ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

EEM 451 - INDUSTRIAL CONTROL SYSTEMS

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Assist.Prof.Dr. Hakkı Ulaş Ünal

Final Report

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Project number	1
Partrners:	

NUMBER	**Name-Surname**
21190898222	Göktuğ Saray
10882517732	Hacı Ali Sayar
17669013272	Ahmet Hakan Demirel
47287421678	Mustafa Enis Çimen
38563007136	Hasan Sucukçu
25123528064	Gökberk Batuhan Duran

CONTENTS

LIST OF FIGURES

1.PROJECT OBJECTIVE

Consider a conveyor which has a single DC motor located at the drum of a conveyor and a pneumatic linear lifting crane. This project aims to sort incoming products in two different stations. Products are a (matte red), b (matte black) and c (metallic gray). These products, which are coming from the conveyor band (with N rpm) without a specific order, will be taken from the light barrier sensor dent which is located at the middle of the band and be placed on the correct station in the correct order. The entries to the dent will be made by an electric gate or an air pump. Product entries will be made only through the conveyor band (through a detection module at the beginning of the band). Detection module has a diffuse sensor, a fork light barrier and an inductive sensor. Order of each station will be made by the position sensors.Priority will be given to the first station, and if the incoming product is in the right order, then, it will be placed. Otherwise, the product will not be placed to the dent and be dropped at the end of the conveyor line.After that conveyor will increase its speed until the desired product is detected.The process will start by resetting the memory and the counters.

2. SENSORS

Sensor is defined as a device that converts a physical stimulus into a readable output. The role of a sensor in a control and automation system is to detect and measure some physical effect, providing this information to the control system

In this project, there are three types of metal, black and red. For separating the objects on the conveyor belt; inductive, reflective (diffuse), light barrier and position sensor sensors are used.

2.1 Inductive Sensor

An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects. An inductor develops a magnetic field when a current flows through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes.

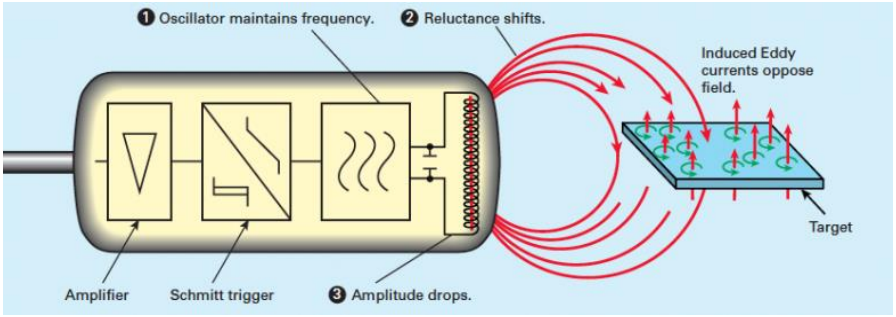


Figure 1: Inductive Sensor working principle

2.2 Reflective (Diffuse) Sensor

Laser diffuse (reflective) sensors are featured by a high accuracy and are made for the exact detection of smallest parts. Transmitter and receiver are positioned in the same housing whereas the receiver is detecting the light being emitted by the transmitter and reflected by the object.

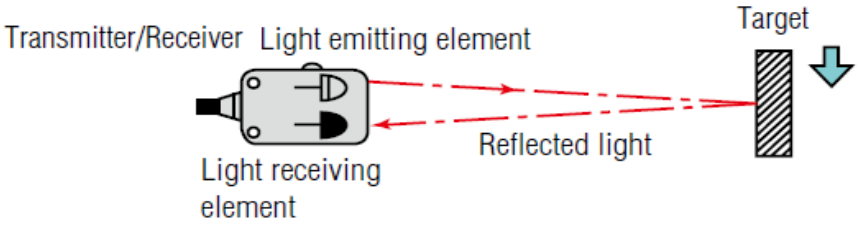


Figure 2: Reflective Sensor working principle.

2.3 Light Barrier Sensor

These Sensors operate on the principle that an object interrupts or reflects light, so they are not limited like Proximity Sensors to detecting metal objects. This means they can be used to detect virtually any object, including glass, plastic, wood, and liquid.

