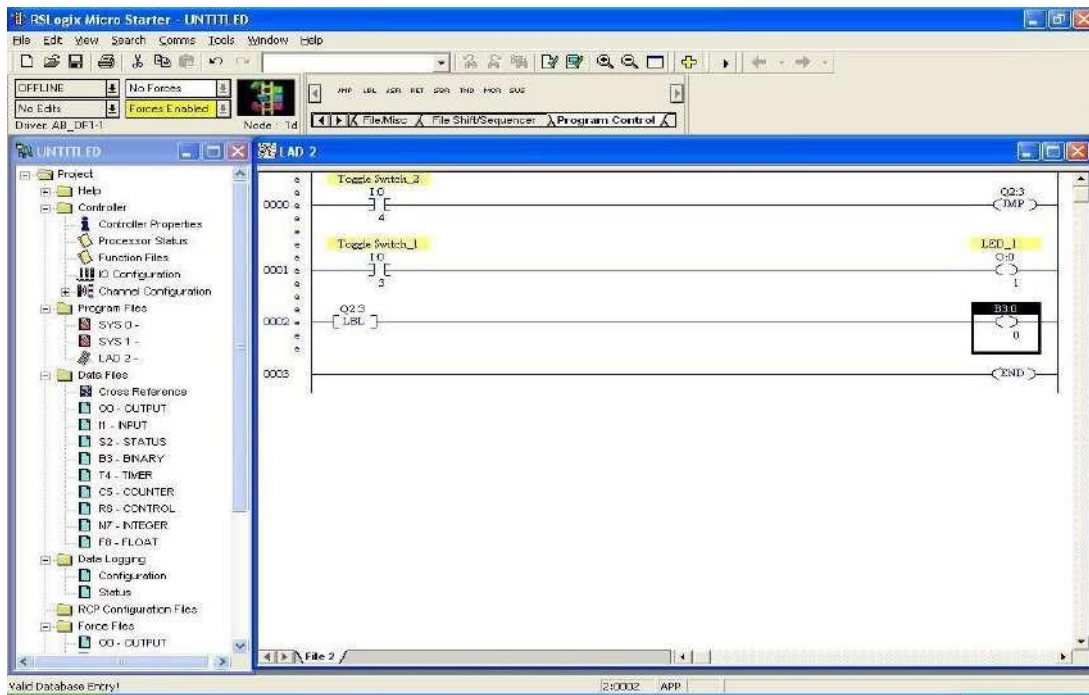
- Assign address to JMP instruction to 3 is shown below.



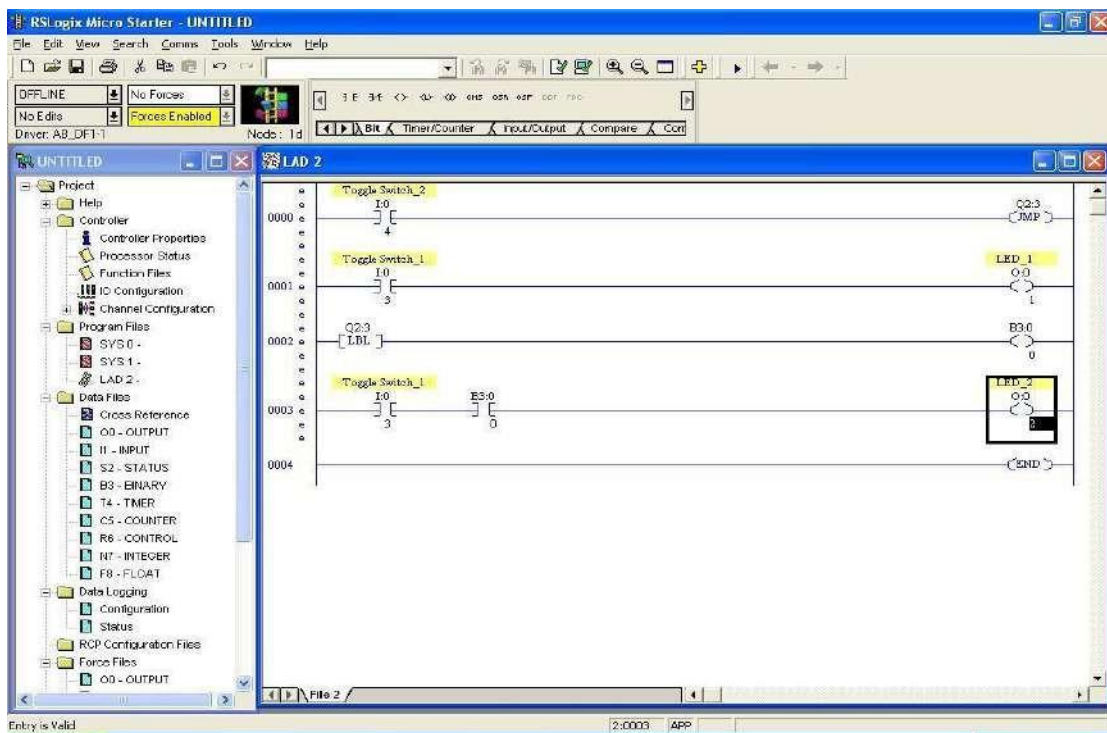
- Take NO bit and assign address I:0/3 (ToggleSwitch_1) and take coil and assign address O0:0/1 (LED_1) is shown below



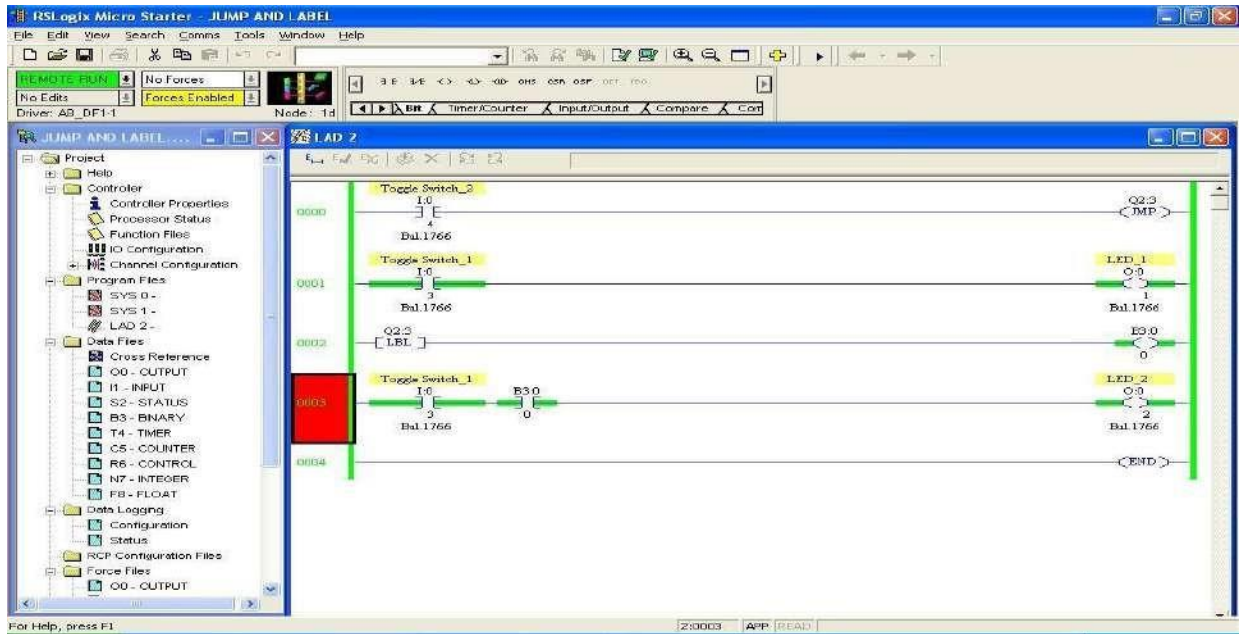
- Take LBL instruction from Program Control instruction and assign address Q2:3 and take Coil and assign address B3:0/0 is shown below.



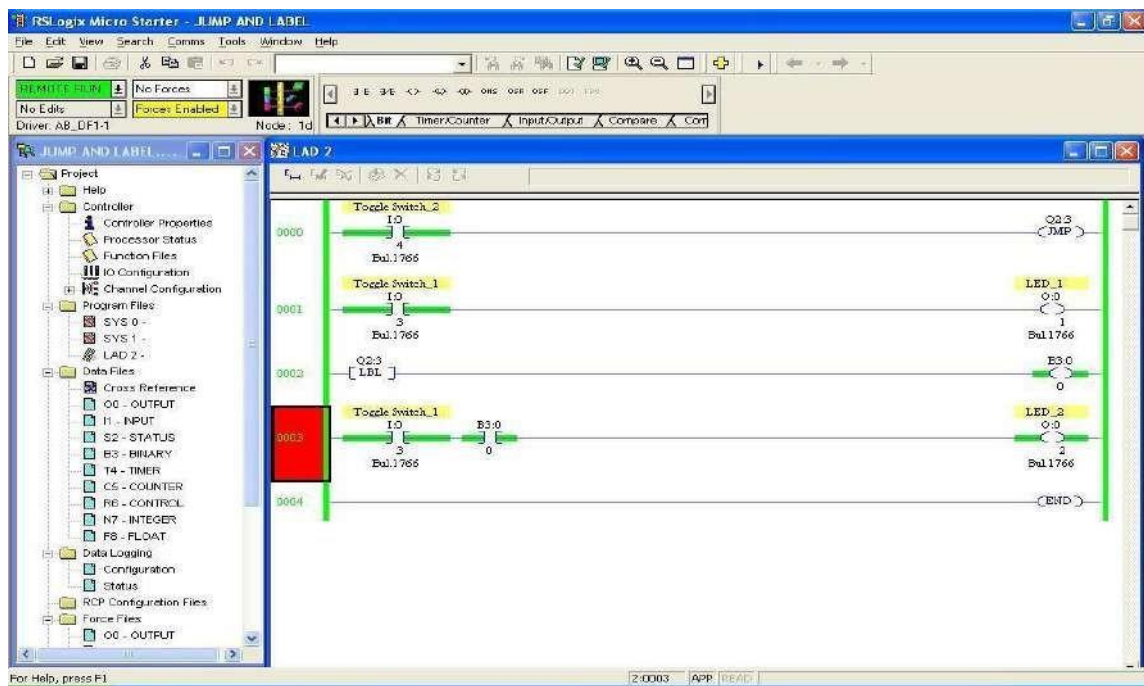
- Take NO bit and assign address I:0/3(ToggleSwitch_1) and take another NO bit and assign B3:0/0 and take coil and assign O:0/2(LED_2) is shown below.



- Verify, download and run the program of Jump and Label instruction.
- When you enable the I:0/3(ToggleSwitch_1) then output O:0/1(LED_1) and O:0/2(LED_2) will be ON is shown below.



- When you enable I:0/4(ToggleSwitch_2) then JUMP instruction is ON.
- When you enable the I:0/3 (Toggle Switch_1) then output O:0/1 is off because execution of instruction is Jump on network3 (0003) means output O:0/2(LED_2) will be ON is shown below.



CONCLUSION:

Thus, the Control operation was performed and verified successfully using PLC software.

MATH FUNCTION

AIM OF THE EXPERIMENT:

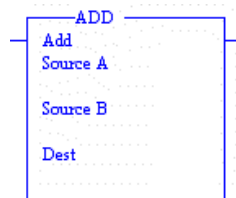
Write a simple ladder logic program using Math instruction (Addition).

