Implementation of a Robotic Arm for Manufacturing Analysis Using Image Acquisition and Processing for Tracking Moving Objects

JOB IDENTIFICATION CODE #7

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INTRODUCTION

Integrating robotic arms into the manufacturing process permits the create **more efficient, precise, and adaptable production methods**.

The initiative addressed **key industry challenges** such as improving production line adaptability, reducing costs, and enhancing product quality.

The **incorporation of real-time image processing** allows the robotic arm to **recognize, track, and interact with moving objects**, this is crucial because the robotic arm can adjust its movements precisely to align with the objects it interacts with, and the ability to recognize and track objects quickly means that the **robotic arm can operate at higher speeds without sacrificing accuracy.**

METHODOLOGY AND METHODS

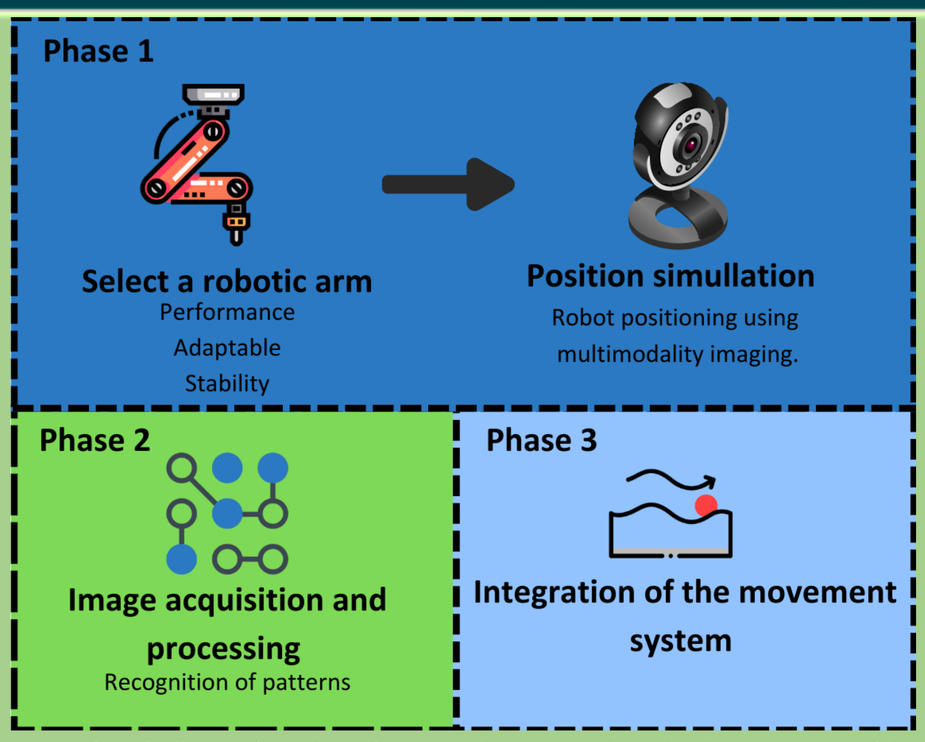

Fig. 1 Methodology for implementing a robotic image tracking and processing system

To simulate and control the robot two controllers were implemented:

- Proportional-Derivative controller

$$u(t) = K_p\, e(t) + K_d \frac{de(t)}{dt}$$

- Nonsingular Terminal Sliding Mode

$$s = \dot{x} + \beta |x|^{\gamma} \operatorname{sgn}(x)$$

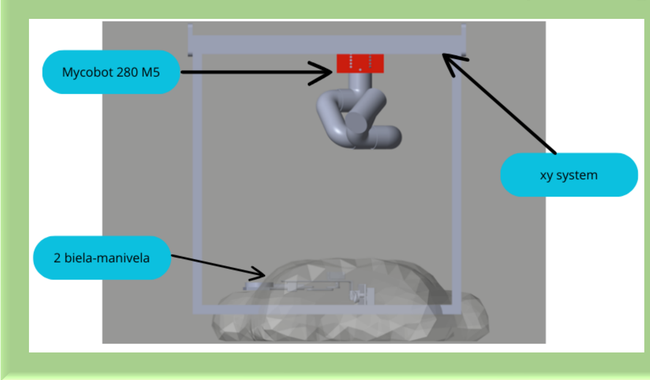

Fig. 2 Simulink model to monitor and control the entire system.

