

ECT 663: Electronic Control Systems Design
Laboratory Exercise #1
Programmable Automation Controller Project Development & Configuration

Name: _____ Due date: February 13th, 2023

SIGNOFF:

PAC Project Operates as expected _____
Emulator operation correct _____
HMI works as expected _____
Code Commented & tag database _____

NOTES:

Objective: (A) Configure a Virtual PAC Chassis using RSLogix Emulate 5000, (B) Configure a simulated Ethernet network driver using RSLinx Classic, (C) Configure a PAC program using Studio5000 programming software, (D) Develop a Logix5000 ladder logic program using tags, (E) download the program to the emulator and successfully test run the program, & (F) Create a FactoryTalk View shortcut to allow an HMI to interact with the Logix5000 program using pushbuttons, animated graphic displays, and alarms.

Programming Assignment: The Warehouse Elevator

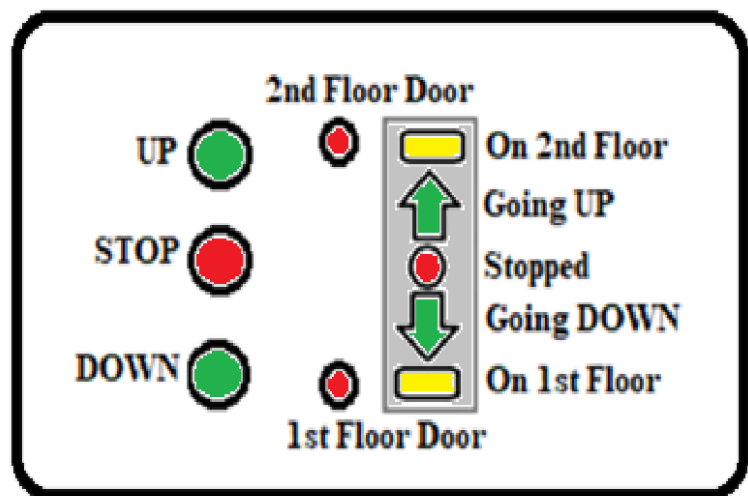
A warehouse has an elevator that moves between the ground floor (1) and the top floor (2) to move materials down to the process lines. For safety reasons the elevator is enclosed by a fence with a loading gate on both floors operated by the employees. The elevator drive is operated by a 3 phase AC motor with a reversing starter for control. One coil rotates the motor to raise the elevator, the other coil to lower. The motor cannot be made to run in both directions at the same time without severe damage to the equipment, so you have interlocks on the UP and DOWN coils. To change direction the motor must first be stopped.

Both floors have access to an HMI screen where there is a set of virtual Pushbuttons on the screen to control the operation (UP, DOWN, & STOP). The HMI screen also has status indicators to indicate (a) the elevator is stopped on the Top floor, (b) the elevator is stopped on the Ground floor, (c) the elevator is moving UP, (d) the elevator is moving DOWN, (e) the elevator is stopped somewhere between the floors, (f) the door on the 2nd floor is open, & the door on the 1st floor is open. Some indicators will blink.

This is the screen layout an operator on either floor would see during normal operation with inputs to the left, and indicator outputs to the right

Create the display in FactoryTalk View, then add momentary pushbuttons for UP, DOWN, & STOP.

Draw objects, or use predrawn objects from the supplied library to represent the pilot lights. Give them different colors where bright means they are active and dull indicates they are off.



Remember also that you can copy & paste objects on the screen. So the Up & Down button can be copies of each other simply pointing to a different tag. Likewise for the graphics where the On Floor lights can be the same display just copied and linked to a different tag, and so on. The Up & Down arrows can be the same arrow just copied and flipped, then linked to a different tag.

Output graphics should be developed which show the status of the operation:

1. A 0.5 second blinking indicator that is only visible when the elevator is moving down and is between floors.
2. A 0.5 blinking indicator that is only visible when the elevator is moving up and is between floors.
3. A steady indicator that is only visible when the elevator is stopped on Floor #1.
4. A steady indicator that is only visible when the elevator is stopped on Floor #2.
5. A blinking indicator that is only visible when the elevator is stopped between floors



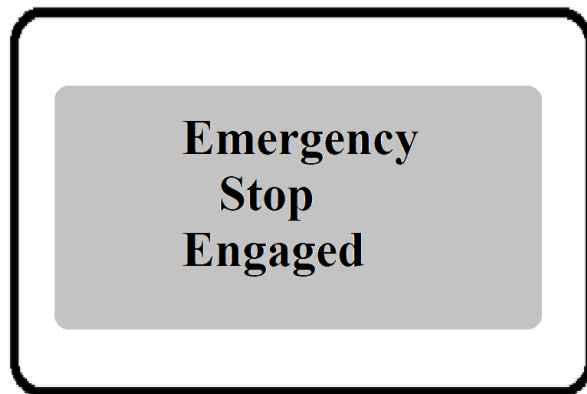
To write your program link the lights to tags representing device I/O on the emulator, and/or logic in the studio5000 program. For example: how do I know when the “Going UP” arrow should be bright green? Because “Elevator_MTR_UP” tag is TRUE. How do I know I am on the First Floor? Because “First_FL_OT_LS” tag is TRUE. Link the light operation to the Tag conditions in the program & emulator.

