AUTONOMOUS ROBOT ARM

Combining Reinforcement Learning and Computer Vision for Robotic Autonomy

- JUAN DIEGO LOZADA GONZALEZ
- CRISTIAN SANTIAGO LOPEZ CADENA

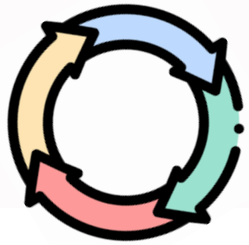
DEPARTMENT OF ENGINEERING, UDFJC

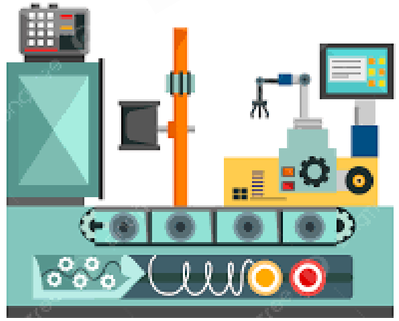
CONTENT

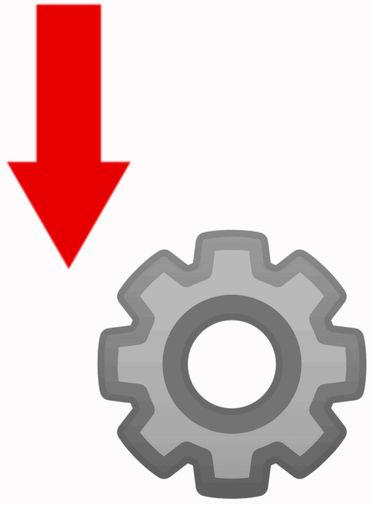
PROBLEM CONTEXT

In factories and warehouses, object handling remains a repetitive task managed by humans or rigid robots.

Traditional robots lack flexibility they fail when object position or shape varies, requiring constant reprogramming.



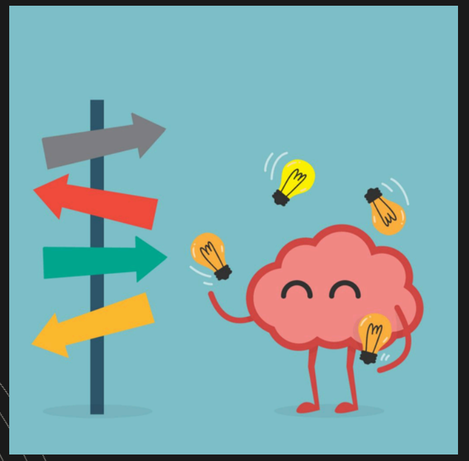


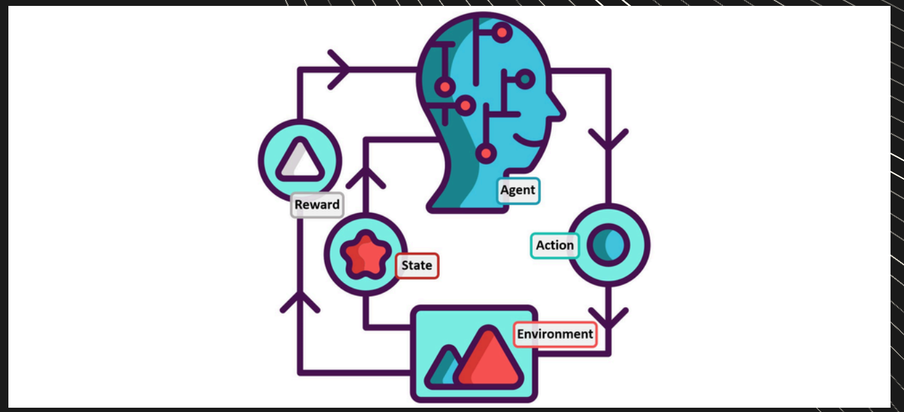


POSSIBLE SOLUTION

- We propose simulating a robotic arm capable of perceiving its environment and making autonomous decisions using AI

- Apply reinforcement learning so the robot can learn through experience, improving its performance over time.





