Lab 5: Cascading Sequence

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Humber Polytechnics

Programmable Logic Controllers: MENG 3500 0NB

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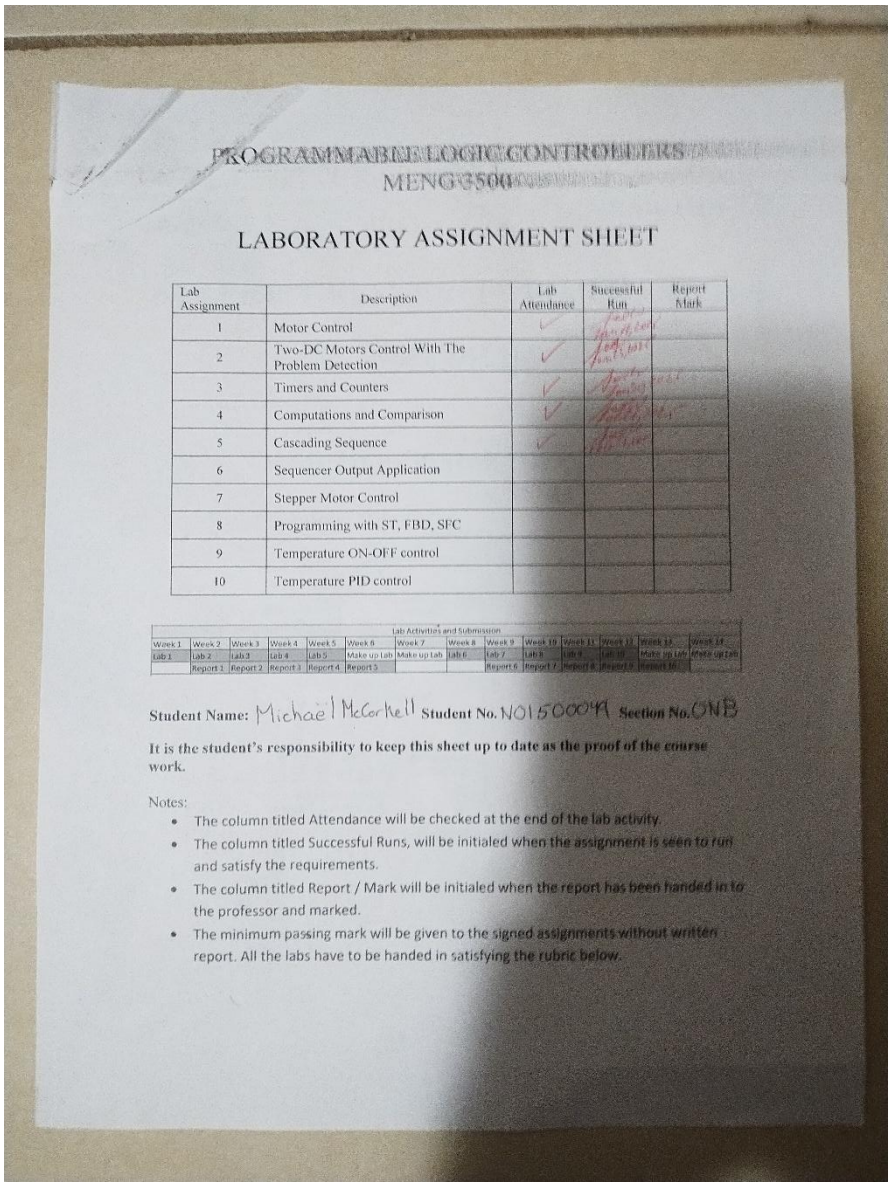

PROGRAMMABLE LOGIC CONTROLLERS
MENG 3500

LABORATORY ASSIGNMENT SHEET

Lab Assignment	Description	Lab Attendance	Successful Run	Report Mark
1	Motor Control	✓		
2	Two-DC Motors Control With The Problem Detection	✓		
3	Timers and Counters	✓		
4	Computations and Comparison	✓		
5	Cascading Sequence	✓		
6	Sequencer Output Application			
7	Stepper Motor Control			
8	Programming with ST, FBD, SFC			
9	Temperature ON-OFF control			
10	Temperature PID control			

Lab Activities and Submission													
Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Make up Lab	Make up Lab	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10	Make up Lab	Make up Lab
	Report 1	Report 2	Report 3	Report 4	Report 5			Report 6	Report 7	Report 8	Report 9	Report 10	

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It is the student's responsibility to keep this sheet up to date as the proof of the course work.

