

Autoalign overhead crane

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Introduction

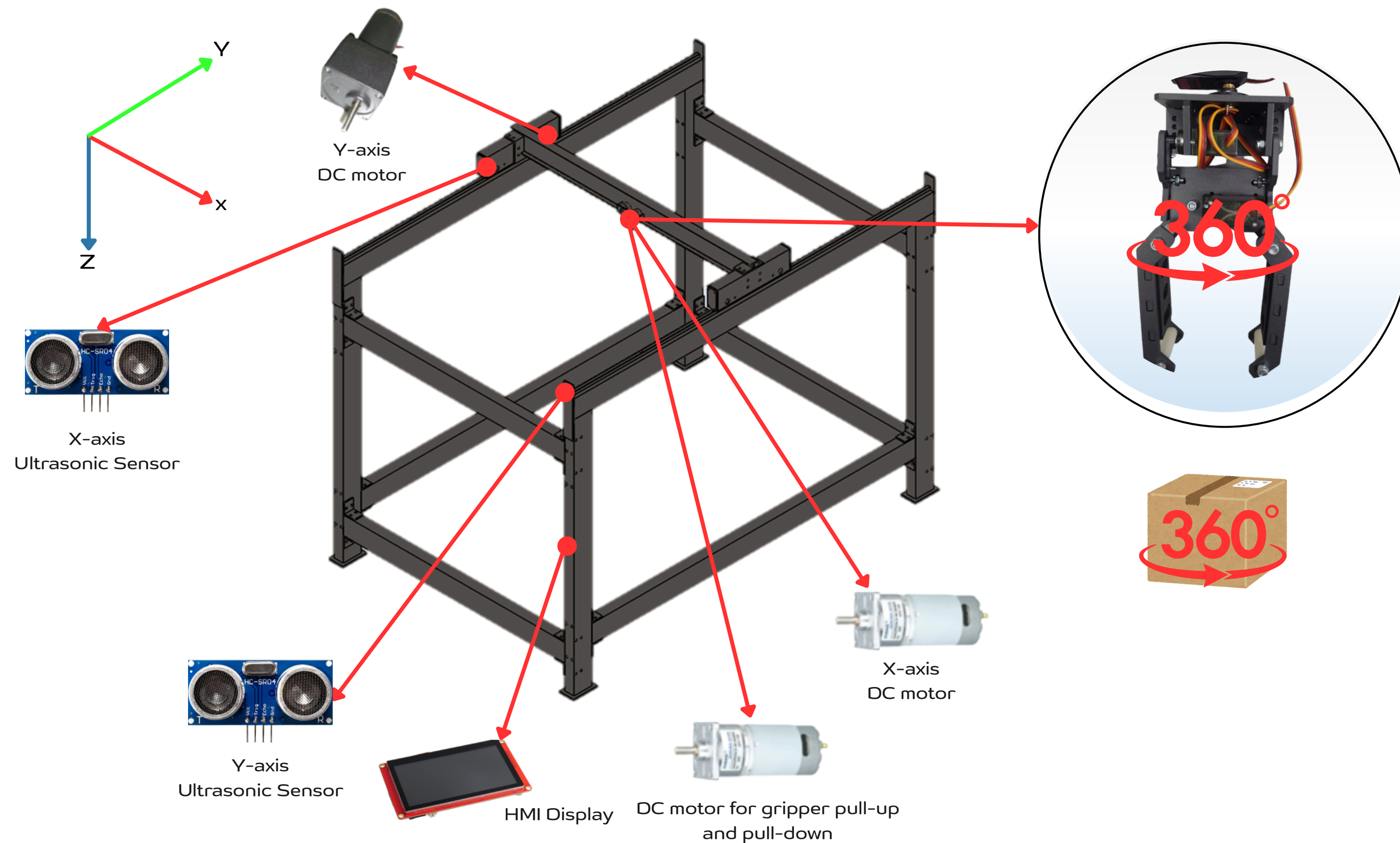
This project develops an Auto-Align Overhead Crane featuring a 360° auto-rotating gripper. By combining real-time image processing and Arduino, it fully automates X-Y-Z movements, ensuring high-precision, autonomous grasping without manual adjustments.

