KTO KARATAY UNIVERSITY

FACULTY OF ENGINEERING

MECHATRONICS ENGINEERING

ROBOTICS
(MEM-720)

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Working Area	: Adaptive Assembly System Project

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1. INTRODUCTION

Automation systems are an important technology in modern industries aiming to increase productivity by reducing labor. In this project, an automation system is designed in which a conveyor belt system and a robot arm are integrated. The project is based on detecting and classifying products of different sizes and performing appropriate operations. The system is a complex mechatronic application where sensors, microcontrollers and robotic elements are used together.

1.1 Objective

The main objective of this project is to automatically detect the various products being transported on the production line and guide them with robotic operations within the framework of a production scenario designed for the product. Thus, it is aimed to reduce human intervention, error margins and costs by automating product classification, quality control and handling processes on production lines.

1.2 Research or Implementation Methods Used

Various research and implementation methods were adopted for the successful completion of the project. These methods were selected and applied in order to achieve the project's objective and solve the problems effectively.

Utilization of Internet Resources

During the project process, internet resources were utilized to obtain information on various topics and to access existing solutions. These resources have played an important role in keeping up to date with current developments in the project area, evaluating the experiences gained from similar projects and finding solutions to the problems encountered. [2]

Article and Thesis Reviews

In order to strengthen the theoretical foundation of the project and integrate knowledge from similar studies, various academic sources were reviewed. In this context, relevant articles, theses and scientific publications were reviewed to gain an in-depth understanding of the key issues of the project. This information was used to develop the methodology of the project and to evaluate the results. [3]
These various research and implementation methods contributed to the successful realization of the project and increased the reliability of the results obtained. These methods strengthened the scientific basis of the project and were used as an effective tool to achieve the objectives.

2. PROJECT

2.1 Adaptive Assembly System

The project was developed using Mitsubishi Industrial robotic arm. The working algorithm of the system can be summarized as follows:

1. Triggering with Sensor: The proximity sensor stops the system when it detects product on the conveyor belt.
2. Product Measurement: The size of the product is measured with sensors and the appropriate robotic scenario is triggered according to the measured distance.
3. Robot Operation: After the robot completes its operation, it informs the system with the "done" signal and the system is ready to work again.

Technical Specifications:
- **Industrial Robot Arm:** Mitsubishi CR750 2F-D Industrial Robot
- **Sensors:** Industrial proximity sensor,
- **Actuators:** Conveyor system
- **Inputs:** 3 robot pins for different scenario