EQUIPMENTS REQUIRED:

- PLC software
- Desktop Computer

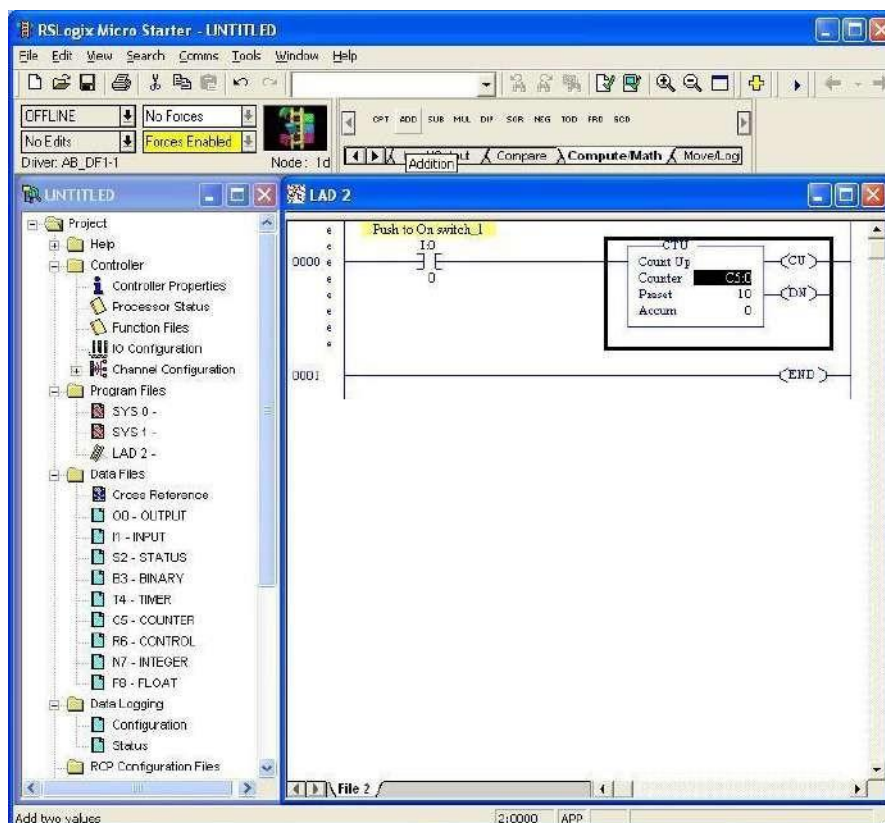
THEORY:

Use the ADD instruction to add one value to another value (Source A to Source B) and place the SUM in destination.

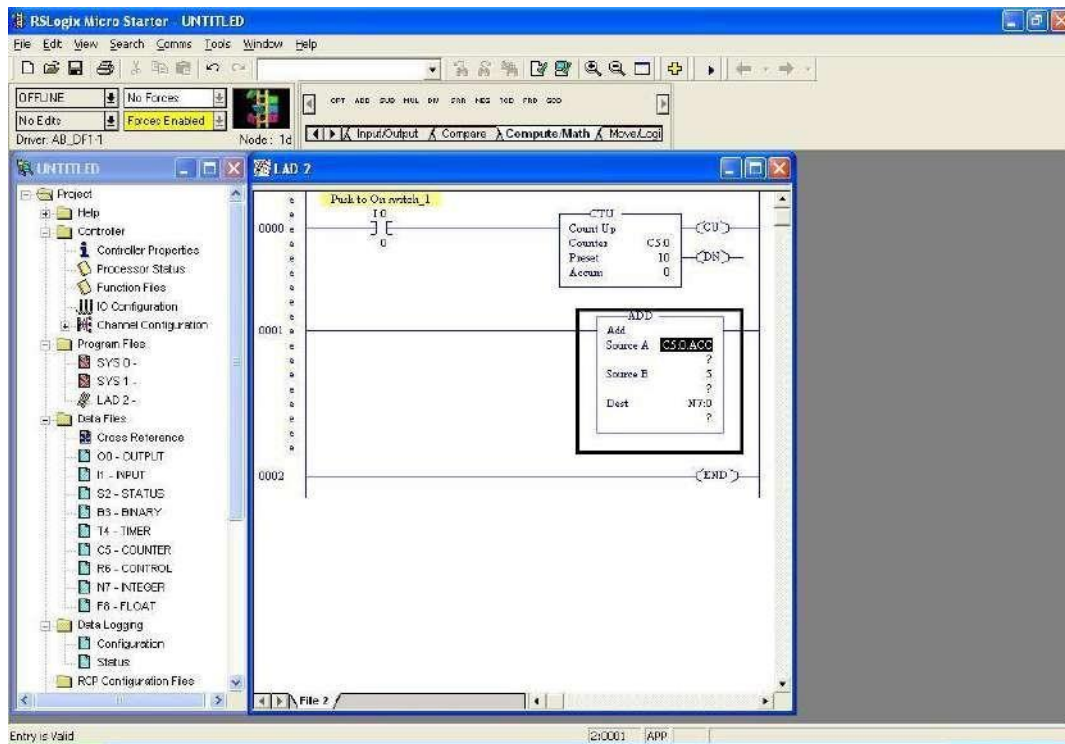


PROCEDURE AND LADDER LOGIC PROGRAM:

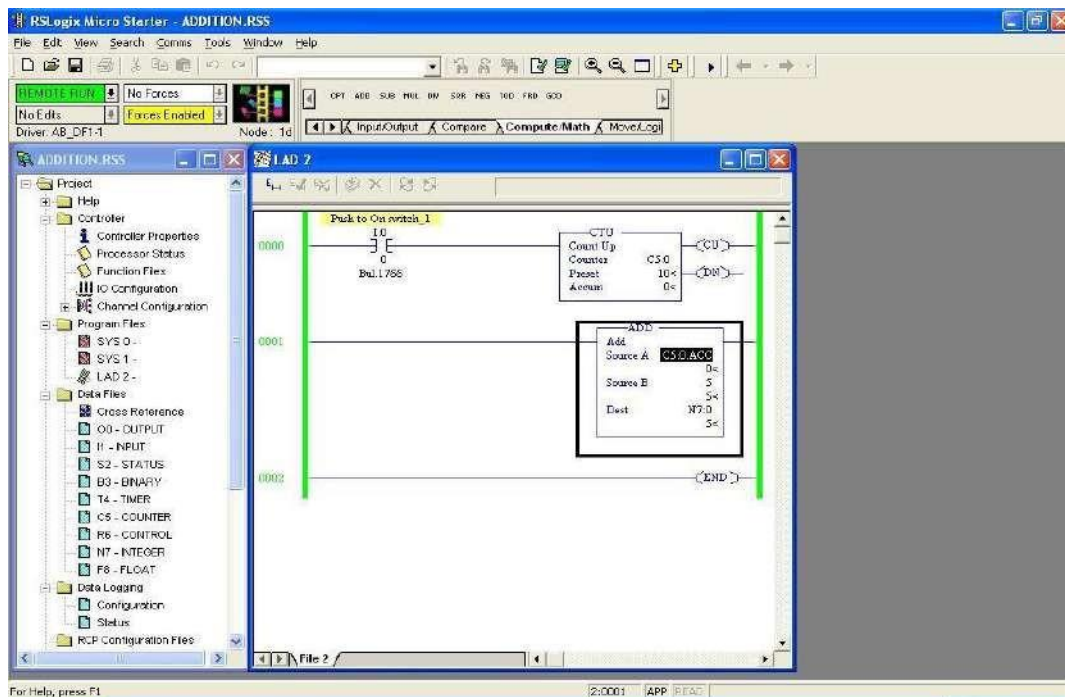
- Take one Examine if closed bit and assign it I: 0/0 (Pushbutton Switch_1) and Take one up counter and assign it Counter to C5:0 and Preset to 10 and Accumto0 is shown below.



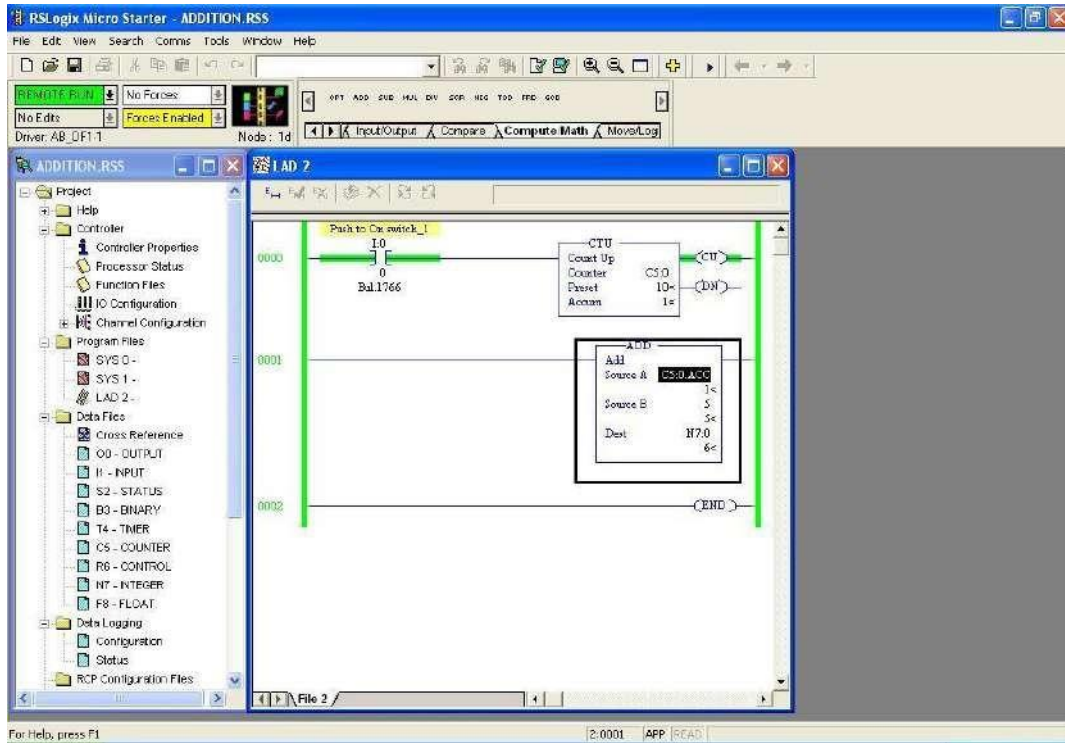
- Take Addition instruction from Compute Math (in instruction Bar) and assign it Source A to C5:0.ACC and Source B to 5 and Destination to N7:0 is shown below.



- Compile and Download and Run the Program.



- When you press I:0/0 (Push button Switch_1) counter C5:0 start counting and add it on is shown in N7:0. Use of Addition Instruction



CONCLUSION:

Thus, the ADDITION operation was performed and verified successfully using PLC software.

DATA MANIPULATION

AIM OF THE EXPERIMENT:

Write a simple ladder logic program using data manipulation technique (Bit shift left).

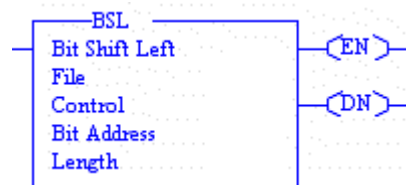
EQUIPMENTS REQUIRED:

- PLC software
- Desktop Computer

THEORY:

Bit shift instruction is used to shift the bit in any direction as user wants such as Bit Shift Left (BSL), Bit Shift Right (BSR).

Bit shift left (BSL): When the rung goes from false to true, the controller set the enable bits (Enable Bit 15) and the data block is shifted to the left one-bit position. The specified bit at the bit address is shifted into the first bit position. The last bit is shifted out of array and stored in unloaded bit. The shift is completed immediately.



The following general information applies to bit shift instruction

Entering parameter:

Enter the following parameter when programming these instruction

File is the address of the bit array you want to manipulate. You must use the file indicator (#) in the bit array address.

- Control is the address of control element that store the status byte of instruction, the size of array (in number of bits).

