Delta Robot Arm For Pick And Place Applications

Muhammed Çelik
Dr.Neslihan Avcu
DEU Faculty of Engineering
Department of Electrical & Electronics Engineering
F20

1 INTRODUCTION

Industrial robots are an excellent option in production areas where human resources are not sufficient and require fast and precise production. The Delta robot is the robot type that exhibits the best performance in terms of speed and precision among industrial robots.

Within the scope of the project, firstly, the working mechanism of the delta robot was examined, and its kinematic equations were obtained. Then, the delta robot was designed using the WEBOTS simulation program. In the light of the simulation results, the delta robot was physically constructed.

2 METHOD

The positions of the objects were determined by image processing. The image taken with the webcam was processed using Python and OpenCV library. The obtained position information was converted into angle data with the help of inverse kinematic equations, and the angle data of all three motors were sent to STM32 UART protocol.

When the robot is first started, it is completely blind. In order for the robot to go to the desired location, it must first know its own location. To ensure this, an endstop switch was installed on each of the three motors.

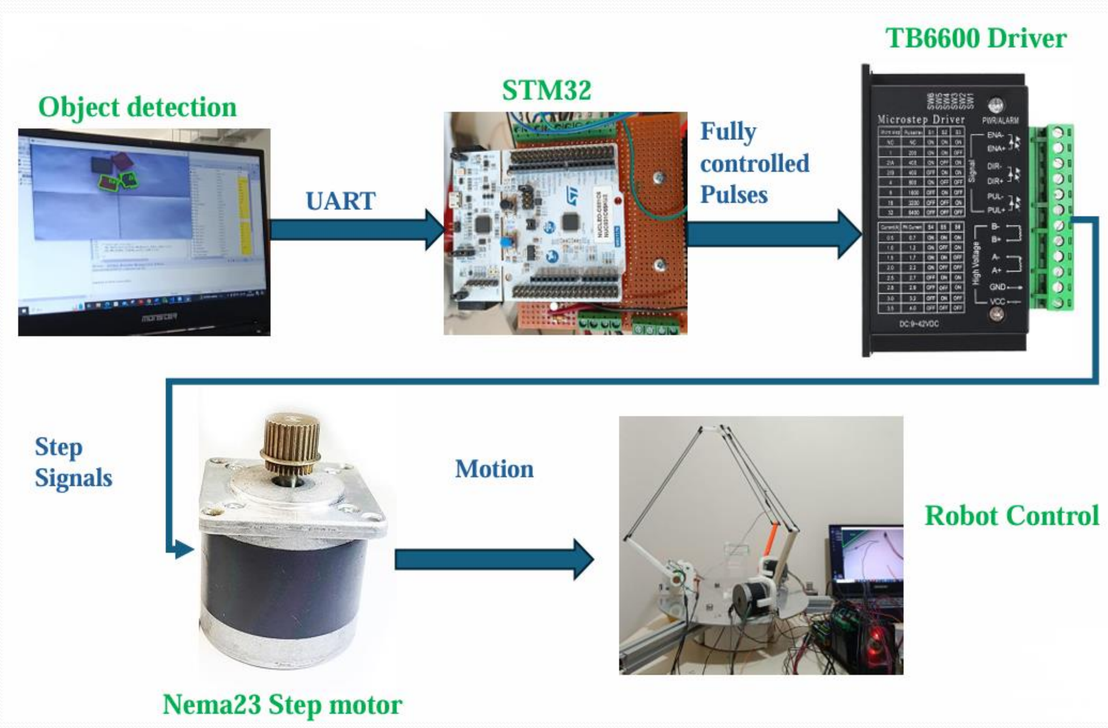

Figure1 System workflow

3 EXPERIMENT / SIMULATION

After the kinematic equations of the Delta robot were obtained, these kinematic equations were converted to C code and integrated into the Delta robot designed in Webots. Thus, the simulation of the robot is completed.

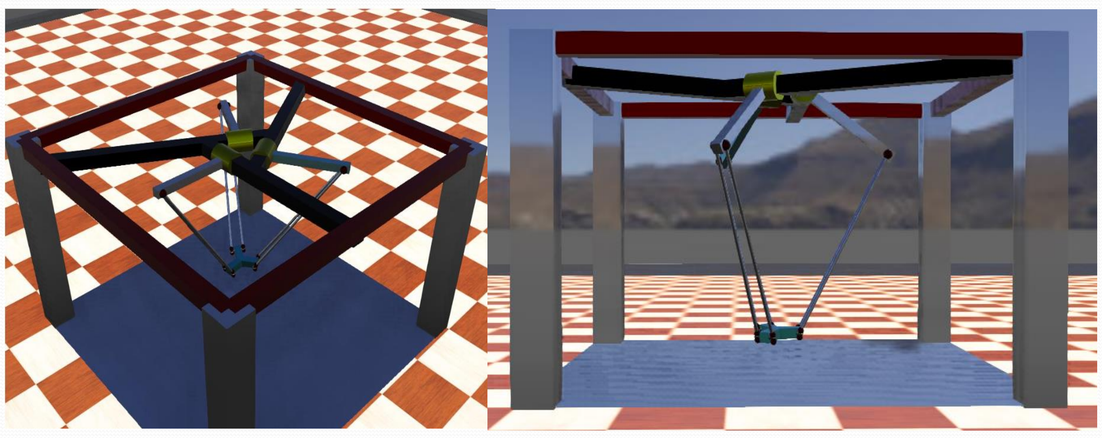

Figure2 Delta robot designed in Webots environment

4 RESULTS

The robot successfully processed the data required for movement, picked up the object at the determined location, and dropped the object into the positions determined by default, that the default location can be changed at any time. Thus, the goals at the beginning of the project were achieved.