Notes:

- The column titled Attendance will be checked at the end of the lab activity.
- The column titled Successful Runs, will be initialed when the assignment is seen to run and satisfy the requirements.
- The column titled Report / Mark will be initialed when the report has been handed in to the professor and marked.
- The minimum passing mark will be given to the signed assignments without written report. All the labs have to be handed in satisfying the rubric below.

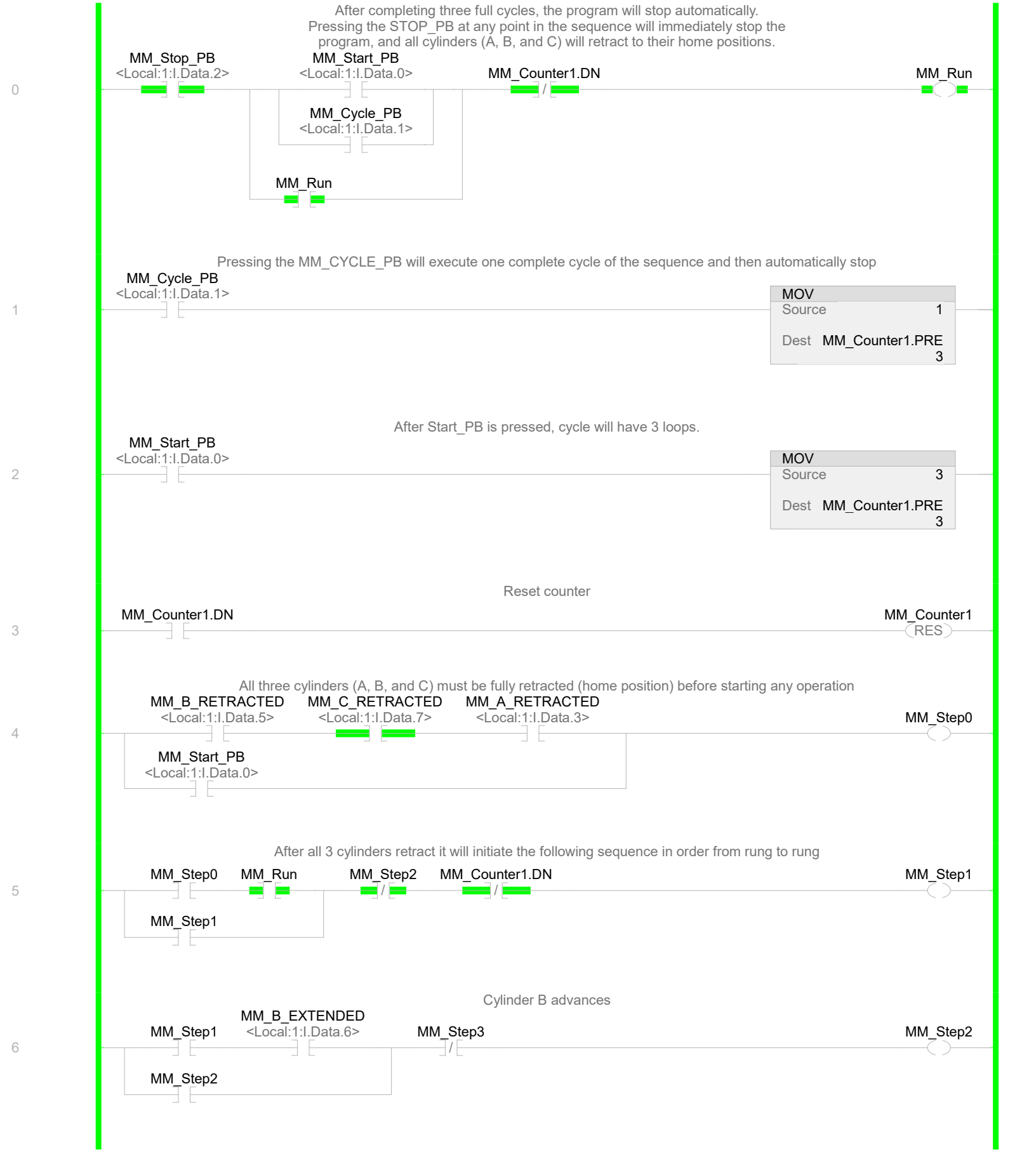
Objectives

This lab focused on implementing a **Cascading Sequence Technique** to control three pneumatic cylinders (A, B, and C) in a predefined order. The key objectives were:

1. Establishing stable communication between the **PLC and the computer**.
2. Implementing **Cascading Sequence logic** for sequential cylinder operation.
3. Developing a **Start-Stop mechanism** to control the process.
4. Enabling a **Cycle Counter** to track and limit the number of completed sequences.
5. Ensuring that all cylinders return to their **home positions** when stopped.
6. Testing the **CYCLE_PB** functionality to allow single-cycle execution.
7. Running the program and troubleshooting any errors in sequencing or logic.