OBJECTIVES

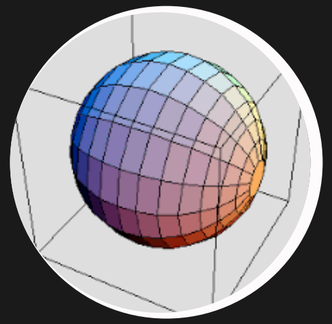
Develop a robotic arm capable of autonomously manipulating objects with varying shapes and positions.

Integrate computer vision to perceive and interpret the environment.

Train the system using Reinforcement Learning (RL) to enable adaptive behavior.

Validate performance in a simulated environment before real-world deployment.

SOLUTION DEFINITION

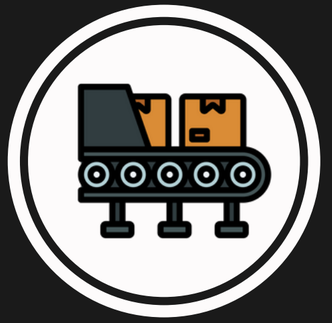


Perception System

The robot uses vision tools like Processing and Gymnasium Robotics to detect objects and understand their position and orientation.

Decision Making AI

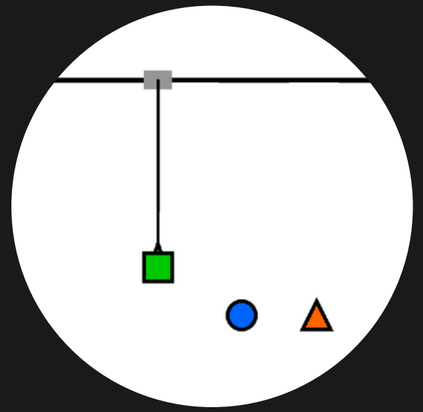
With Reinforcement Learning, the robot learns the best way to grasp objects through trial and error.



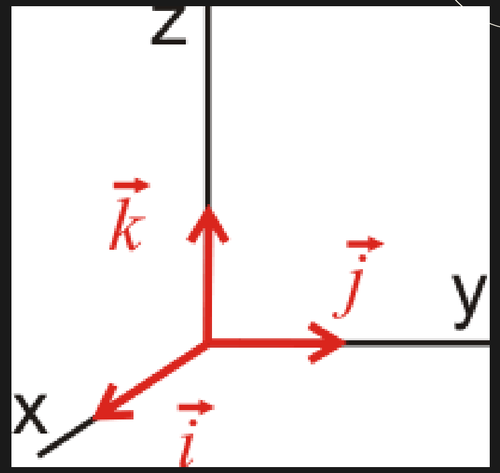
Autonomous Execution

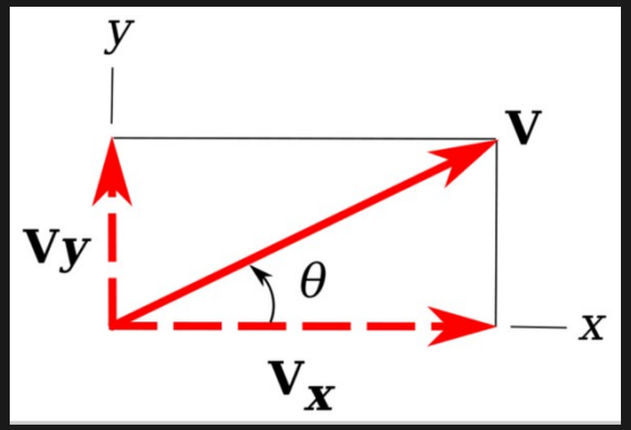
Once trained, the robot acts independently, adapting to new tasks without reprogramming.

IMPLEMENTATION APPROACH



- We use Processing and Gymnasium Robotics to achieve object recognition and spatial awareness through simulation and visual tracking, without relying on deep learning models.