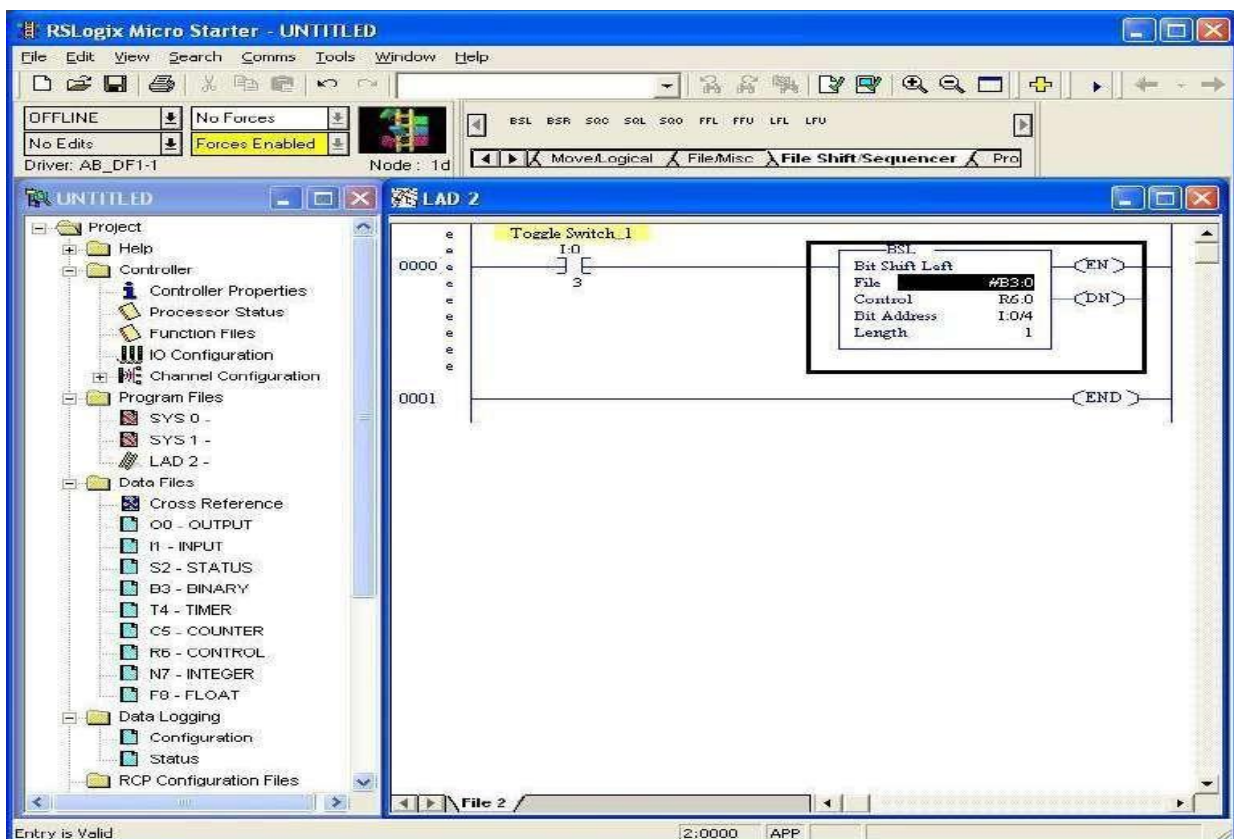
The control element is shown in below

	15	13	11	10	00
Word 0	EN	DN	ER	UL	Not used
Word 1	Size of bit array (number of bits)				
Word 2	Reserved				

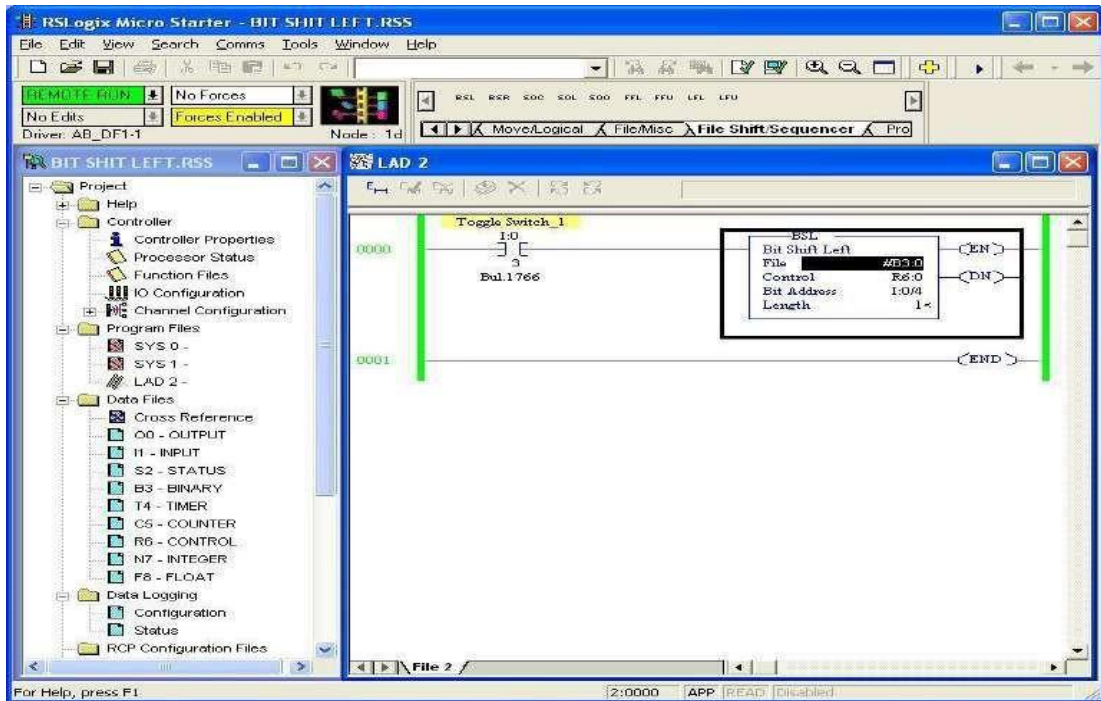
- Status bits of control element may be addressed by mnemonics.
- They included Unloaded bit UL (Bit 10) is the instructions output.
- Error bit ER (Bit11) when set, indicates the instruction detected an error such entering a negative number for length or position.
- Done Bit DN (Bit 13) when set indicate the bit array shifted one position.
- Enable bit EN (Bit 15) is set on a false to true transition of the rung and indicate the instruction is enabled.
- Bit address is the address of the source bit. The status of this bit is inserted in either the first (lowest) bit position (BSL) or last (highest)bit position (BSR).
- Length (size of bit array) is the number of bits in bit array up to 1680 bits.

PROCEDURE AND LADDER LOGIC PROGRAM:

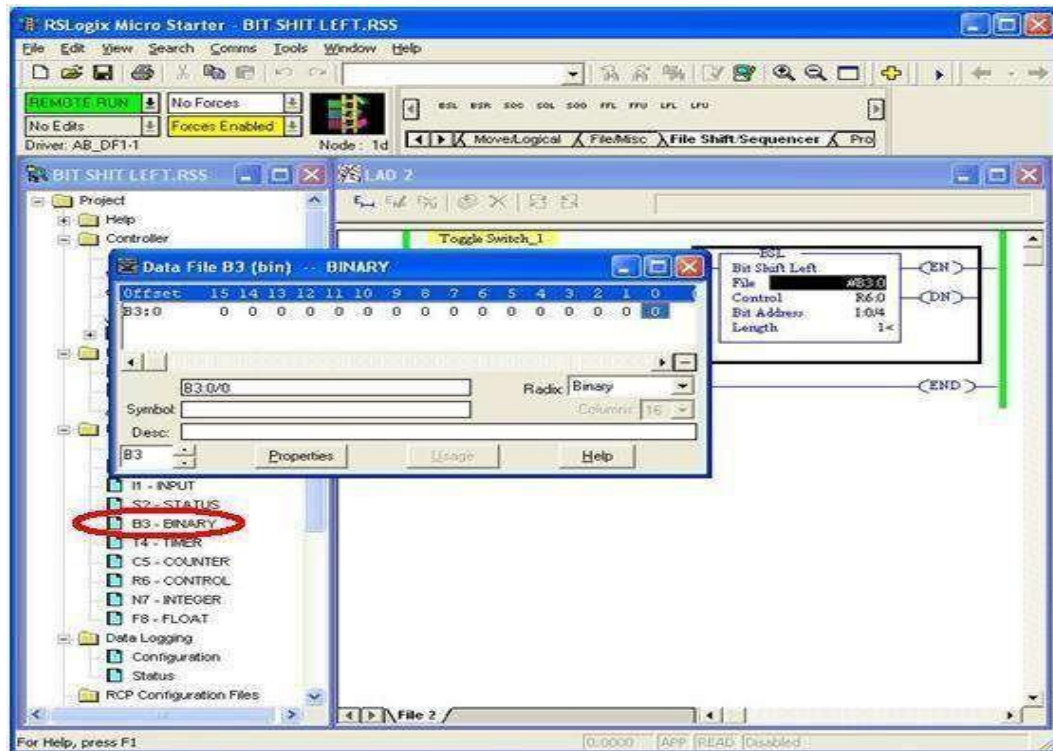
- Take No bit assigns I:0/3 (Toggle Switch_1) and select a File shift / sequencer instruction in Tool bar then take a BSL (Bit Shift Instruction) and assign it File to #B3:0 and Control to R6:0 and File Address I:0/4 and Length 1 is shown below.



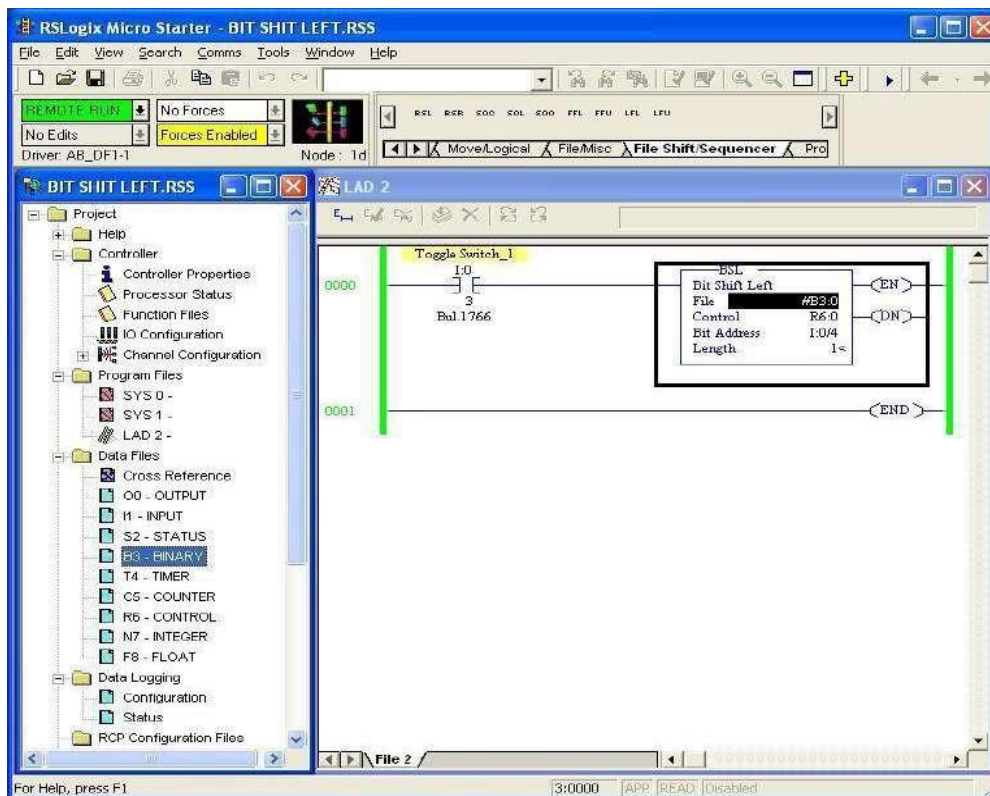
- Compile and download and run the program.