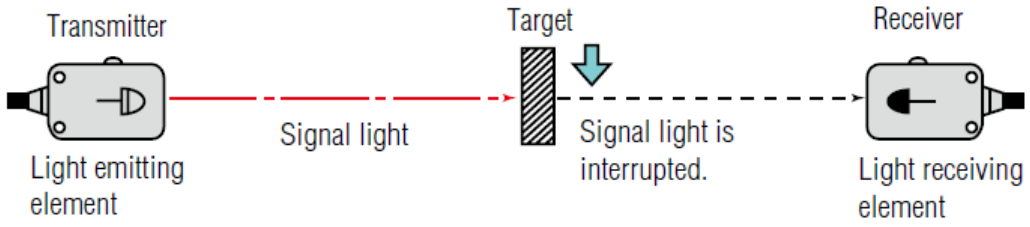


Figure 3: Light Barrier working principle

2.4 Position Sensors

Potentiometric position sensor is operated based on the principle of resistive effect. A resistive track acts as a sensing element, and a wiper is attached to the body or part of the body whose displacement is to be measured.

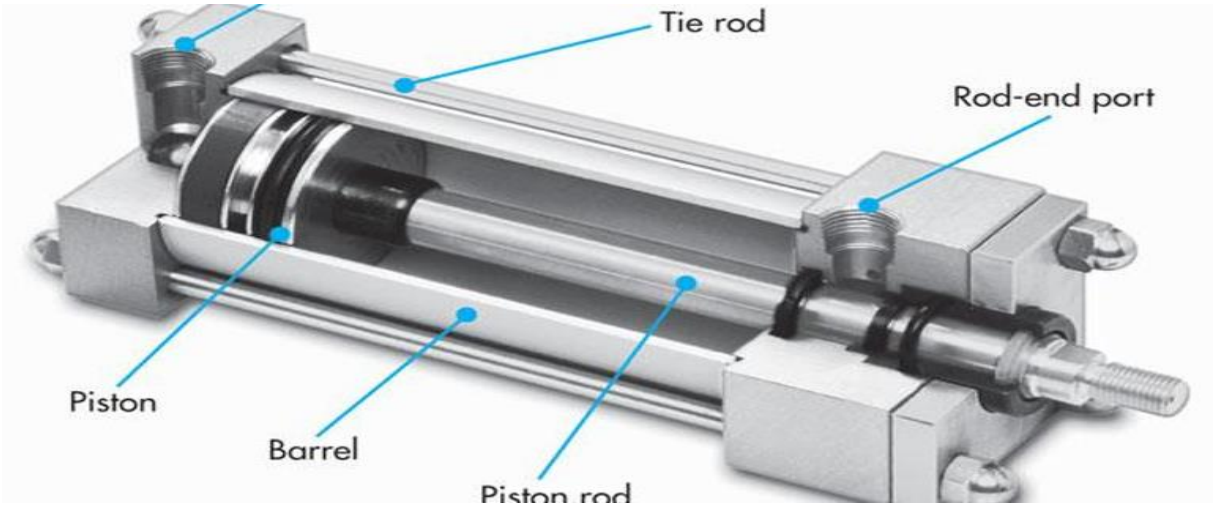


Figure 4: Position Sensors

3. ACTUATORS

Actuators are mechanical or electro-mechanical devices that provide controlled and sometimes limited movements or positioning which are operated electrically, manually, or by various fluids such as air, hydraulic, etc. The industrial actuator can use air, hydraulic fluid, or electricity for motive power. These are referred to as pneumatic, electro-hydraulic, or electric actuators. Two basic motions are linear and rotary. Linear actuators convert energy into straight line motions, typically for positioning applications, and usually have a push and pull function. Some linear actuators are unpowered and manually operated by use of a rotating knob or handwheel. Rotary actuators convert energy to provide rotary motion. A typical use is the control of various valves such as a ball valves or butterfly valves.

In our Project we have 2 types of actuators.Those are the actuators which are working with the principle of DC machines and Pneumatic System.

3.1 DC Machine

A DC machine is an electromechanical energy alteration device. The working principle of a DC machine is when electric current flows through a coil within a magnetic field, and then the magnetic force generates a torque which rotates the dc motor. The DC machines are classified into two types such as DC generator as well as DC motor. The main function of the DC generator is to convert mechanical power to DC electrical power, whereas a DC motor converts DC power to mechanical power.In our project the actuators which are working with DC machines are;conveyor belt motor,electronic gate and handling.