ACKNOWLEDGEMENTS

The paper was prepared with the partial financial support of the Tecnologico de Monterrey, Institute of Advanced Materials for Sustainable Manufacturing under the grant Challenge-Based Research Funding Program 2022 number I006-IAMSM004-C4-T2-T.

RESULTS AND DISCUSSION

The real-time image acquisition and processing enabled the arm to track and manipulate moving objects effectively**, reducing manual intervention and associated errors.**

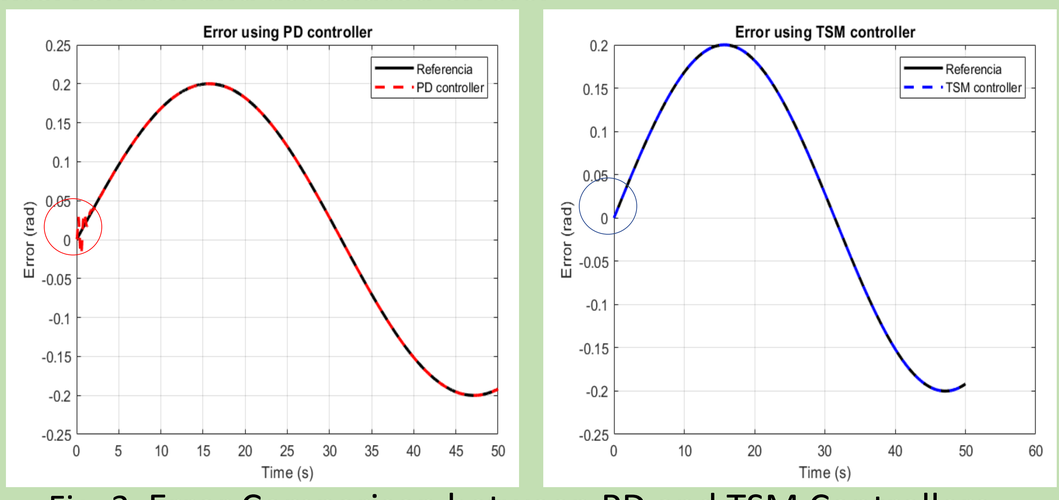

Fig. 3 Error Comparison between PD and TSM Controllers

Fig. 4 Object to be analyzed

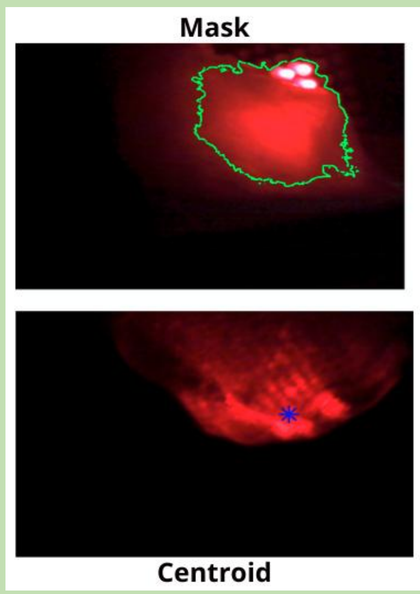

Fig. 5 Analysis of image acquisition and object localization

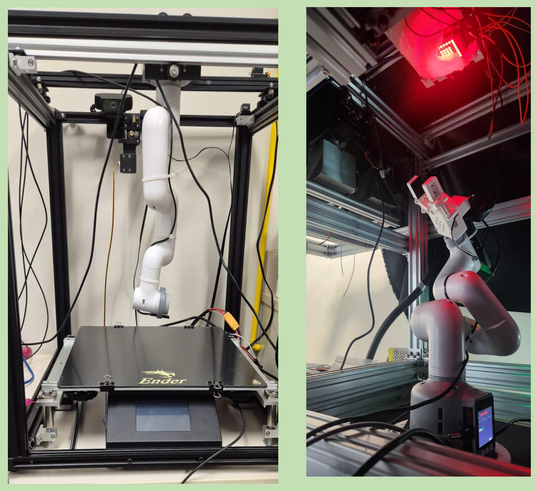

Fig. 6 Integration of robotic automation

CONCLUSIONS

Integrating the robotic arm with image acquisition and processing technologies has demonstrated promising results in **improving manufacturing efficiency and accuracy**.

Looking ahead, implementing deep learning algorithms presents a viable path forward. These algorithms could significantly refine the system's ability to discern and react to complex patterns and movements, more adaptable manufacturing solutions.

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