# Color Recognition Based Tic Tac Toe Playing Robot

**Vishrut Chawla**
**Master's in Robotics and Autonomous System, Arizona State University**

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**ABSTRACT**

This project introduces a sophisticated robotic system designed for autonomous Tic Tac Toe gameplay. Central to the system's capabilities are the integration of the MyCobot 6-DOF robotic arm and a camera module for vision-based position recognition. The camera module captures real-time images of the game board, employing advanced image processing techniques to identify the positions of the game pieces accurately.

The MyCobot robotic arm, renowned for its 6 degrees of freedom, plays a pivotal role in executing precise and dynamic movements for picking and placing game pieces on the Tic Tac Toe board. This integration not only underscores the adaptability of the MyCobot for diverse tasks but also showcases the synergy between robotic hardware and computer vision in creating an interactive and intelligent system.

## 1. INTRODUCTION

In recent years, the integration of robotics into recreational activities has emerged as a captivating area of research, offering innovative solutions for interactive and dynamic experiences. This project delves into the development of a robotic system tailored for playing Tic-Tac-Toe, a classic game that serves as an ideal platform to showcase the versatility and adaptability of robotics in recreational settings.

The inherent challenge lies in creating a robotic system capable of autonomously recognizing and responding to the evolving state of a Tic-Tac-Toe game. Traditional approaches often encounter limitations in precision and real-time decision-making. To address this, our project focuses on leveraging the capabilities of the OpenCV library's camera module, which enhances the robot's vision and positional awareness. This technology infusion aims to overcome the limitations posed by conventional methods, providing a more dynamic and responsive gameplay experience.

Extensive literature review reveals a growing interest in the intersection of robotics and gaming, with a specific emphasis on computer vision for enhanced perception. Existing works explore various applications of robotic systems in gaming scenarios, but the intersection of the MyCobot robotic arm and OpenCV for Tic-Tac-Toe gameplay represents a novel and promising avenue for innovation.

The proposed approach integrates the MyCobot robotic arm with the OpenCV camera module, enabling the robot to accurately recognize the position of blocks on the Tic-Tac-Toe game board. This union of hardware and vision-based technology is anticipated to provide a robust and intelligent solution, allowing the robot to make strategic decisions and execute precise movements during gameplay.

Innovation in this context lies in the seamless fusion of robotics and computer vision, offering a tangible solution to the challenges posed by conventional methods in recreational gaming applications. The project's contribution extends beyond the mere automation of a game; it represents a pioneering effort to demonstrate the practicality and potential of robotic systems in providing engaging and interactive experiences. The research not only advances the capabilities of the MyCobot robotic arm but also underscores the broader implications of integrating cutting-edge technologies to enhance recreational activities.

## 2. Setup for the Robot

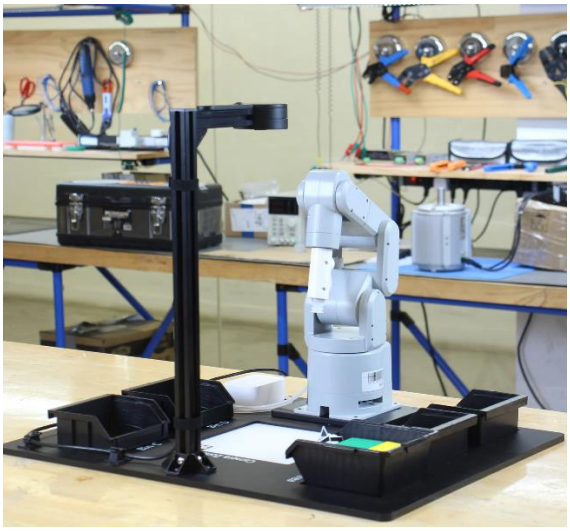
## 2.1 System Architecture

The System architecture is divided into two main sections :-

1. Hardware Configuration
2. Software Configuration

### 2.1.1 Hardware Configuration

We utilize the MyCobot 280 M5, a six-degree-freedom robot, as our base robotic system. The robot is equipped with an AI Camera Kit and features an end-effector suction pump, although it was non-functional during the demonstration. Consequently, blocks were manually placed due to the pump's unavailability.



### 2.1.2 Software Implementation

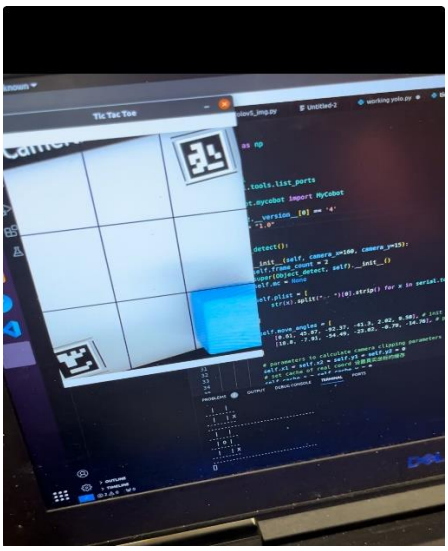
The software aspect of the system centers around the seamless integration of OpenCV for image processing. The camera captures the live feed of the Tic-Tac-Toe game board, and sophisticated color recognition algorithms are employed to identify the exact positions of each block. The coding process was carried out using Python within the Ubuntu environment. All Preferred Installer Program or PIP used is mentioned below :-

| Package | Description |
|---|---|
| cv2 | OpenCV library for computer vision applications. |
| Numpy | NumPy library for efficient array manipulation in Python. |
| Time | Python module for working with time-related functions. |
| Os | Python module for interacting with the operating system. |
| Sys | Python module providing access to some variables used or maintained by the Python interpreter. |
| serial | Python library for serial communication. |
| serial.tools.list_ports | Part of the serial library, used for listing available serial ports. |
| pymycobot | A Python library for controlling MyCobot robotic arms. |

## 3. Block Recognition and Decision Making

### 3.1 Color Recognition

As soon as the camera opens we can see the camera pointing on a slab with two Aruco markers placed diagonally. The Arcuo helps the robot to calculate precise inverse kinematics to choose the best path for picking blocks.




### 3.2 Decision-Making Algorithm

The decision-making algorithm employed by the robot is a multifaceted process. It takes into account the current state of the game, analyzes the opponent's move, and explores potential winning combinations. The algorithm for Tic Tac Toe is developed in Python. The positions for the grid,is, coded in the program and it is ensured that all nine grid positions are in perfect sync. By evaluating various possible moves, the robot intelligently selects the one that either maximizes its chances of winning or minimizes the opponent's opportunities, thereby demonstrating a nuanced and strategic approach to gameplay.

This comprehensive hardware-software integration, coupled with sophisticated block recognition and decision-making algorithms, establishes the methodological foundation for the autonomous Tic-Tac-Toe playing system.

## 3. RESULTS AND DISCUSSION

The robot was successful in playing Tic Tac Toe with aid of the algorithms developed. Multiple trials were conducted and after playing Tic Tac Toe the final message of the winner was displayed on the screen.The robot SN number was **ERMC2800120230201218**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