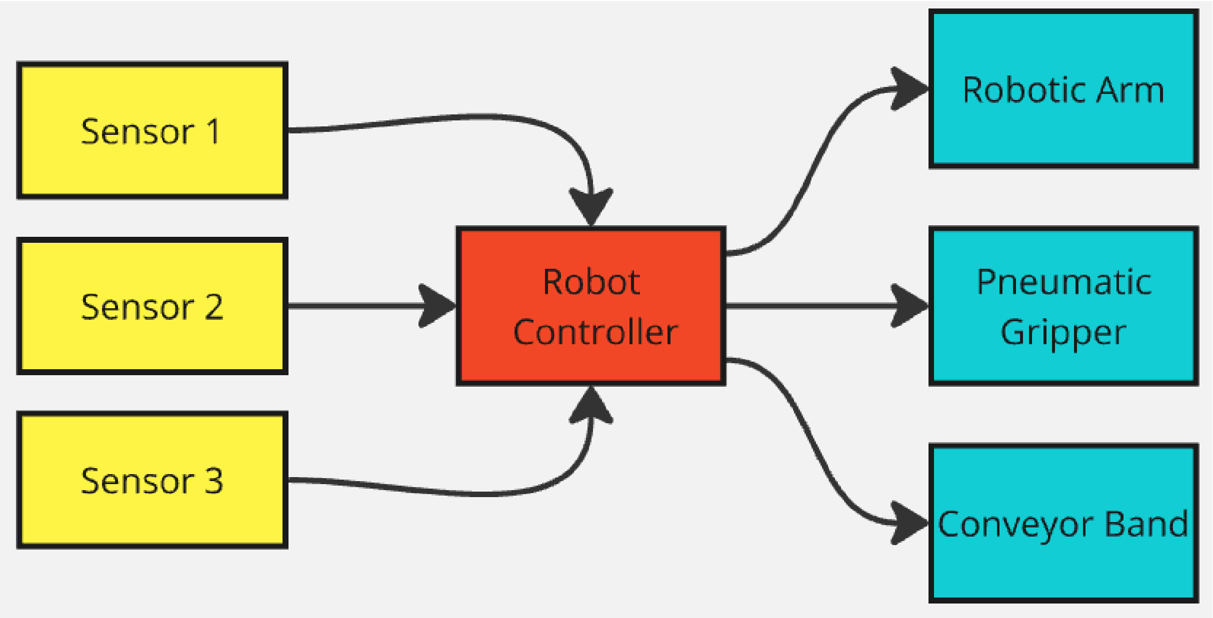


Figure 1. Industrial Automation System Operation Logic Demonstration

2.2 Fields of Use

This system has various applications in the field of industrial automation:

- **Production Lines:** Sorting and routing products of different sizes.
- **Storage and Logistics:** Sorting products by size before packaging.
- **Food Processing:** Sorting food products according to size.
- **Quality Control:** Detecting and sorting defective or substandard products.
- **E-Commerce:** Directing products to appropriate areas before storage and shipping.

The scalable nature of the project makes it possible to easily adapt it to other industries. These features enable the system to have a wide range of uses provides.