Description of Work Completed

- **PLC Communication Setup:** Communication between the PLC and the computer was configured and tested.
- **Control Logic Development:**
    - **Start Cycle (START_PB):** Initiates a **fixed sequence** of cylinder movements:
        1. **Cylinder B advances**
        2. **Cylinder A advances**
        3. **Cylinder B retracts**
        4. **Cylinder C advances**
        5. **Cylinder C retracts**
        6. **Cylinder A retracts**
    - **Stop Function (STOP_PB):**
        - Pressing the STOP button at any time **immediately stops the sequence**.
        - All three cylinders **retract to their home positions**.
    - **Single Cycle Mode (CYCLE_PB):**
        - Pressing the **CYCLE_PB** executes **one full cycle** and then stops automatically.
    - **Cycle Counting and Limitation:**
        - A **counter** tracks completed sequences.
        - The system **automatically stops** after **three full cycles**, and the counter resets.
- **Field Device Wiring & Testing:**
    - The input devices (START_PB, STOP_PB, CYCLE_PB) and output devices (cylinder actuators) were wired per specifications.
    - The program was downloaded, executed, and monitored for **correct sequencing and stopping behavior**.
- **Troubleshooting & Debugging:**
    - Live monitoring of cylinder positions ensured proper **step-by-step operation**.
    - The **STOP function was tested** at different points to confirm that all cylinders retracted immediately.
    - The **CYCLE_PB** was tested to verify **single-cycle execution**.
    - Errors such as **misalignment of sequence timing or incorrect retraction behavior** were identified and corrected.


After completing three full cycles, the program will stop automatically.
Pressing the STOP_PB at any point in the sequence will immediately stop the
program, and all cylinders (A, B, and C) will retract to their home positions.
MM_Stop_PB
<Local:1:I.Data.2>
MM_Start_PB
<Local:1:I.Data.0>
MM_Counter1.DN
MM_Run
MM_Cycle_PB
<Local:1:I.Data.1>
MM_Run
0
Pressing the MM_CYCLE_PB will execute one complete cycle of the sequence and then automatically stop
MM_Cycle_PB
<Local:1:I.Data.1>
MOV
Source 1
Dest MM_Counter1.PRE
3
1
After Start_PB is pressed, cycle will have 3 loops.
MM_Start_PB
<Local:1:I.Data.0>
MOV
Source 3
Dest MM_Counter1.PRE
3
2
Reset counter
MM_Counter1.DN
MM_Counter1
RES
3
All three cylinders (A, B, and C) must be fully retracted (home position) before starting any operation
MM_B_RETRACTED
<Local:1:I.Data.5>
MM_C_RETRACTED
<Local:1:I.Data.7>
MM_A_RETRACTED
<Local:1:I.Data.3>
MM_Step0
MM_Start_PB
<Local:1:I.Data.0>
4
After all 3 cylinders retract it will initiate the following sequence in order from rung to rung
MM_Step0
MM_Run
MM_Step2
MM_Counter1.DN
MM_Step1
MM_Step1
5
Cylinder B advances
MM_Step1
MM_B_EXTENDED
<Local:1:I.Data.6>
MM_Step3
MM_Step2
MM_Step2
6

Cylinder A advances

7

MM_Step2 | MM_A_EXTENDED <Local:1:I.Data.4> | MM_Step4 / | MM_Step3
MM_Step3 |

Cylinder B retracts

8

MM_Step3 | MM_B_RETRACTED <Local:1:I.Data.5> | MM_Step5 / | MM_Step4
MM_Step4 |

Cylinder C advances

9

MM_Step4 | MM_C_EXTENDED <Local:1:I.Data.8> | MM_Step6 / | MM_Step5
MM_Step5 |

Cylinder C retracts

10

MM_Step5 | MM_C_RETRACTED <Local:1:I.Data.7> | MM_Step6

Cylinder A retracts, then loops back for counter

11

MM_Run | MM_Step1 | MM_B_Extend <Local:2:O.Data.2>

Rung that operates the MM_A_Extend

12

MM_Step2 | MM_Step6 / | MM_A_Extend <Local:2:O.Data.0>
MM_A_Extend <Local:2:O.Data.0> |