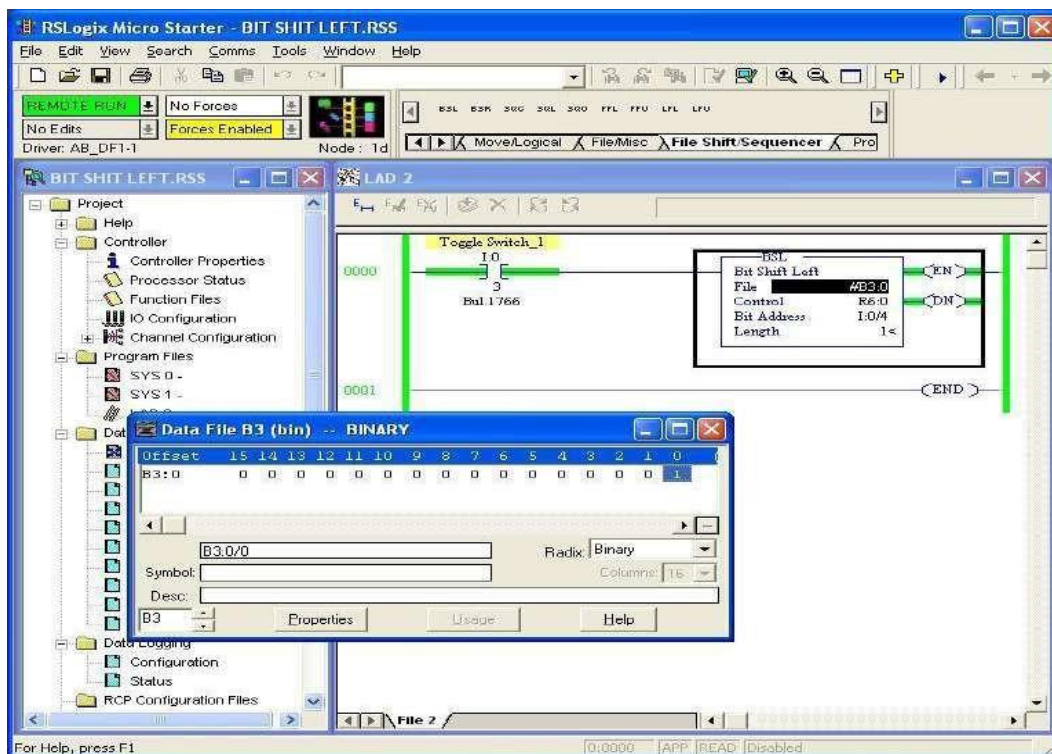
- Click on B3:0 Binary Option is shown below. After click on B3:0 Binary this window will open.



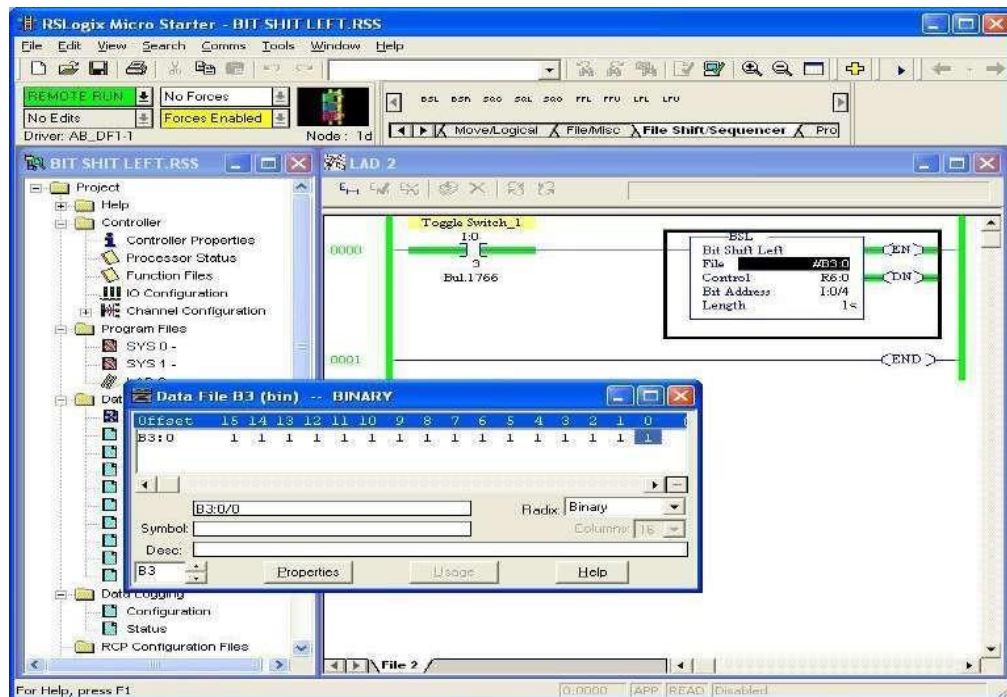
- You enable the I:0/4 (ToggleSwitch_2) is shown below.



- When you enable the Toggle switch, B3:0 bit position is shown below.



- When you Enable the I:0/5 many times, B3:0 Bit position Shift Left is shown below.
- When You Enable and Disable the I:0/3 (Toggle Switch_1) bit will be shift left.



CONCLUSION:

Thus, the data manipulation operation was performed and verified successfully using PLC software.

CONVEYOR CONTROL SYSTEM

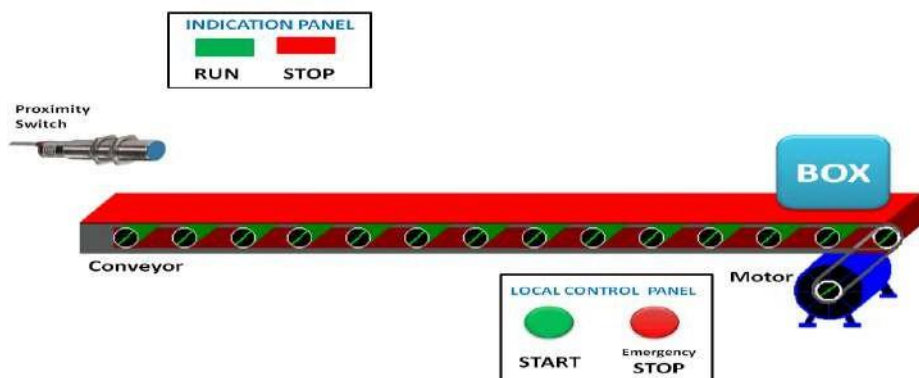
AIM OF THE EXPERIMENT:

To study about conveyor control system using PLC

APPARATUS REQUIRED:

Sl. no.	Apparatus Name
1.	VPAT-24 kit
2.	VPLCT-03 kit
3.	PLC software installed PC
4.	STEPPER MOTOR
5.	Patch chords
6.	Power chord

THEORY:



Conveyor System:

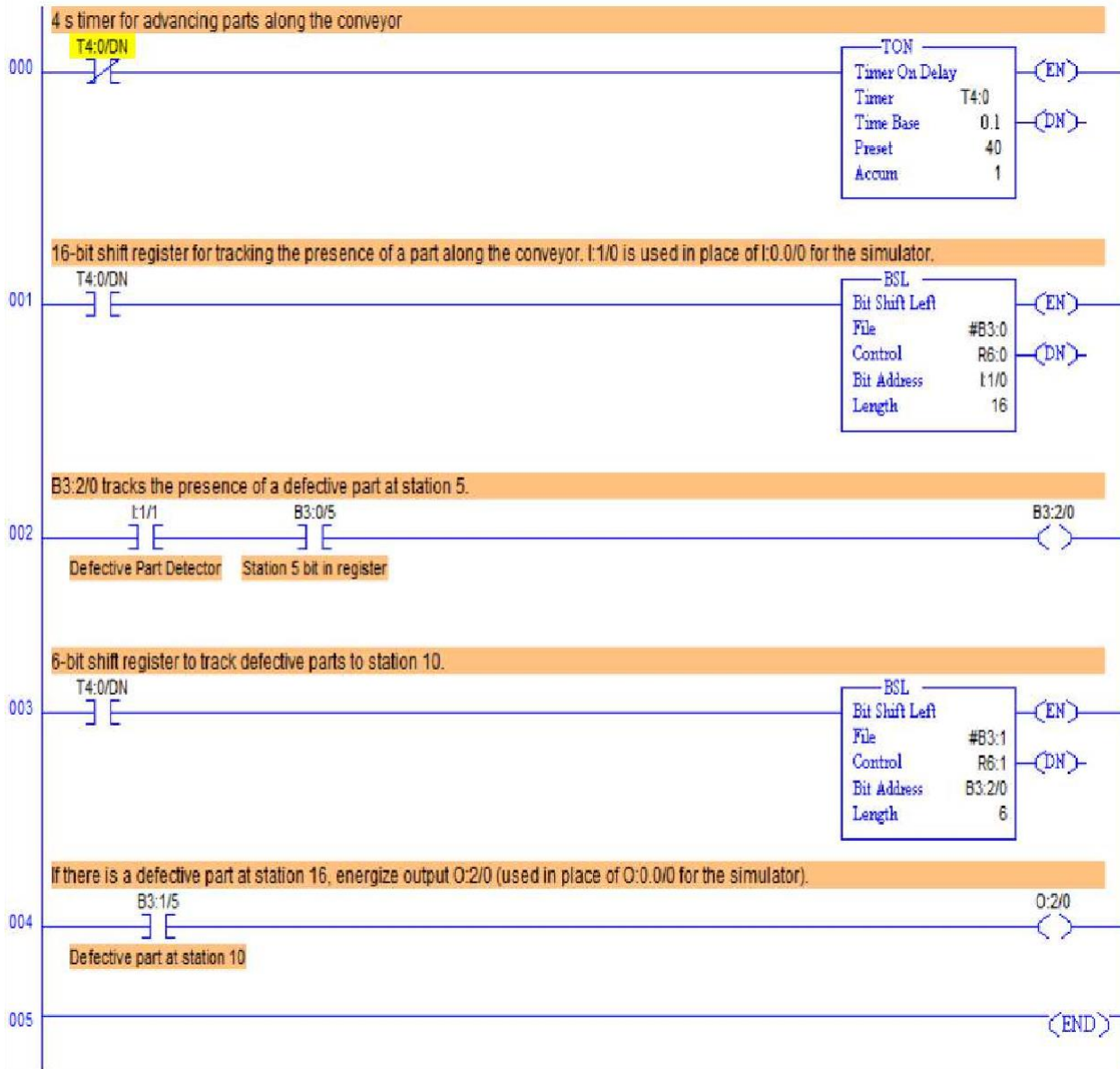
- ✓ A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another.
- ✓ Conveyors are especially useful in applications involving the transportation of heavy or bulky materials.
- ✓ Conveyor system allows quick and efficient transportation for a wide variety of materials, which makes them very popular in the material handling and packaging industries.