2.3 Model Circuit Schematic

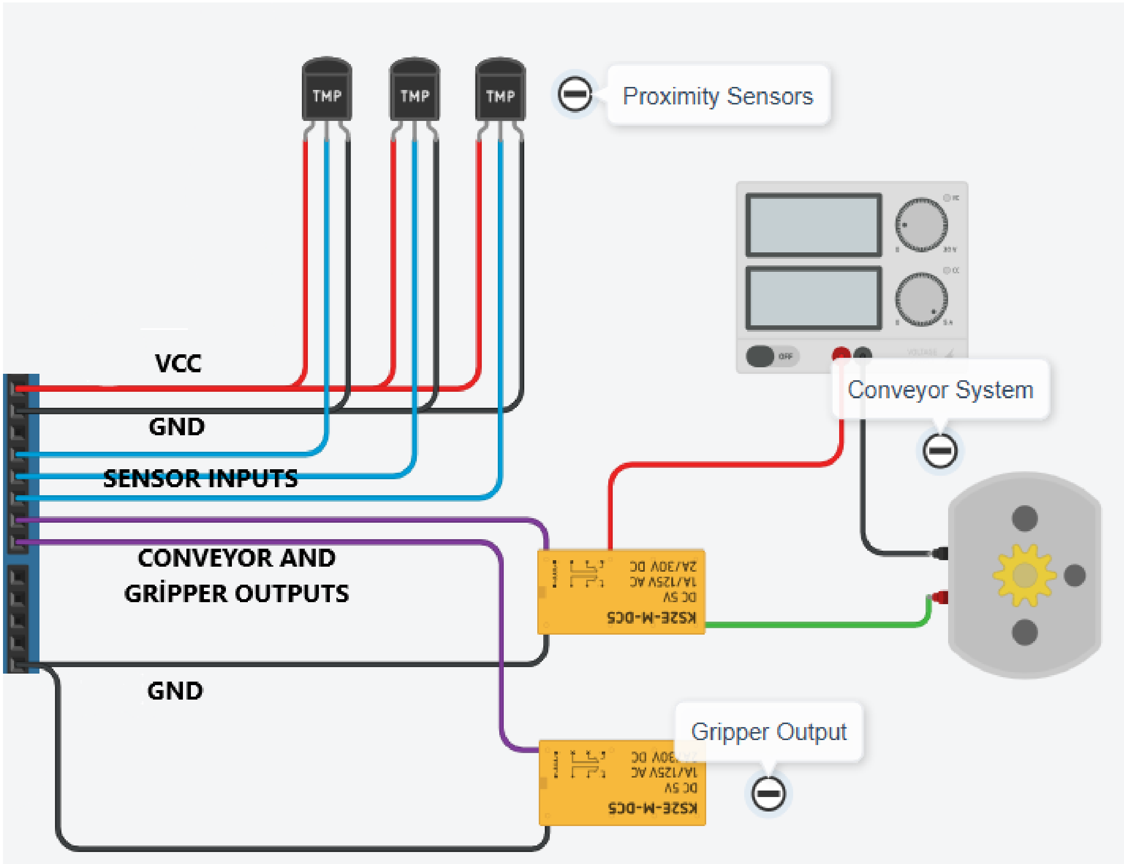
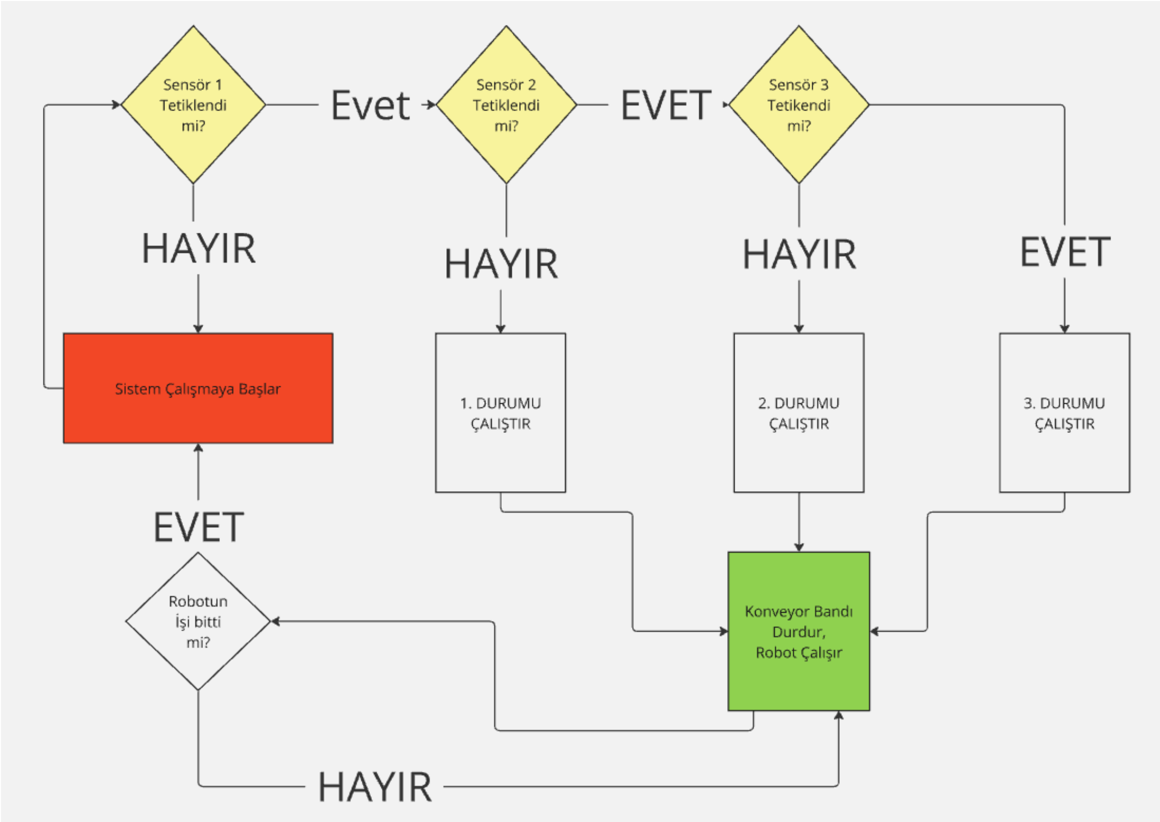