Cylinder B retract

13

MM_Step3 | MM_B_Retract <Local:2:O.Data.1>

Cylinder C Extend

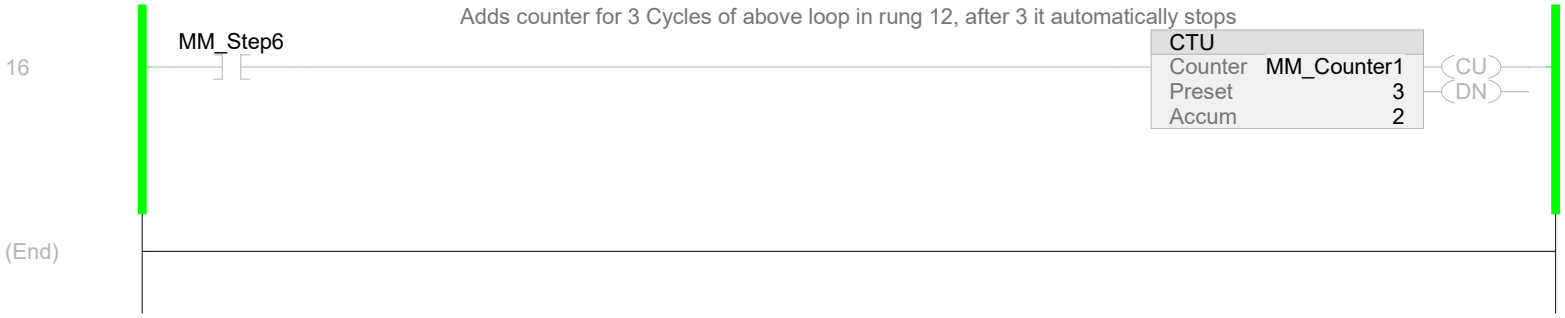
14

MM_Step4 | MM_C_Extend <Local:2:O.Data.4>

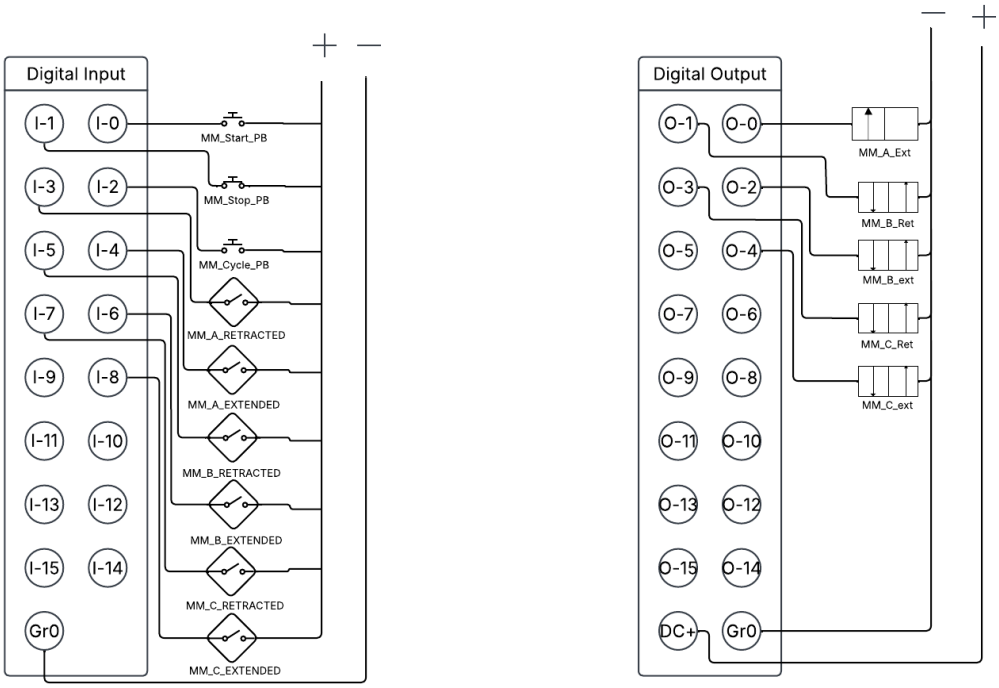
Cylinder C retract

15

MM_Step5 | MM_C_Retract <Local:2:O.Data.3>


Adds counter for 3 Cycles of above loop in rung 12, after 3 it automatically stops
16
MM_Step6
CTU
Counter MM_Counter1
Preset 3
Accum 2
CU
DN
(End)

Wiring Diagram



Conclusions

The lab was successfully completed, demonstrating **accurate sequencing, controlled cycle execution, and proper stop mechanisms**. The use of the **Cascading Sequence Technique** reinforced the principles of **step-based automation, real-time control, and fail-safe operation** in PLC programming. The **cycle counter and immediate stop function** added robustness to the system, making it a reliable model for sequential pneumatic control applications.