5/20/2023

Voltaire Dupo

eLECTRONICS AND cOMMUNICATIONS eNGINEER

Automation System Integration 1

Laboratory Activity Guide

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# Authors Notes:

This Manual is dedicated to my late father Henry C. Dupo who taught me more than what I learned in the three courses in higher education that I finished.

This Manual contains suggested activities that match the required learning applications based on the course syllabus for EMT 213. As such this book uses the materials stored in the tool room at Ferrari A Bldg. Users of the manuals can reappropriate the tasks to match other complements of equipment but I am asking that they continue to use my Authors notes and make the manual publicly available for others to use.

Use this book in conjunction with the Automation System Integration Manual published publicly earlier.

Engr. Voltaire B. Dupo, ECE

Electronics and Communications Engineer / Clinical Technology Officer / Engineering Educator

5/20/2023

# Task 1: Door Entry and Exit

Create a PLC Program that counts how many people entered using a sensor (switch) and how many exited. Assume that there is an entry door and another exit door. Each time they enter or exit they need to press the switch and step on a pressure switch. This releases the both for the exit and entry door for 3 seconds enough time for a person to push the door open.

**Group #:** \_\_\_\_\_\_\_\_\_\_\_\_

**Group Members:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

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**Modbus Slave Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Circuit Diagram:**

**Final PLC Program:**

**HMI Illustration with Modbus Addressing Notes**

Grading

Graphical user interface

Description automatically generated

Individual Performance

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# Task 2: Automated Crop Watering System

Create an automated Watering System that:  
1. Takes its input water from a 1 Gallon Bottle.   
2. Pumps Water Up using a DC Water Pump Motor  
3. Waters every 3 hours for only 1-3 seconds  
4. Counts the number of times watering has occurred  
5. Has an HMI that tells the status of the system (1) Standby (2) Active (3) KO and tells the number of deliveries of water done.

**Group #:** \_\_\_\_\_\_\_\_\_\_\_\_

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**Modbus Slave Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**HMI Illustration with Modbus Addressing Notes**

Grading

Graphical user interface

Description automatically generated

Individual Performance

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# Task 3: Soap and Perfume Dispensing Tool

**Problem:** Automated Dispenser with Reporting

The problems with any type of dispenser are:

1. No prompt for an empty container
2. No Frequency Recording for usage
3. No Security to ensure that the contents are not harvested in mass but used one at a time.

Mechanical Design:

A computer screen shot of a blue and yellow building block

Description automatically generated with low confidence

Create a Dispenser for Restroom that dispenses:

1. Soap when a hand is pressed on C button
2. That dispenses a perfume for the room every 30 minutes
3. Alerts a Central HMI when the Soap has only 20 shots left out of 500 shots.
4. Alerts a Central HMI when the perfume dispense is already empty (600 shots used up)
5. Resets the Soap counter when the A button is pressed on the HMI
6. Reset the Perfume Counter when the B button is pressed on the HMI

You HMI should be located at the Janitorial Office

**Group #:** \_\_\_\_\_\_\_\_\_\_\_\_

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**Modbus Slave Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Circuit Diagram:**

**Final PLC Program:**

**HMI Illustration with Modbus Addressing Notes**

Grading

Graphical user interface

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Individual Performance

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# Task 4: Belt Drive System Control

**Problem:**  Belt Drive System Control

Create a Belt Drive System using the lego blocks assigned to you and a rigid frame of preference.

A screenshot of a video game

Description automatically generated with low confidence

Create a Program that uses the Belt Drive system and moves an object loaded on top of it X% of the way then back again.

X% is set from the HMI.

HMI should have an estimate of the actual position the drive is moving in.

**Group #:** \_\_\_\_\_\_\_\_\_\_\_\_

**Group Members:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

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**Modbus Slave Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Circuit Diagram:**

**Final PLC Program:**

**HMI Illustration with Modbus Addressing Notes**

Grading

Graphical user interface

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Individual Performance

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# Task 5: 2 Axis Robot

**Problem:**  2 Axis Belt Control System

Create a Belt Drive Systems using the lego blocks assigned to you and a rigid frame of preference.

A picture containing LEGO, screenshot, board game, games

Description automatically generated

Create a Program that uses the Belt Drive systems and moves the crosshairs to the desired point as indicated by the  motor position sensors

HMI should have 5 plot points stored and once the button is pressed to start the machine it should proceed to make the cross hairs go to each point successfully

HMI should have an estimate of the actual position the drive is moving in.

**Group #:** \_\_\_\_\_\_\_\_\_\_\_\_

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**Modbus Slave Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Circuit Diagram:**

**Final PLC Program:**

**HMI Illustration with annotated Modbus Addresses**

A screenshot of a computer

Description automatically generated with medium confidence

Grading

Graphical user interface

Description automatically generated

Individual Performance

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# Task 6: Cross Over Cable and IP Basics

Operational Technology Traditionally uses Unshielded Twisted Pairs for connecting devices thru the RS485 Standard but lately due to the much extensive use of Ethernet this has moved to Crimped CAT – 5 Cables that uses EIA/TIA 568 instead of your plain RJ45 wire stuck into the terminal block. In this activity we will explore and practice creating these type of wiring devices from scratch.

Diagram

Description automatically generated with medium confidence     Diagram

Description automatically generated

Figure 1. Cross Over Cable                                 Figure 2. Crimping Tool

|  |  |
| --- | --- |
| How to crimp Cat5e/Cat5  twisted wires into RJ45   1. Strip the UTP (Cat5, Cat5e , Cat6, Cat6A) cable using your crimping tool stripper, or you can use a separate cable stripper. 2. Untwist the twisted wires. 3. Set the wire according to the color-coding above and cut it with your cutter. The wire must be half-inch long to fit inside RJ45. | Crimp rj45 properly |
| crimp rj45 picture | 4. Insert the  wires into the RJ45.        5. Now, insert the RJ45 connector into the 8-pin crimper of your crimping tool.        6. Finally, crimp the RJ45. |

Grading:     [ ] Passes Test Tool       [ ] Passes IP Test Ping Process

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|  | TTL Value:  Latency: |