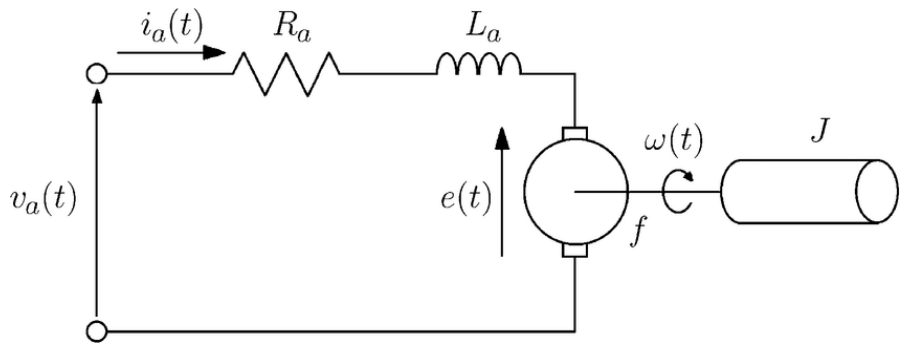


Figure 5: DC motor equivalent circuit

3.2 Pneumatic Actuators

A pneumatic system is a system that uses compressed air to transmit and control energy. Pneumatic systems are used extensively in various industries. Most pneumatic systems rely on a constant supply of compressed air to make them work. This is provided by an air compressor. The compressor sucks in air from the atmosphere and stores it in a high pressure tank called a receiver. This compressed air is then supplied to the system through a series of pipes and valves.In our Project the actuators which are working with pneumatic systems are;cylinder and gripper.

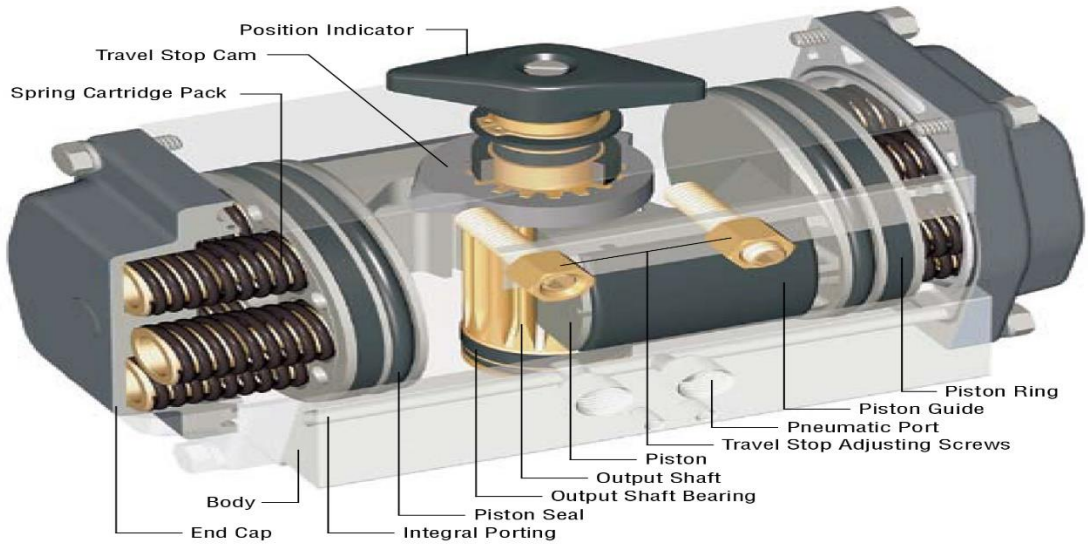


Figure 6: Pneumatic Actuators

4) <u>Relay Connection</u>

One premise of this project was to control the speed of the belt depending on the incoming product. If the dedected product is not the right one belt was going to speed up to drop the wrong product at the end of the conveyor. To achieve this, 2 relays was used in the project, eac