For picking objects, a small electromagnetic gripper was used to achieve fast pick-and-place operations.

STM32C031C6 microprocessor has 32 kilobytes of flash memory[1]. When the algorithm for motor control was completed, seventy percent of the memory was used. Therefore, the inverse kinematic calculations, which involve floating-point operations, were performed in Python, and the resulting angle values were sent to the STM32

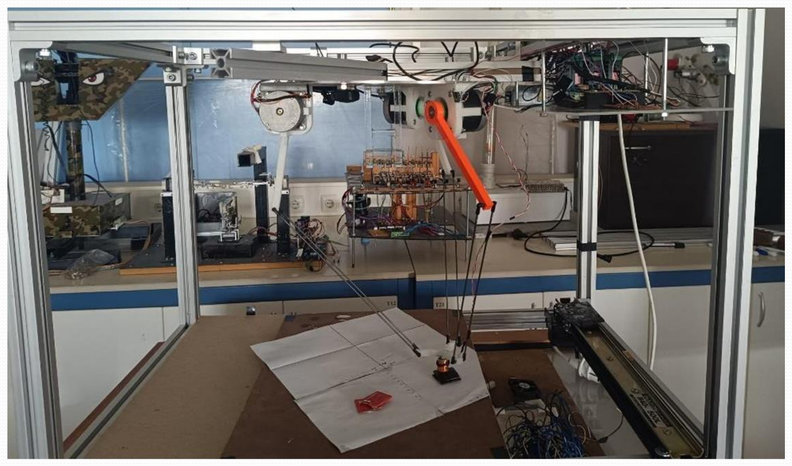

Figure3 delta robot after placing the objects on the desired locations.

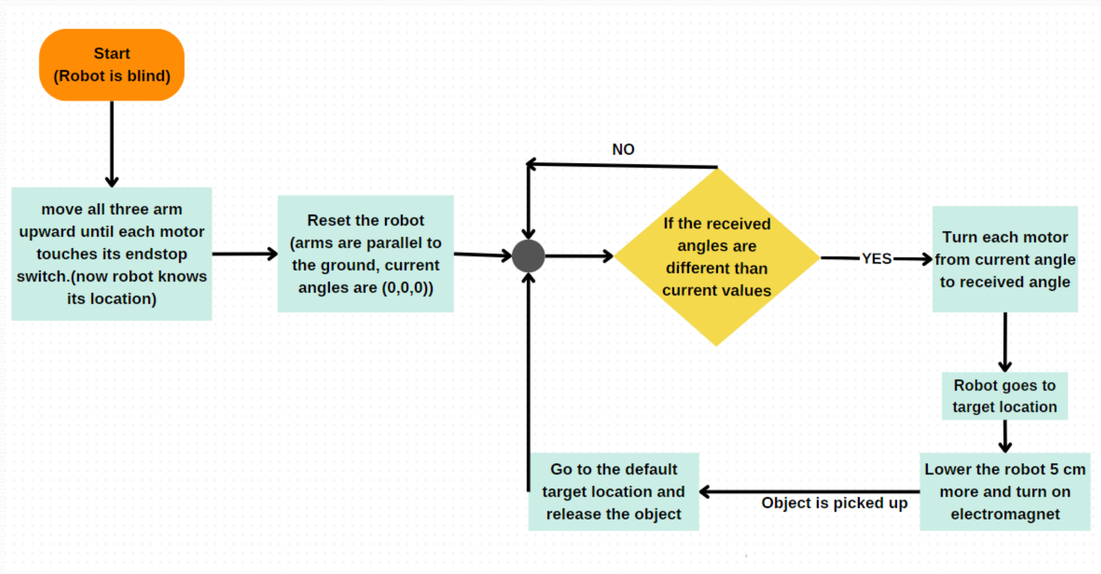

Figure4 Flow Chart of the operation

5 CONCLUSION

Since the robot accelerates suddenly while moving, the arms tremble when the target points are reached. To prevent this, speed control can be achieved using a trapezoidal graph.

Additionally, a more powerful STM32 microprocessor can be used to enable the robot to follow and pick up moving objects.

6 REFERENCES

[1] STMicroelectronics, "STM32C031C6 datasheet," accessed May 12, 2024. [Online]. Available: https://www.st.com/en/microcontrollers-microprocessors/stm32c031c6.html

I would like to express my sincere gratitude to my advisor, Dr.Neslihan AVCU, for her invaluable support, guidance, and interest throughout the project process. I am equally grateful to all my esteemed teachers who have contributed to my university education.