Abstract

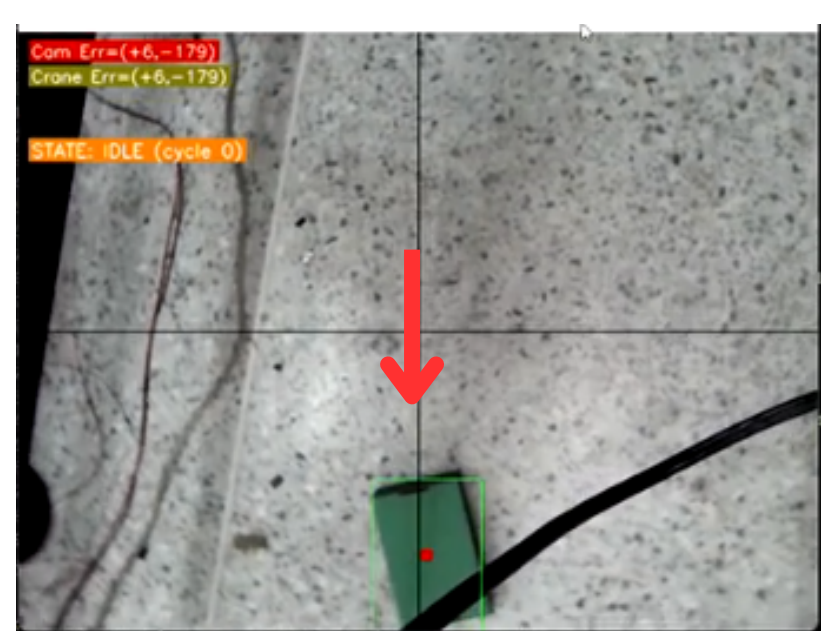
This project presents an Auto-Align Overhead Crane for industrial use, featuring a 360-degree auto-rotating gripper. Using real-time image processing, the system identifies the target object's centroid and angle. An Arduino microcontroller then automates X-Y-Z axis movements and perfectly aligns the gripper with the object. Experimental results show that this automated system ensures highly precise grasping, significantly minimizing operational errors and time compared to manual handling.

Objective

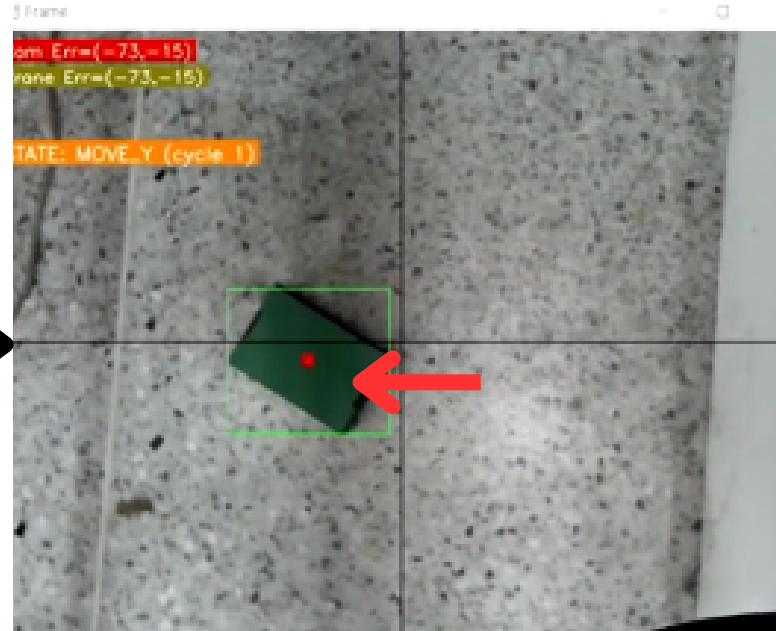
- Autonomous Precision:** Develop an overhead crane with camera-based detection for high-precision grasping.
- Intelligent Control:** Implement real-time image processing for automatic alignment and gripper rotation.
- Efficiency Optimization:** Minimize operational time and eliminate manual adjustments through full automation.