Stages in the System:

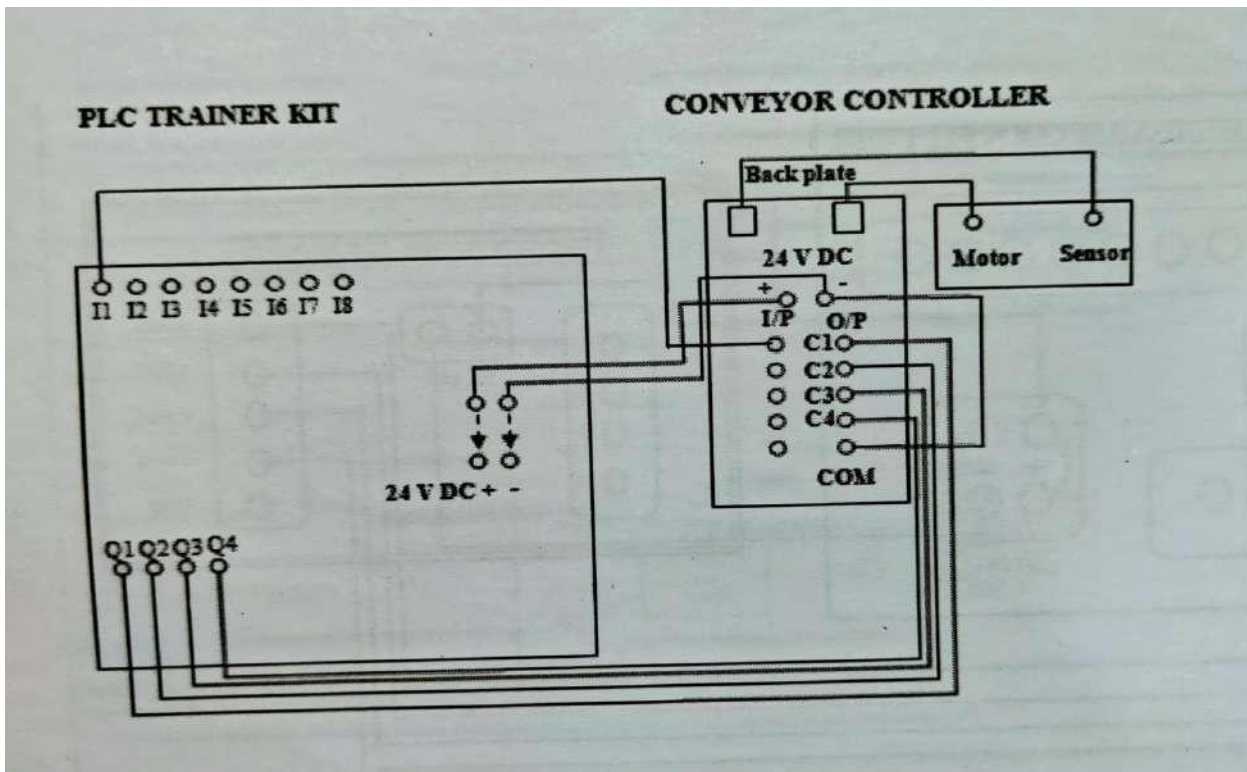
1. **Comparator:** - Two inputs (Threshold & Feedback); compares the output of detecting network and a preset.
2. **Converter/Switching circuit:** - Controller; takes decision based on the comparator output.

3. **Stepper Motor:** - A stepper motor is a brushless, synchronous electric motor that converts digital pulses into mechanical movement.
4. **Conveyor belt:** - Object translational mechanism.
5. **Object presence detector:** - To give feedback based on presence of object at the end position.

LADDER LOGIC: -



WIRING DIAGRAM:



PROCEDURE:

1. Open the PLC Software and design the ladder diagram.
2. Interface the PLC with the system using Ethernet cable.
3. Make electrical connections as per wiring diagram.
4. Download the program and run it.
5. Place the object on the conveyor. If the sensor the object, conveyor stops for 2 seconds and again starts automatically.

CONCLUSION:

Thus, the study of conveyor control system had been studied.

ON-OFF THE DC MOTOR

AIM OF THE EXPERIMENT:

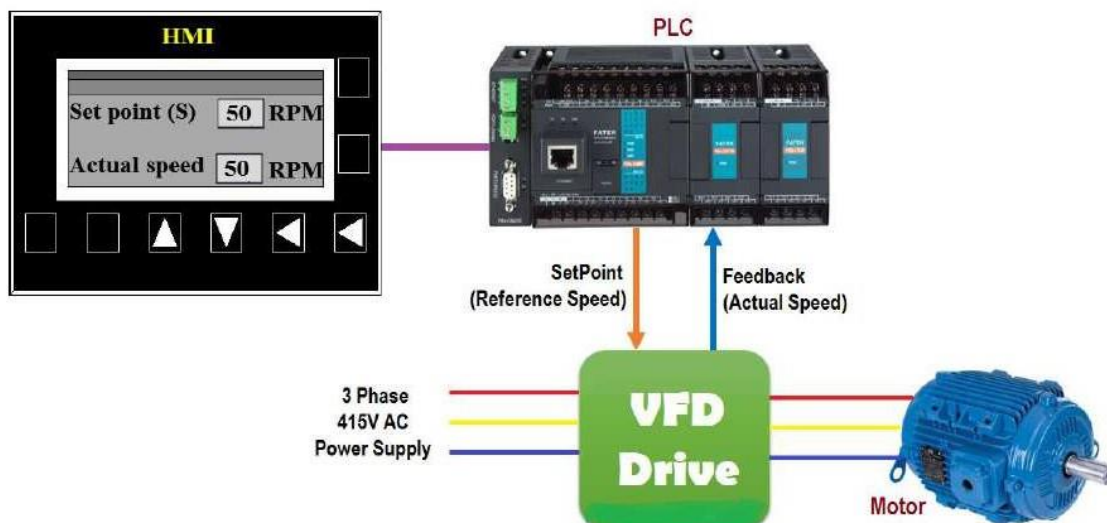
Write and implement ladder logic program to on-off the DC motor using PLC.

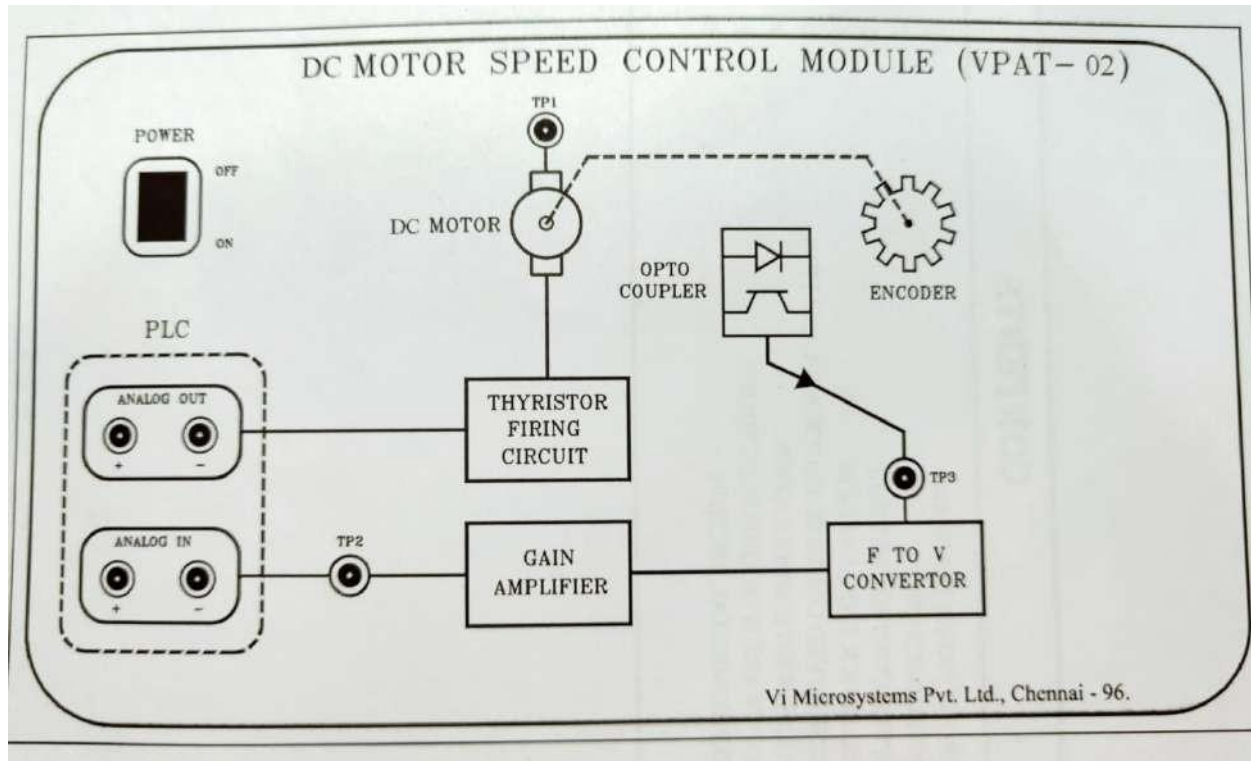
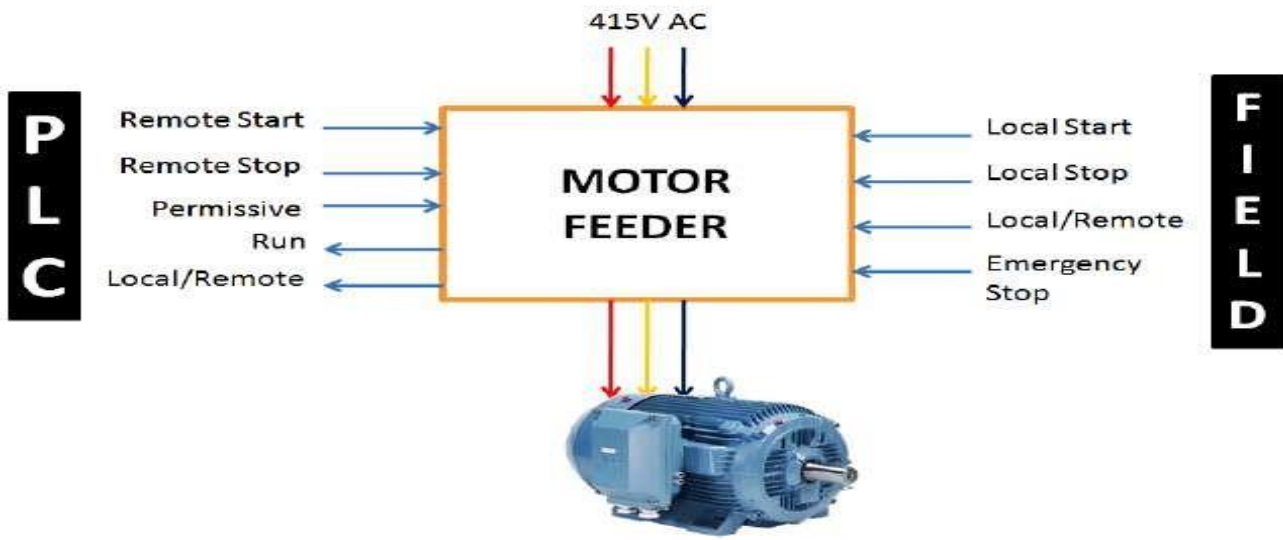
APPARATUS REQUIRED:

Sl. no.	Apparatus Name
1.	Speed control module trainer (VPAT-02)
2.	PLC trainer kit
3.	Personal computer installed with TIA portal software
4.	DC Motor
5.	Patch chords

THEORY:

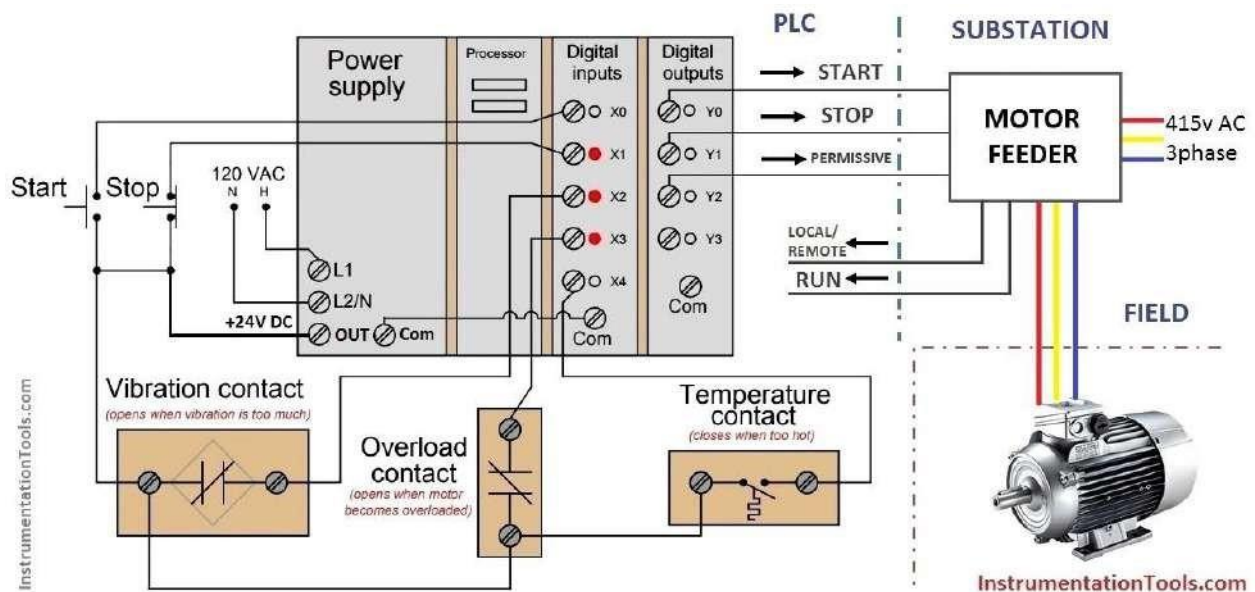
PLC Program to Control Motor Speed using VFD Drive





