R7008E – Industrial Automation
Lab 1
The Latch Principle

Lab Objectives

- Understand the Latch Principle
- Understand the operation and the characteristics of a Relay
- Understand the operation of NO and NC contacts of a push button
- Build an automation for ON/OFF controlling the operation of a light
- Build an automation for controlling the direction of movement for a conveyor belt
- Get experience with a more a complicated Industrial Automation
- Utilize and get training in wiring and building industrial automations with a large number of relays
- Utilize limit switches and integrate them in the automation scheme

Lab Materials

The students should build the automations by utilizing the following items:

- Breadboard and cables
- Solid State Relays (24Volts)
- Light indicators
- LEFT and RIGHT buttons or START and STOP buttons
- 2 Limit Switches
- DC Motor (5 Volts)
- Conveyor Belt Setup

All the specifications for the utilized relays and buttons are in Fronter in the LAB 1 folder. Students should not proceed in directly providing power supply to the testbed, before informing the lab assistants, after completing all the necessary cabling. It is widely suggested before starting the cabling to design the proper electrical wiring scheme that solves the requested problem.

- **The students before starting the lab should have already designed the electrical circuits that will solve the suggested problems. All the designs (solutions) to these problems should be uploaded by each team in Fronter.**

- **The time duration of the lab (3hours) will not be sufficient enough if the previous step is not followed.**

Part A - Lab Description

The fist aim of the lab is to get practical experience in building automations with relays in a typical application of controlling the ON/OFF operation of a light by pressing a START and STOP button.

Lab Assignments

Task A1: Get familiar with the Relay

- ➢ Connect the relay to the breadboard
- ➢ Identify the relays coil and contacts
- ➢ Measure contacts under and without power supply
- ➢ Make a pin out of all the relay's contacts

Task A2: Constant OFF/Temporarily ON Operation

The operational specifications should be the following ones:

- ➢ By pressing a button the light should be turned ON
- ➢ After releasing the button the light should be turned OFF
- ➢ The previous operation should be able to be repeated without any additional changes in the wiring

Task A3: Constant ON/Temporarily OFF Operation

The operational specifications should be the following ones:

- ➢ By supplying power to the circuit the light should be turned ON
- ➢ If no button is pressed the light should remain ON
- ➢ By pressing a button the light should be turned OFF
- ➢ After releasing the button the light should be turned ON
- ➢ The previous operation should be able to be repeated without any additional changes in the wiring

Task A4: Constant OFF/ON Operation

The operational specifications should be the following ones:

- ➢ By pressing a START button the light should be turned ON
- ➢ After releasing the START button the light should be continue to be ON without pressing any button
- ➢ By pressing a STOP button the light should be turned OFF
- ➢ The previous operation should be able to be repeated without any additional changes in the wiring

Part B - Lab Description

The second aim of the lab is to design an Industrial Automation for controlling the movement of a conveyor belt. The control of the movement will be made by appropriate direction control of a DC motor. During the movement, limit switches will be integrated to signal the end of directional movements (safety) or signal the automatic operation of the conveyor belt.

Task B1: Design and Build an H-Bridge for the directional control of a DC motor

- ➢ Identify and understand the operation of the H-Bridge circuit presented in the following figure. The V_{in} is a constant voltage power supply, while S_1 and S_2 are contacts controlled by corresponding relays.
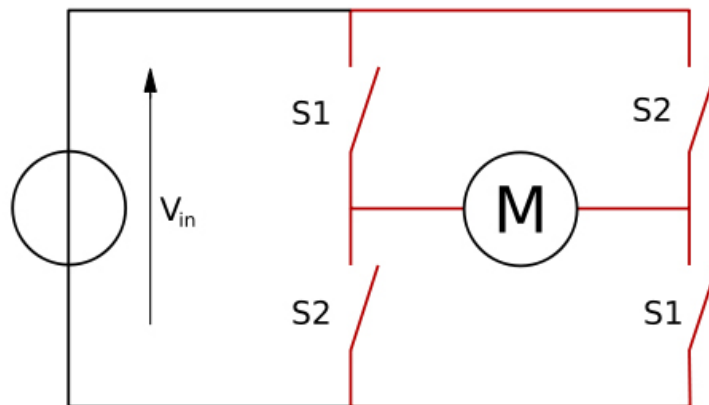
- ➢ Design the electrical wiring for controlling the motor's direction by constantly pressing a LEFT or a RIGHT button, by utilizing the H-Bridge circuit described before. Indicate the true movement of the motor (and not the commands from the buttons) by light indicators. Deliver the electrical wiring to the lab assistant
- ➢ Build the automation by utilizing solid state relays and evaluate it on the provided test-bend

Task B2: Integrate Limit Switches in the motion of the conveyor belt

- ➢ The operation of the motor should be the same as described in Task 1 with the addition that when a limit switch is pressed (LEFT or RIGHT limit switch) the corresponding movement of the motor should be terminated independently if the button that controls that movement is being pressed. In this case the limit switches are being utilized as safety switches, since they are signaling an error command that should stop the movement of the conveyor belt and break the signaling for the START and STOP buttons. As before indicate the true movement of the motor (and not the commands from the buttons) by light indicators, also indicate the press of a limit switch with a constant light ON (It is not necessary to distinct which limit switch has been pressed). When a limit switch is being reached, the continuation of the machine operation will be able to be achieved by pressing the button controlling the opposite motor movement.
- ➢ Design the electrical wiring for having the behavior described and deliver it to the lab assistant
- ➢ Build the automation by utilizing solid state relays and evaluate it on the provided test-bend

Task B3: LEFT – RIGHT autonomous movement with safety limit switches

> ➤ By pressing a button the conveyor belt should start moving clock wise. When the right limit switch is being pressed, the conveyor belt should start moving counter clock wise until pressing the left limit switch. When this switch is being pressed the whole operation is repeated endlessly until another button is being pressed. During movements utilize 3 light indicators for signaling the movement of the conveyor belt and the reaching of a limit switch (It is not necessary to distinct which limit switch has been pressed).
>
> ➤ Design the electrical wiring for having the behavior described and deliver it to the lab assistant
>
> ➤ Build the automation by utilizing solid state relays and evaluate it on the provided test-bend