Figure2. System Schematic

2.4. Operation Algorithm



Resim 3. System Operation Algorithm

2.5. Robot Codes and Locations

2.5.1. System Locations

Konum	X	Y	Z	A	B	C	Flag
P1_0	112.330	333.070	299.060	178.760	0.210	6.170	0
P1_1	112.330	333.070	352.110	178.760	0.210	6.170	0
P1_2	-43.620	333.070	299.060	178.760	0.210	6.170	0
P1_3	-43.620	333.070	352.110	178.760	0.180	5.510	0
P1_4	-199.560	333.070	299.060	178.760	0.210	6.170	0
P1_5	-199.560	333.070	352.110	178.760	0.210	6.170	0
P2_0	129.610	341.470	288.960	178.570	0.190	5.510	0
P2_1	-201.670	341.470	288.960	178.580	0.160	5.540	0
P2_2	-201.670	341.470	332.010	178.580	0.160	5.540	0
P2_3	122.250	341.470	332.010	178.580	0.160	5.540	0
P3_0	-37.450	340.170	281.870	178.570	0.170	5.520	0
P3_1	-37.460	340.180	440.570	178.570	0.180	5.520	0
P3_2	-37.460	340.180	569.260	178.570	0.180	5.520	0
P3_3	129.610	340.180	440.570	178.570	0.180	5.520	0
P3_4	-201.670	340.180	440.570	178.570	0.180	5.520	0
PHome	-0.150	309.110	525.860	178.570	0.180	5.520	0
Px	-0.150	300.000	525.860	178.570	0.180	5.520	0

2.5.2. Robot Codes

```
Servo On
Ovrd 100
Accel 85,60
M_Out(10)=1
Mvs Phome
M_Out(4)=1
Dly 1
'--------------------
If M_In(7)=1 Then
If M_In(14)=0 Then
'Case 1
M_Out(10)=0
'-------------------
'silindir
Mov Phome
Accel 100,30
M_Out(4)=1
Dly 2
Mov psln,-30
Spd 20
Mvs psln
M_Out(4)=0
Spd 70
Accel 100,20
Mvs pyard
Mvs pkonumust1
Spd 20
Mvs pkonumic1
Dly 0.5
M_Out(4)=1
Dly 1
Mov Phome
EndIf
'-------------------
If M_In(14)=1 Then
If M_In(7)=1 Then
If M_In(4)=0 Then
'Case 2
M_Out(10)=0
Mvs Phome
Mvs pyard
Accel 85,20
Mvs pc2yard
Dly 1
M_Out(4)=1
Dly 1
Spd 10
Mvs pc2yard2
Dly 1
M_Out(4)=0
Dly 1.5
Accel 10,50
Spd 100
Mvs pyard
Mvs pyard5
Accel 60,20
Ovrd 35
Mvs pc2yard3
Mvs pc2yard4
Ovrd 10
Mvs pc2kutu
Dly 0.5
M_Out(4)= 1
Dly 1
M_Out(10)=1
Accel 20
Ovrd 70
Mvs pyard
Mov Phome
'Case 2
EndIf
EndIf
'----------------
If M_In(4)=1 Then
'Case 3
Dly 6
M_Out(10)=0
Mvs Phome
Spd 80
Accel 85,10
M_Out(4)=1
Mvs psln
Dly 1
M_Out(4)=0
Spd 30
Dly 1
Accel 20
Spd 40
Mvs p3yard5
Mvs p3yard3
Mvs p3yard6
Spd 20
Mvs p3yard7
Mvs p3kutuic
Dly 0.5
M_Out(4)=1
Dly 1.5
Mvs p3yard7
Mov p3yard5
Mov Phome
M_Out(10)=1
Dly 3
Mov Phome
'Case 3
'----------------
EndIf
```

3.REFERENCES

[2] ADVANCED KINEMATIC CALCULATION METHOD FOR A FIVE-JOINT ROBOT ARMhttps://www.emo.org.tr/ekler/258b2257ce52929_ek.pdf

[3] Saeed B. Niko. Introduction to Robotics
Analysis, Systems,Applications. NJ07458.

Robot Programming and useful documents related to robot:

- https://electrobit.ee/web/file_bank/Manuals/robotid/mitsubishi/cr751/CR750-CR751-CR760-setup-operation-maintenance_ENG.pdf
- https://www.allied-automation.com/wp-content/uploads/2015/02/MITSUBISHI_CR750CR751-Controller-Instruction-Manual-Detailed-Explanations-of-Functions-and-Operations1.pdf
- https://dl.mitsubishielectric.com/dl/fa/document/manual/robot/bfp-a8871/bfp-a8871z.pdf
- https://suport.siriustrading.ro/02.DocArh/09.MS/07.RI/06.RT%20ToolBox3/RT%20ToolBox3%20-%20User's%20Manual%20BFP-A3495-J%20(04.20).pdf