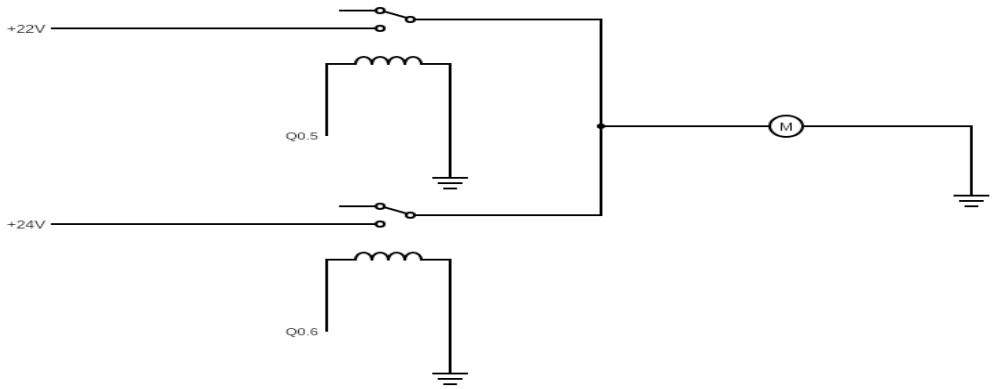
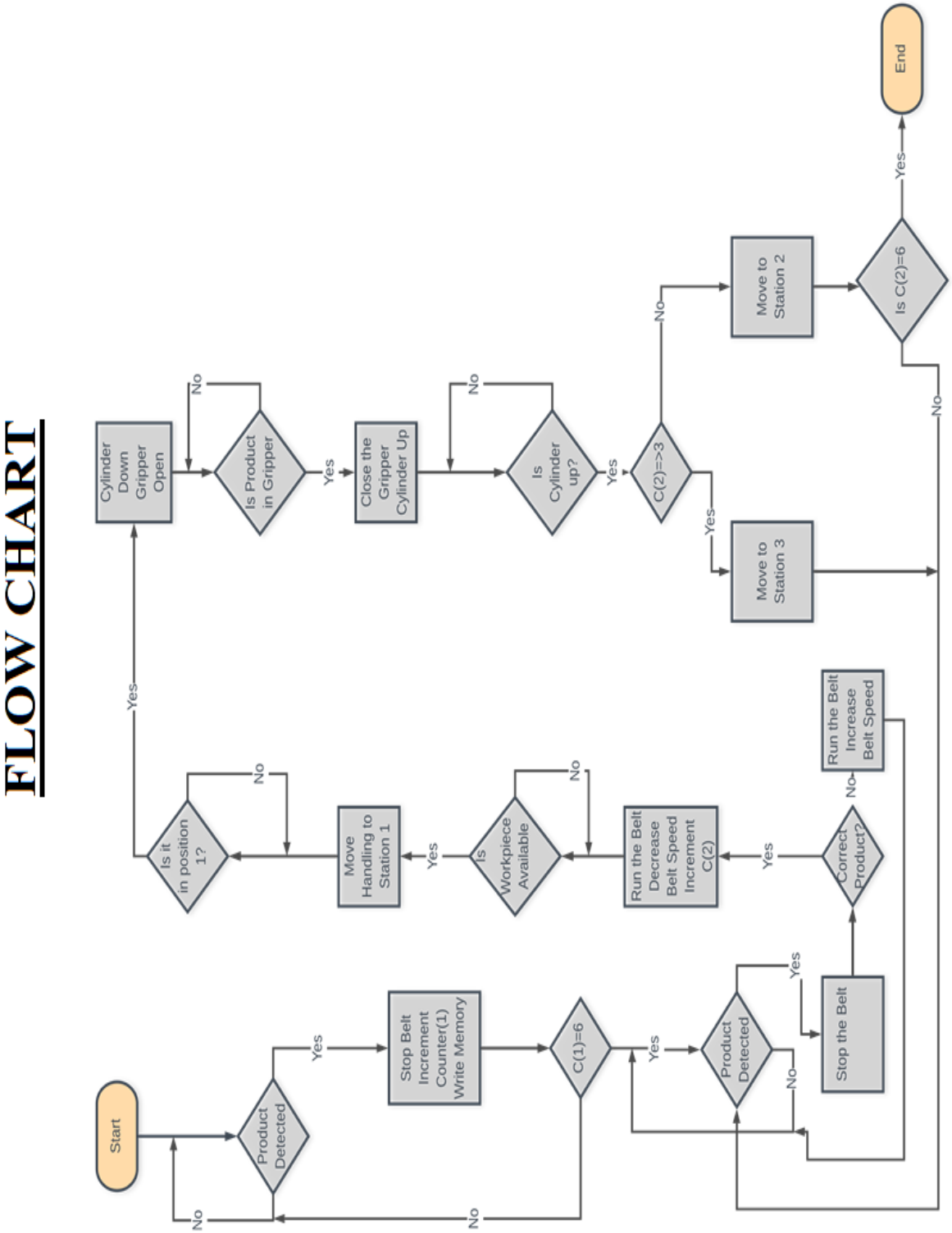


Figure 7: Connection diagram of relays.

h responsible for one speed value. Connection diagram is given below. If Q0.5 is HIGH, then cicuit will be closed for the +22V source and belt will run at a certain speed. If Q0.6 is HIGH however, circuit will be closed for the +24V source and belt will run at a higher speed.

5. FLOW CHART


FLOW CHART
Start
Product Detected
Yes
No
Stop Belt Increment Counter(1) Write Memory
C(1)=6
Yes
No
Product Detected
Yes
No
Stop the Belt
Correct Product?
Yes
No
Run the Belt Decrease Belt Speed Increment C(2)
Run the Belt Increase Belt Speed
Is Workpiece Available
Yes
No
Move Handling to Station 1
Is it in position 1?
Yes
No
Cylinder Down Gripper Open
Is Product in Gripper
Yes
No
Close the Gripper Cylinder Up
Is Cylinder up?
Yes
No
C(2)=>3
Yes
No
Move to Station 3
Move to Station 2
Is C(2)=6
Yes
No
End

6. REFERENCES

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7. " *Mike Hanely is vice president at Electro Hydraulic Machinery Co., Pembroke Park, Fla. For more information, call (954) 981-0023"* https://www.hydraulicspneumatics.com/