Speed Control Module:

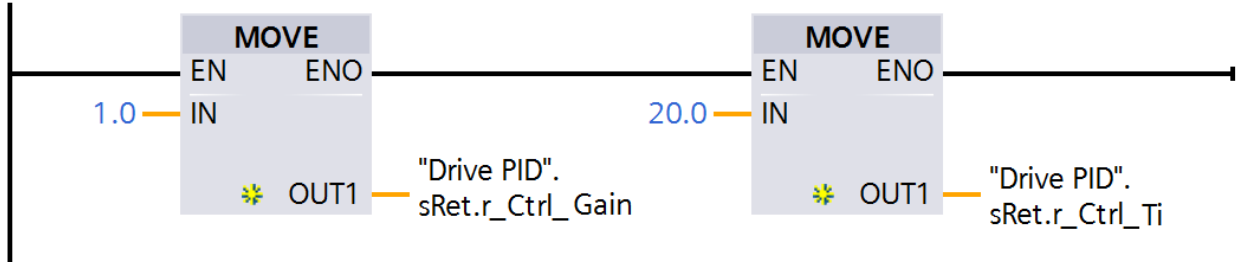
- This module maintains the speed of DC motor to the set point using PLC.
- After giving the set point (SP) the PLC produces the analog output, this will be given to motor.
- So initially the motor starts rotating at some speed.
- The speed of the motor is measured using Optocoupler sensor.
- The output of Optocoupler will be a series of pulses are converted into voltage using frequency to voltage converter.
- This voltage is process variable (PV) and is applied to the analog input of PLC.
- In PLC program PID block reads this PV and compares the both set point (SP) and process variable (PV), it creates error value and produces the control variable (CV) to the motor unit through analog output.
- This controlled output will maintain the speed of AC motor at its set point (SP).
- Likewise, it forms the closed loop control using PLC.



PLC Ladder diagram to control Motor Speed

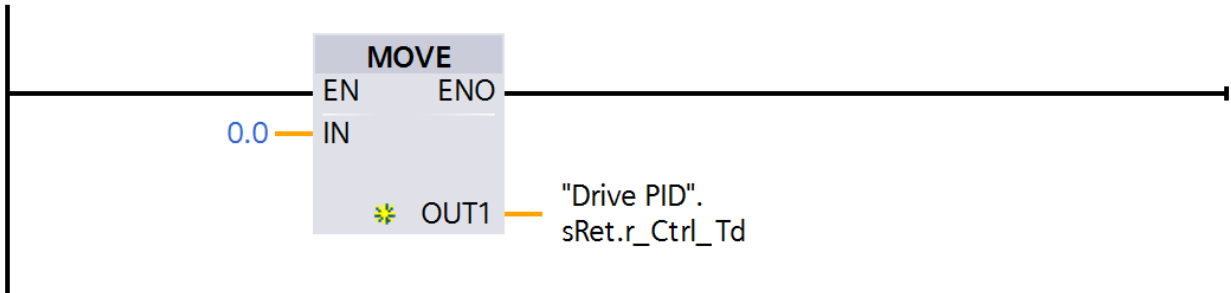
Network 1 : Integral Action Time (Ti), Proportional Gain

InstrumentationTools.com



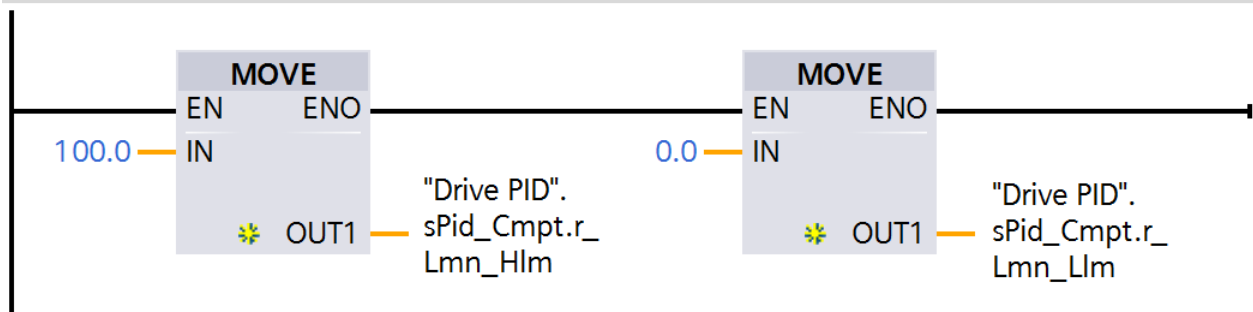
Network 2 : Derivative Action Time (Td)

InstrumentationTools.com



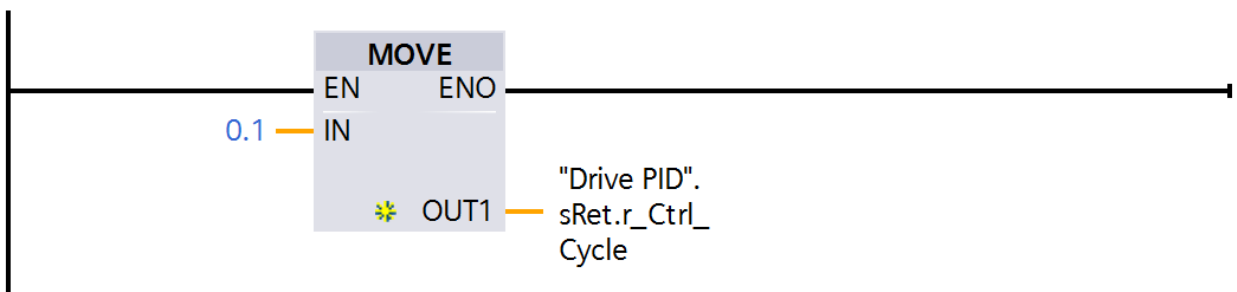
Network 3 : Max and Min Output Limit

InstrumentationTools.com



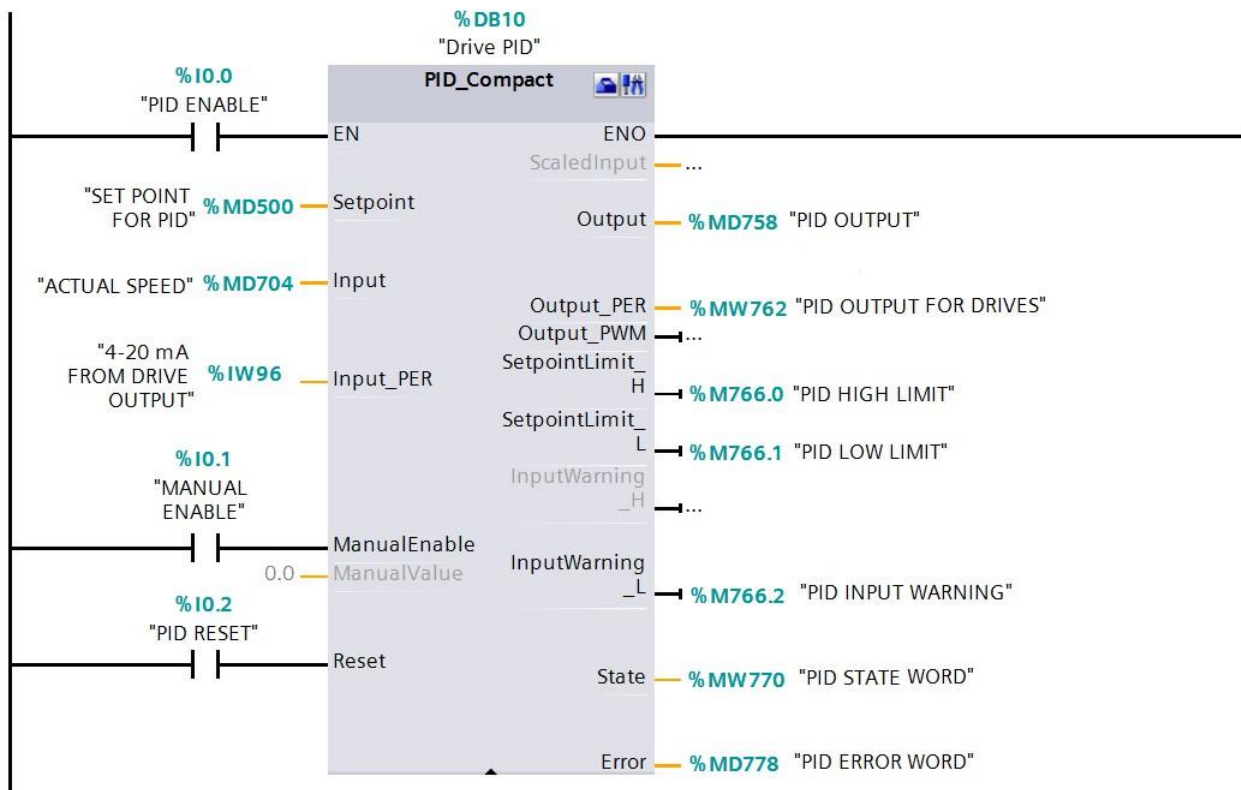
Network 4 : PID Sampling Time

InstrumentationTools.com



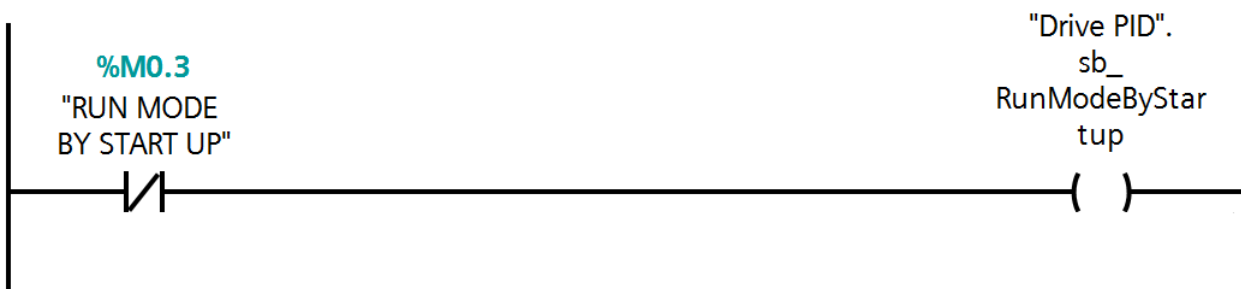
Network 5 : PID Block (Linear PID for Drives Output

InstrumentationTools.com



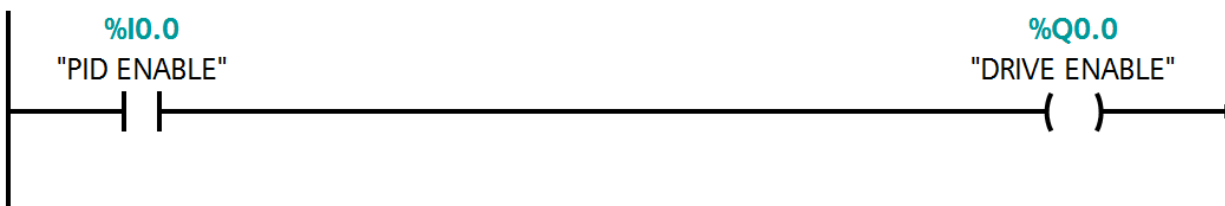
Network 6 : Enable Running Last State Re-Start or Start-up