SAFETY CIRCUITS:

In addition there are some safety circuits which are to be created:

(A) Emergency Stop Pushbutton

There is a hidden indicator which overlays the usual Stopped indicator which informs the operator that the manual E-STOP PB has been engaged. This item is only visible on the screen when the E-Stop input on the emulator is engaged (you would use the visibility animation to control this). Once the E-Stop is engaged nothing in the system can be made to run until the E_Stop contact is cleared. The Emergency stop covers the switch inputs and pilot light outputs so the operator can do nothing until the manual E-Stop pushbutton is reset on the elevator by the operator.



(B) Starter Motor Overload Contact

In the Logix Emulator create a Normally closed contact which act as current overload safety for the motor starter. If these contacts Open then the motor will stop immediately and cannot be made to run until the overload is manually reset NC on the emulator IO. If the Overload contacts open an indicator will appear on the display to inform the operator that the motor starter is tripped.

(C) Door Open Alarms

A danger exist if an operator opens a gate while the elevator is moving between floors. An alarm is created in FactoryTalk View which posts a message on the display screen if a dangerous condition exists (the alarms monitor operation looking for situations specified by the programmer and notify the operator if one occurs). Create two alarms (notifies the HMI operator & must be Acknowledged) to trigger when:

1. The elevator is located between the two floors AND the gate on floor One is opened.
2. The elevator is located between the two floors AND the gate on floor Two is opened.

The alarm message must identify the problem (gate was opened) and where the problem is (which floor). NOTE: the alarm is NOT generated if a door is opened while the elevator is stopped at either the first floor or the second, only when it is between the floors.

Emulator Input/Output addresses

Use the addresses shown below in your Emulator I/O Module for devices that would be hardwired to the PLC. Use the tag names shown. Note that other devices such as pushbuttons are done virtually in the FactoryTalk Software and are not “real,” the same applies to indicator lights as well as control relays for interlocks and seal-in contacts. There are very few actual connections from field devices to the PLC to implement this design.

Input Description	Address		Output Description	Address
First_FL_OT_LS	0		Elevator_MTR_UP	0
Second_FL_OT_LS	1		Elevator_MTR_Down	1
First_FL_Security_Gate	2			
Second_FL_Security_Gate	3			
Emer_Stop	4			
Elevator_MTR_OL	5			

How does the circuit work in normal operation?

In Normal operation: Once a direction button is pushed the motor will seal-in and continue to operate in the indicated direction until a either (a) the STOP PB is used, or (b) a gate is opened, (c) an overtravel limit switch built into the elevator frame is made (TRUE) to indicate the elevator has reached its destination, (d) the manual E-Stop is pressed, or (e) the motor starter overload contacts open. All pushbuttons should have clear labeling to inform the operator what action they perform, and the buttons should change color when ‘pressed.’ When in operation (the elevator is moving between floors) the UP and DOWN indicators should flash in approximately 0.5 second intervals to help inform the operator the elevator is moving.

NOTE: If the E-Stop is pressed the elevator stops immediately, the display is covered by a panel and NOTHING operates until the E-stop contact on the emulator is reset. If the elevator is MOVING between floors and someone opens a door at either level the elevator stops and an Alarm message is generated to the operator on the screen identifying that a door was opened and which door it was. The operator must acknowledge the alarm and wait for the door to close before the elevator can be made to move again.

The Overtravel switches are configured so that when the elevator is moving in one direction it cannot be made to go the other, the elevator must be stopped first, then reversed. When the elevator is at the 2nd floor it cannot be made to go up, when it is on the 1st floor it cannot be made to go down.

When the elevator arrives at a floor it automatically stops in place, the doors can be opened without triggering an alarm. However, the doors must be closed (the door lights are green) before the elevator can be made to move again.

SUMMARY:

This program requires only 7 emulator I/O devices be programmed, the Studio5000 program can be made function with one routine and about 6 rungs of code. The FactoryTalk View HMI program requires only one display and uses 3 momentary pushbutton switches, and 8 indicators you can draw or import from the image library. There are two alarms to create. This is not a difficult program and ALL of these can be found in tutorials which explain how to do them at the Bryce Automation site on the internet. So I would like to see this submitted by February 6th, but will give you until the 13th as it is the first lab. My expectation is that you will work on this OUTSIDE of lab time preparing the outline for your coding and graphics which you will implement in class. IF you do your preparation work outside of class you can easily have the lab ready to submit by the 6th, and certainly by the 13th.