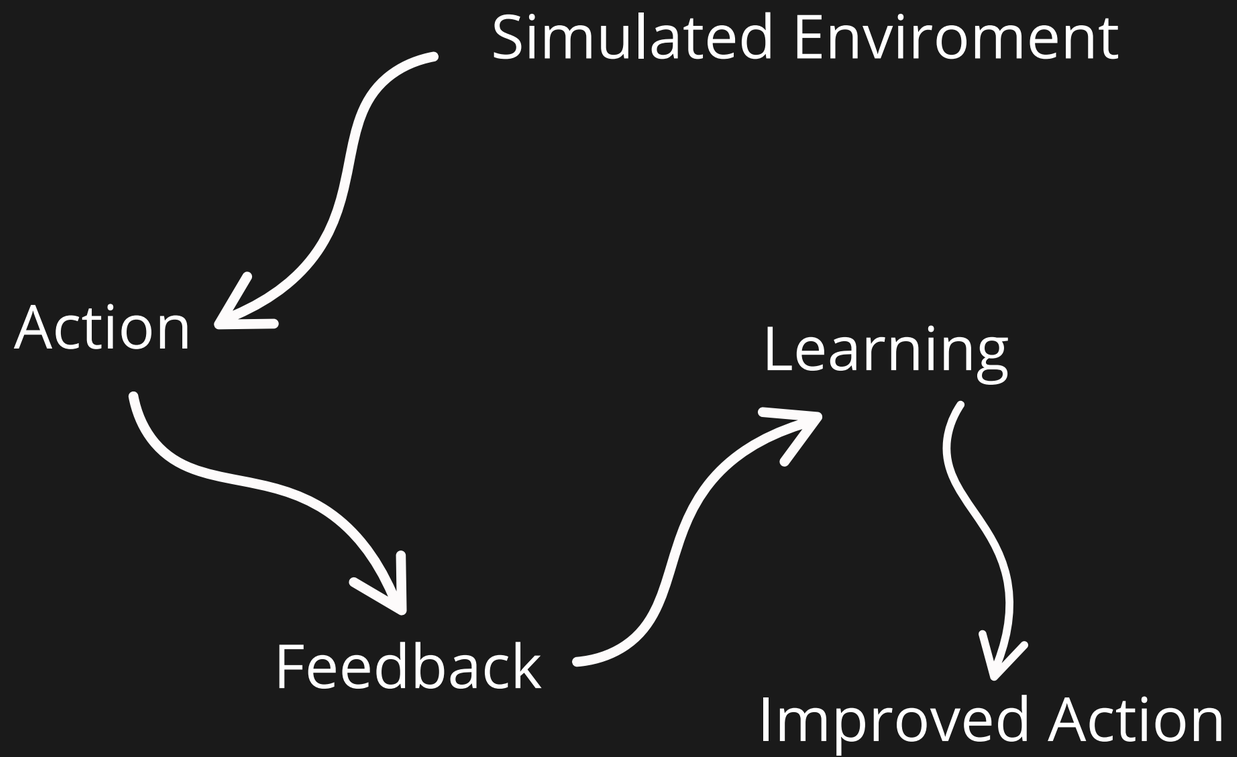




IMPLEMENTATION APPROACH

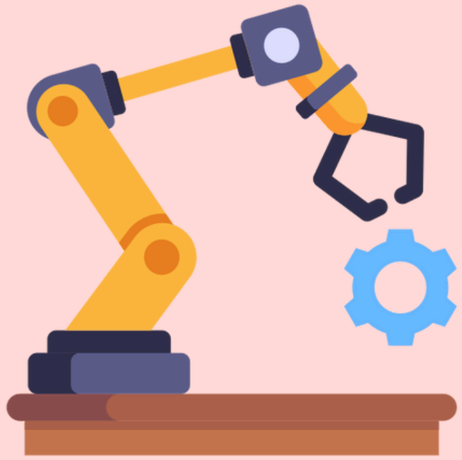
OpenAI Gym

- This approach allows fast iterations, safer testing, and eliminates the need for physical prototypes during early development.



IMPLEMENTATION APPROACH

- we will train the robot’s decision-making system using reinforcement learning with SAC
- Over time, the robot will learn optimal gripping strategies



- GR + SAC + TensorFlow + OpenAI Gym

CONCLUSIONS

1

Reinforcement learning makes it possible for robots to learn from trial and error without needing labeled data.

2

Simulated training environments reduce risks and allow faster development before moving to real-world robots.

3

Combining vision and RL can improve automation by allowing robots to adapt to different objects and tasks.