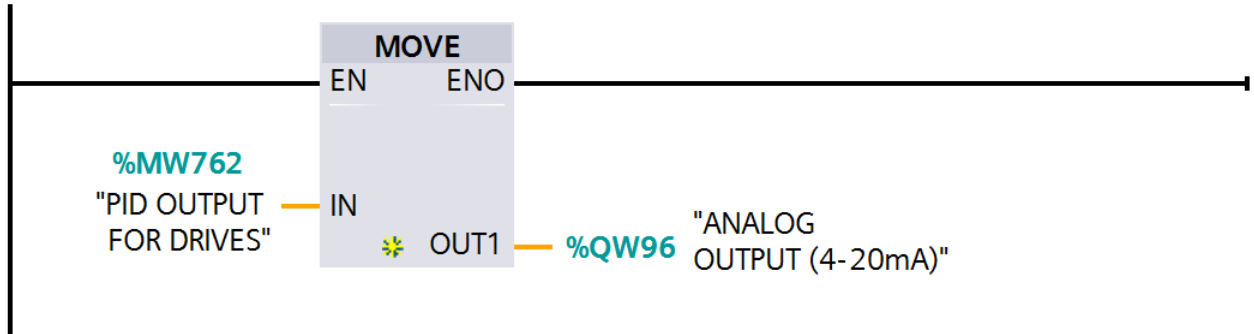
InstrumentationTools.com



Network 7 : PID Output for VFD Drive

InstrumentationTools.com

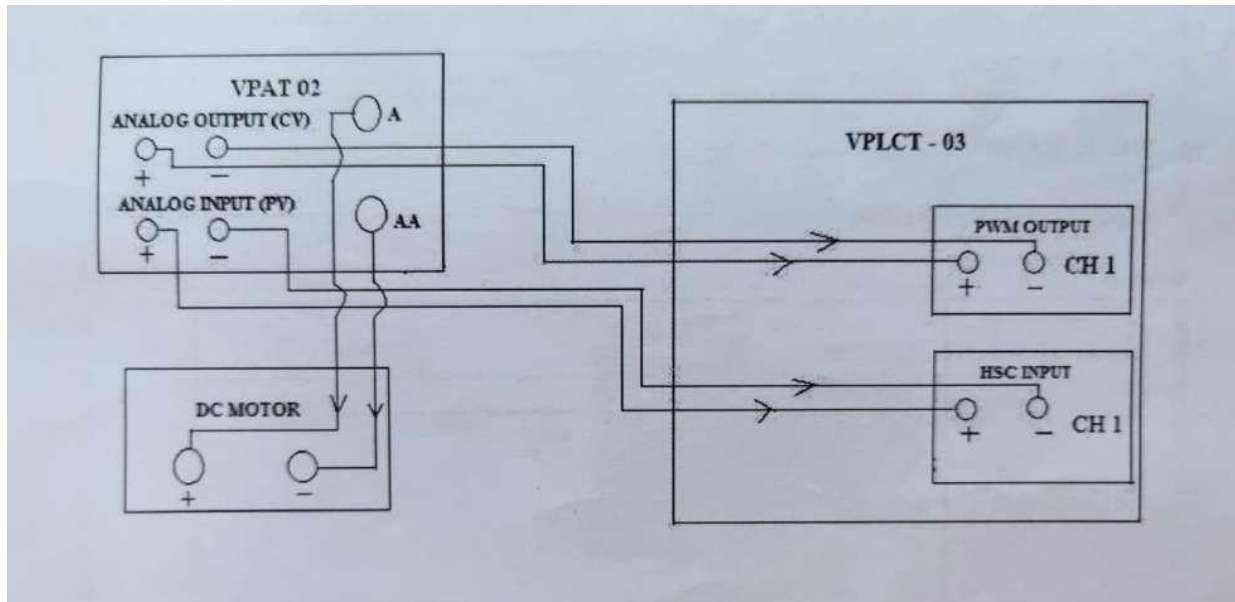




Runtime Test Cases: -

Inputs	Outputs	Physical Elements
I0.0=1	Q0.0=1	Drive ON
MD500=50RPM	MW762=13838 (approx.)	Drive speed =50RPM

WIRING DIAGRAM:



PROCEDURE:

1. Made the connections based on wiring diagram.
2. Switch ON the PLC kit.
3. Interface the PC to PLC through Ethernet Communication Cable.
4. For configuration of software, programming follows the procedure.
5. Switch ON the DC MOTOR SPEED CONTROL kit.
6. Download and run the program to PLC.
7. Set the set point of motor speed (0-1500 rpm) i.e. 0.0 to 100.0 in PID set point block.
8. Based on set point the PID controller enables the PWM output pulses.
9. By this pulse the DC Motor starts rotating at some speed.
10. Opto coupler sensor senses the feedback of high speed ON pulses.
11. That feedback we can read from High speed counter input channel.
12. Now the PID controller compares the set point (SP) and Process (PV) (SPEED).
13. By varying the Control Output (CV) (PWM pulse) it makes the motor running at set speed.

RESULT:

Thus, the ON-OFF operation of DC motor using PLC was studied successfully.

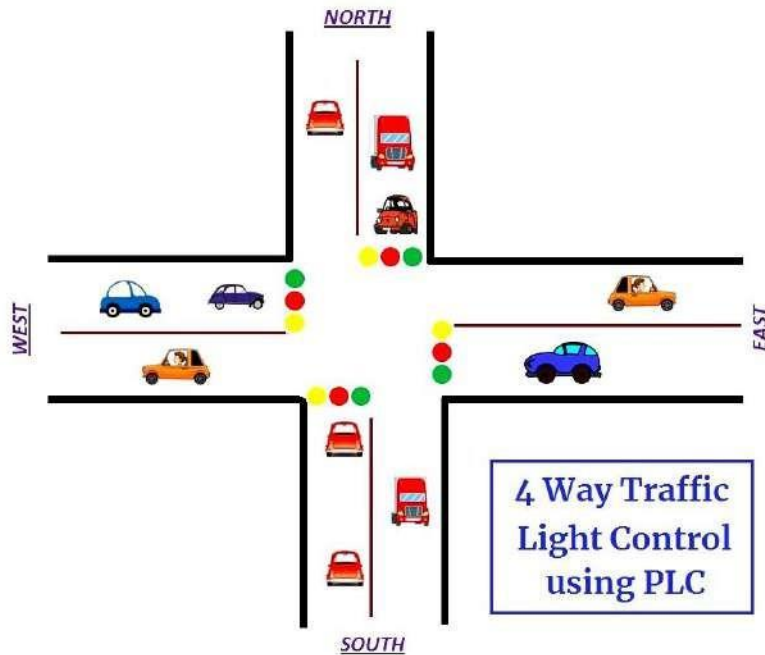
TRAFFIC LIGHT CONTROLLER

AIM OF THE EXPERIMENT:

To study the Traffic light controller system by using PLC.

APPARATUS REQUIRED:

Sl. no.	Apparatus Name
1.	VPAT-03 kit
2.	PLC
3.	PLC software installed PC
4.	ETHERNET cable
5.	Patch chords
6.	Power chord



THEORY:

Density Based Traffic Light Controller System:

- Traffic control system is used to control automatically the vehicle and human beings by using simple program logic.
- Microcontroller system is very complex to programming and wiring. Hence PLC is used to control the traffic.

- For the complex road maps the PLC provides simpler solution by means of ladder programs.
- It is four directions-based traffic light controller system, which is depends upon the density of vehicle.
- If an one direction's density of vehicle is HIGH, but another one direction's density of vehicle is very LOW, then we will give more time duration to high density direction half of time duration to middle density direction, the one third (1/3) of time duration to very low density direction as respective as our decision.
- If one direction is in glow green LED [Run-mode], other directions are in red- LED [Stop-mode].

14. List of Inputs and Outputs:

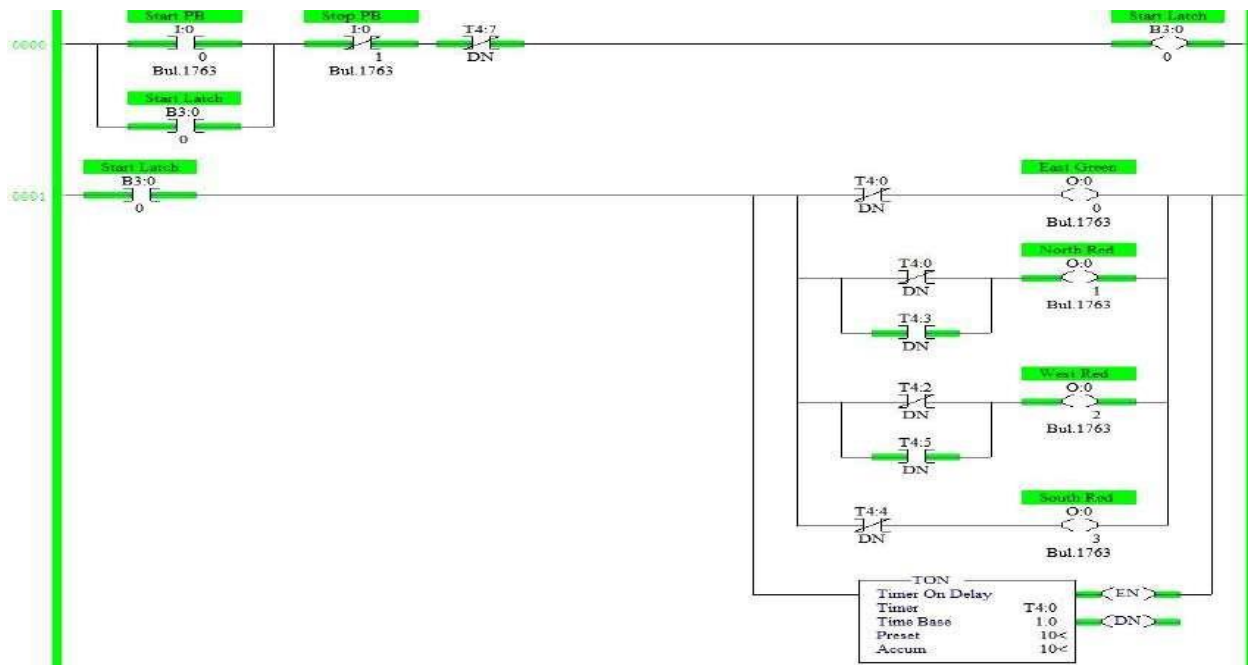
Sl. no	Address	Name	Input/ Output
1	I:0/0	Start	Input
2	I:0/1	Stop	Input
3	B3.0	Memory	Memory
4	O:0/0	East Green	Output
5	O:0/1	North Red	Output
6	O:0/2	West Red	Output
7	O:0/3	South Yellow	Output
8	O:0/4	East Yellow	Output
9	O:0/5	North Yellow	Output
10	O:0/6	North Green	Output
11	O:0/7	East Red	Output
12	O:0/8	West Yellow	Output
13	O:0/9	West Green	Output
14	O:0/10	South Yellow	Output
15	O:0/11	South Green	Output