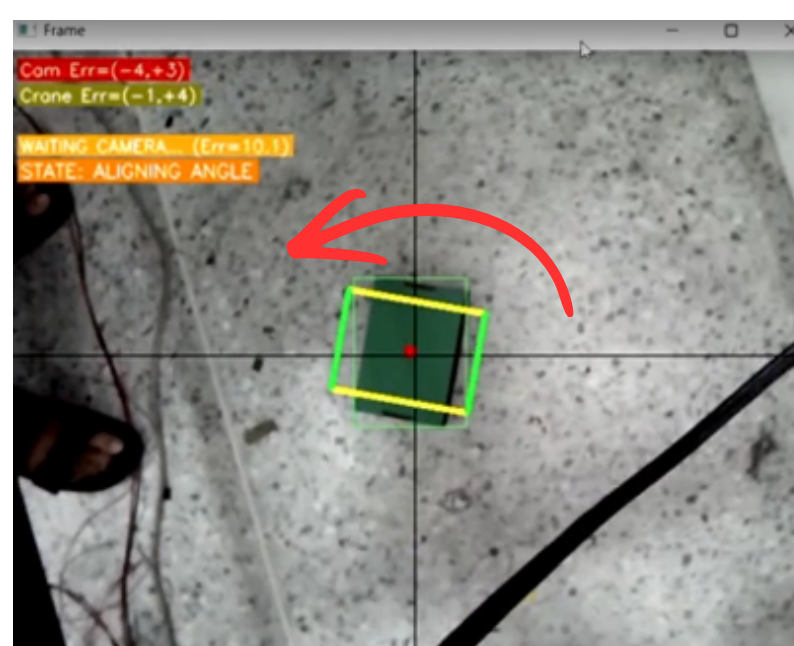
Methodology



Vertical Position Correction
Adjust the crane along the Y-axis to reduce vertical position error and center the object.



Horizontal Position Correction
Move the crane along the X-axis to minimize horizontal offset from the target center.



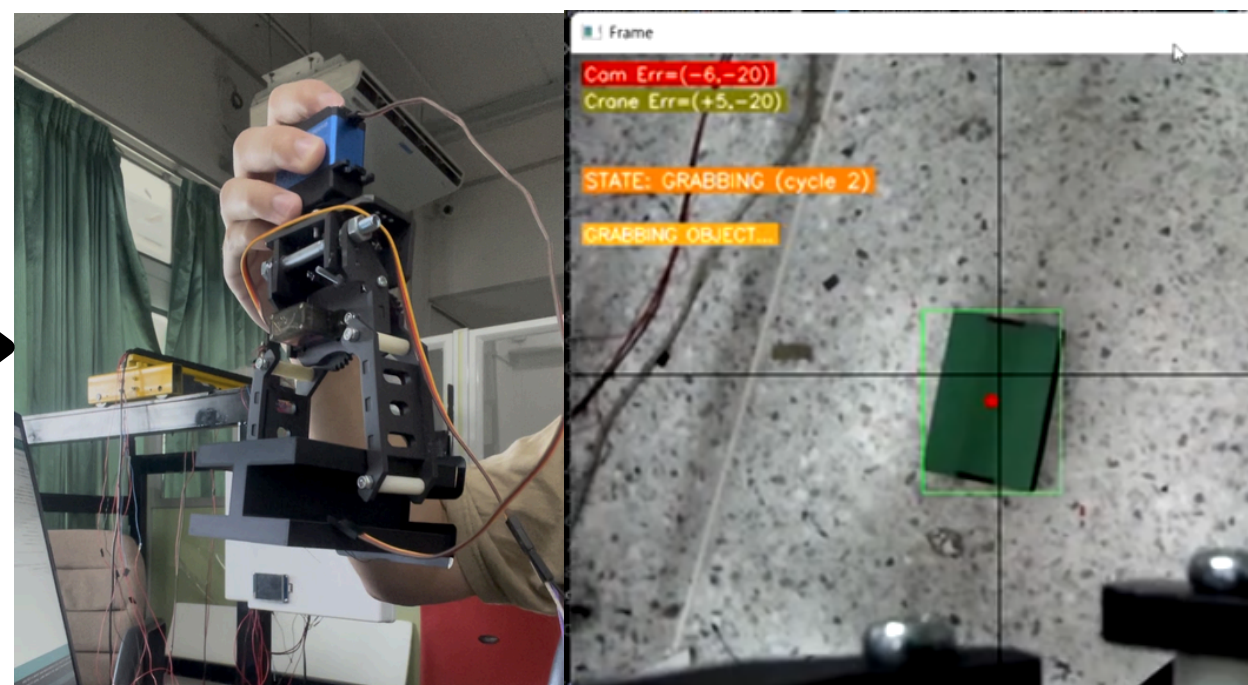
Gripper Orientation Control
Rotate the gripper to align with the detected object angle for stable grasping.



Object Angle Estimation
Detect the orientation of the object using image processing and rotated bounding box analysis.

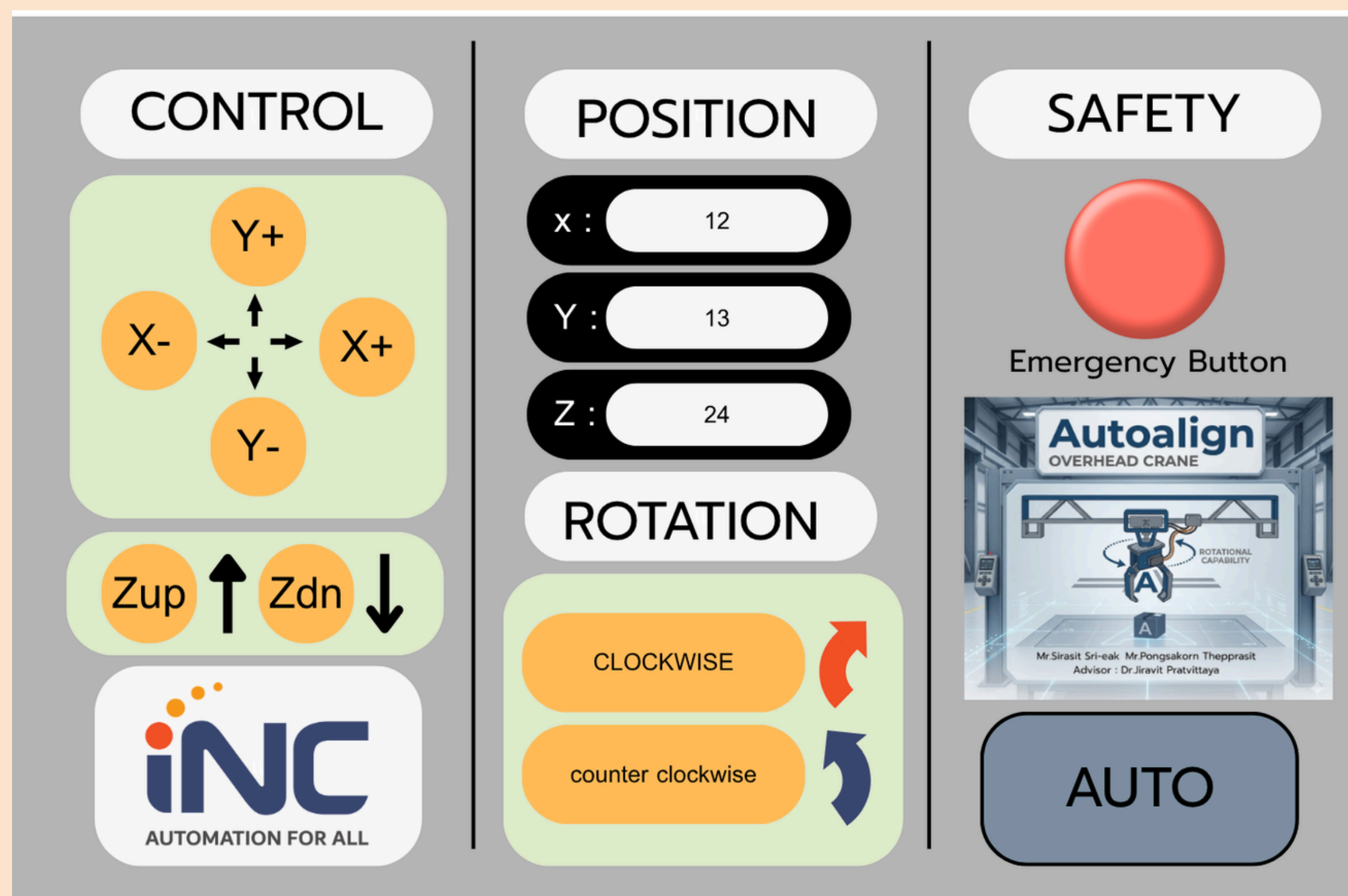


Z-Axis Descent Control
Lower the gripper along the Z-axis while monitoring distance for safe approach.



Object Grasp Execution
Activate the gripper mechanism to securely grasp and lift the object.

Display for control



Conclusion

This project successfully developed a vision-based automatic overhead crane system capable of detecting, aligning, and grasping objects using real-time image processing. The system uses a camera to identify the object position and orientation, then automatically controls the X-, Y-, and Z-axes together with gripper rotation to perform accurate pick-and-place operations. The experimental results demonstrate that the proposed system can reduce manual operation, improve positioning accuracy, and perform autonomous grasping effectively. By combining computer vision, sensor feedback, and sequential state control, the crane is able to complete the grasping process in a stable and reliable manner. This project can be further improved by integrating advanced AI object recognition, trajectory optimization, and industrial-scale control systems for smart warehouse and automated manufacturing applications.

Reference

- [1] Uçar, K., Determination of Angular Status and Dimensional Properties of Objects for Grasping with Robot Arm, 2023.
- [2] G. Du, K. Wang, and S. Lian, "Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers: A review," 2019.
- [3] K. Uçar, "Determination of angular status and dimensional properties of objects for grasping with robot arm" , 2023.