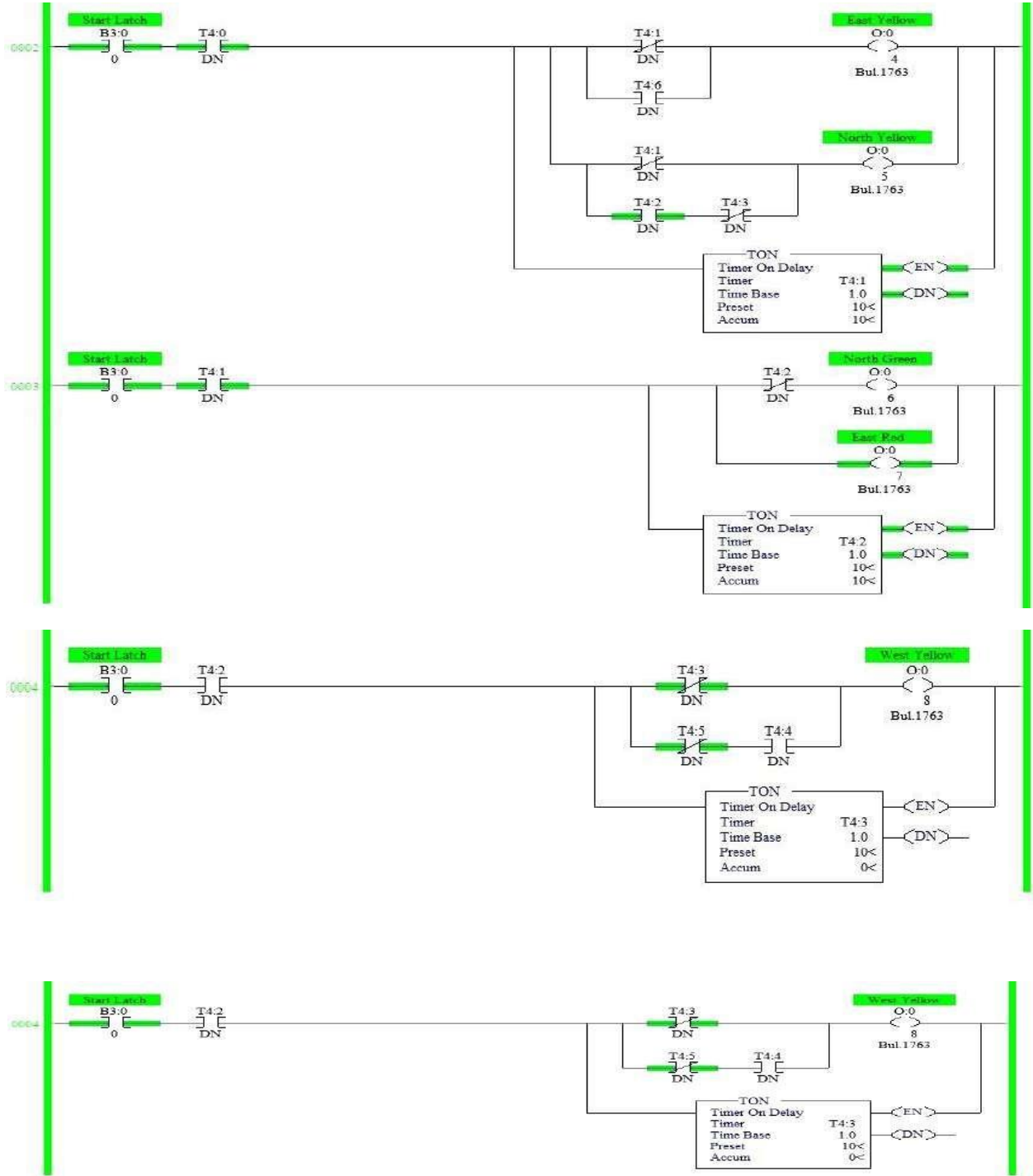
Sequence of Operation

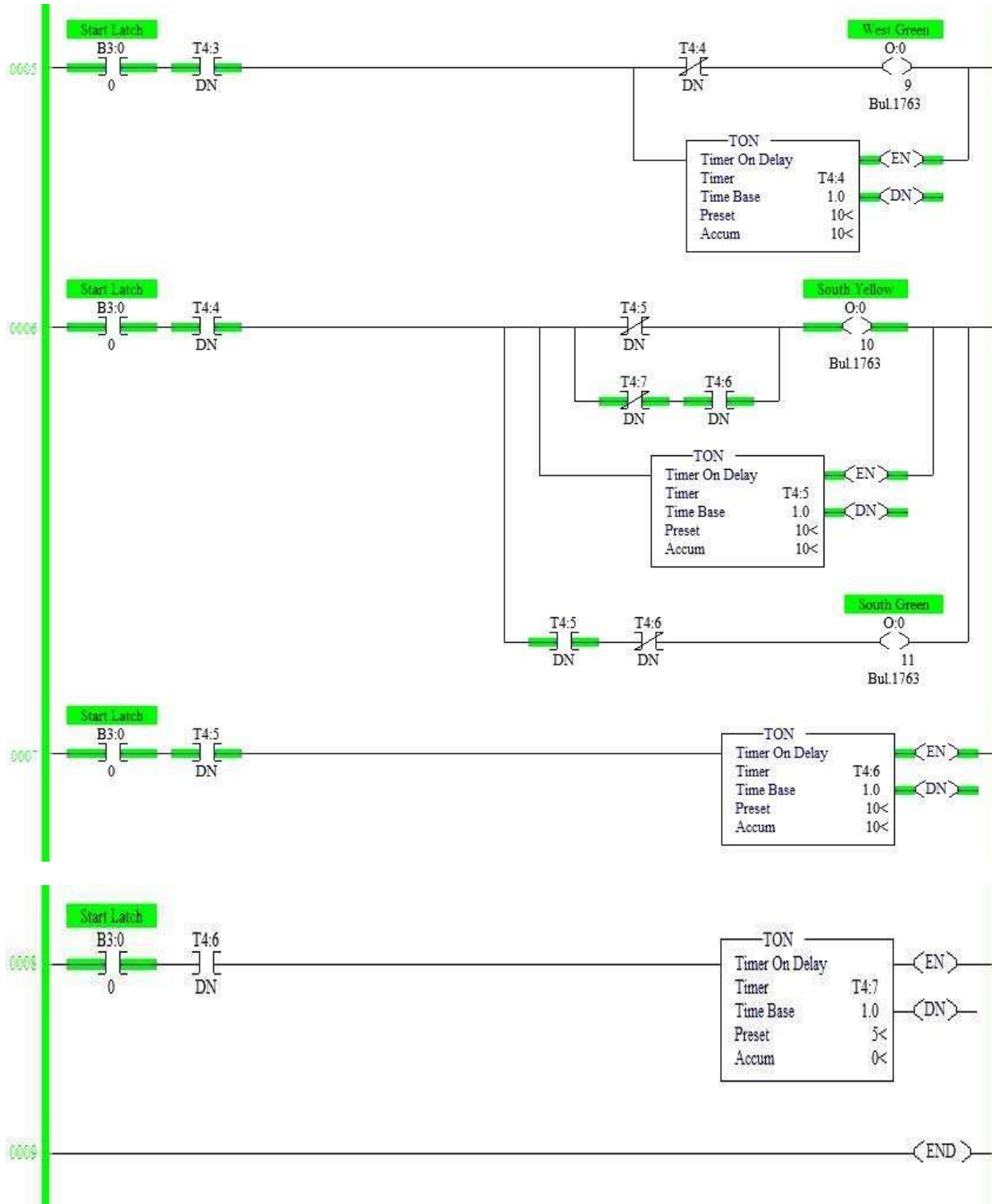
Below tabular column gives the Steps or sequence of outputs to turn ON the traffic system lamps (RED, GREEN, YELLOW)

S.NO	EAST	WEST	NORTH	SOUTH
1	G	R	R	R
2	Y	R	Y	R
3	R	R	G	R
4	R	Y	Y	R
5	R	G	R	R
6	R	Y	R	Y
7	R	R	R	G
8	Y	R	R	Y

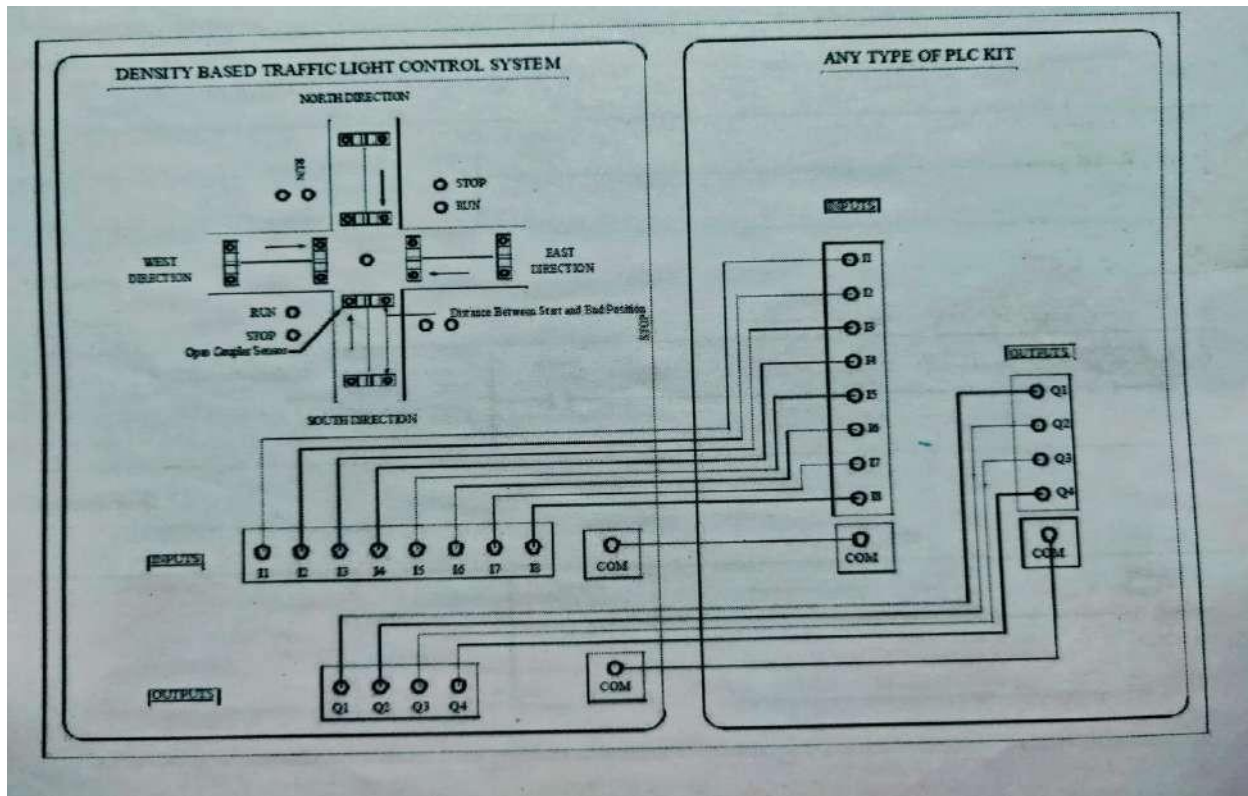
LADDER LOGIC PROGRAM: -







WIRING DIAGRAM:



PROCEDURE:

1. By applying start one triggering pulse to input I1.0(I9), which causes for open coil M0.0 energized in Network 1, Due to energization of open coil M0.0 initiates the operation.
2. It causes the open coil Q0.0 [Q1 coil] energized in Network 5 on delay timer is also energized. After completing the time delay [5sec], which is depending upon preset Time coil M0.0 will be energized. Due to energization of M0.1 it cuts the Q0.0 coil output and enables the Q0.1 west Direction output.
3. Due to Q0.1 (Q2 coil) will energized in Network 7, then Q1 coil Q0.0 de-energized and timer is reset in Network 8. This same process was repeated again in west direction, North Direction, and East direction.

4. In west direction, that means Network 8 ON delay timer will be energized depends upon Q2coil [Q0.1] then M0.2 [open coil] is energized, after completed programmed time delay, which is depends upon preset time, then rest the timer. At that time, Q2 coil [Q0.1] de-energized, timer was reset, Q3 coil [Q0.2] was energized.
5. In network I0, latch connection Q3 coil [Q0.2] is used to energized for continuously. Hence on delay timer are starts ON due to Q3 contact [Q0.2] energization in run- 8, then M0.3 [Q0.2] will energize. After completion of time delay, which is depends upon preset time, then reset the timer. Then Q4 coil [Q0.3] energized and Q3 coil [Q0.2] are de-energized at that same time.
6. In Network I3 ON delay timer is starts ON, due to contact [Q0.3] energization, then M0.4 coil will be energized, after completion of time delay, rest the timer this time delay depends upon the [M0.4] preset time.

CONCLUSION:

Thus, the study of traffic control system was done by using PLC.