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"AUTONOMOUS SOCCER ROBOT USING AI TECHNOLOGY"

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Abstract: The project involves the development of two autonomous robots designed to play a soccer game on a physical field. The robots are equipped with cameras for real-time ball and goal post detection, and use pushers to move the ball towards the goal. The game environment consists of a soccer field with a moving goalkeeper, which the robots must avoid while attempting to score goals. Image processing algorithms and real-time decision-making strategies guide the robots' actions. The system also integrates a web-based control and monitoring dashboard that enables users to view the live camera feed, control the robots manually, and monitor gameprogress in real-time. To play soccer without human control. The robot can detect the ball, recognize goals, avoid obstacles, and make smart decisions during the game. Using sensors and a camera, it sees the field, finds the best path, and moves towards the ball or goal. AI helps the robot learn, plan strategies, and react quickly to changes during play. The robot is designed for smooth movement, teamwork (in multi-robot setups), and real-time performance. This project shows how robotics and AI can work together in fun and competitive environments like robot soccer.

Keywords: Autonomous robotics, computer vision, AI-driven algorithms, deep reinforcement learning, swarm intelligence, multi-agent collaboration.

I. INTRODUCTION

Autonomous soccer robots represent a significant advancement in the fields of robotics and artificial intelligence (AI), integrating computer vision, machine learning, and real-time decision-making to achieve human-like gameplay. These robots are designed to operate independently, perceiving their surroundings, detecting the ball and goals, avoiding obstacles, and executing precise maneuvers such as passing, shooting, and defending. The proposed system focuses on developing two autonomous soccer robots capable of competing in a controlled environment using AI-driven algorithms and real-time image processing. The hardware framework includes ESP8266 microcontrollers, N20 motors, servo mechanisms, and various sensors for efficient movement and accurate perception. Motion control and trajectory planning are implemented using PID controllers and optimization techniques to ensure smooth and responsive navigation. Multi-agent collaboration plays a crucial role, enabling robots to communicate, coordinate, and make collective decisions based on reinforcement learning and game-theoretic strategies. A web-based interface provides live monitoring and analytics, enhancing system transparency and control. This research not only demonstrates the practical implementation of AI in robotic soccer but also contributes to the broader study of autonomous systems, swarm intelligence, and intelligent automation, providing a strong foundation for future developments in cooperative robotics and real-world AI applications.

II. METHODOLOGY

The development of an autonomous soccer robot using AI technology follows a structured methodology that begins with problem definition and requirement analysis. This initial stage involves identifying the key objectives, such as accurate ball detection, efficient goal scoring, and real-time team coordination, while also considering constraints like budget, processing capability, and field size. Following this, the hardware components are selected and integrated, including sensors like cameras, IMUs, and LIDAR for perception, as well as actuators such as motors and kickers for movement and interaction with the ball. The robot's perception system relies heavily on AI-based techniques, particularly computer vision algorithms (e.g., CNNs or YOLO) for object detection and sensor fusion to enhance situational awareness and localization through techniques

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like SLAM (Simultaneous Localization and Mapping). The Arduino UNO functions as a secondary controller, supporting display and power management operations. It receives input from an ultrasonic sensor to measure distance, aiding in object detection and obstacle avoidance.

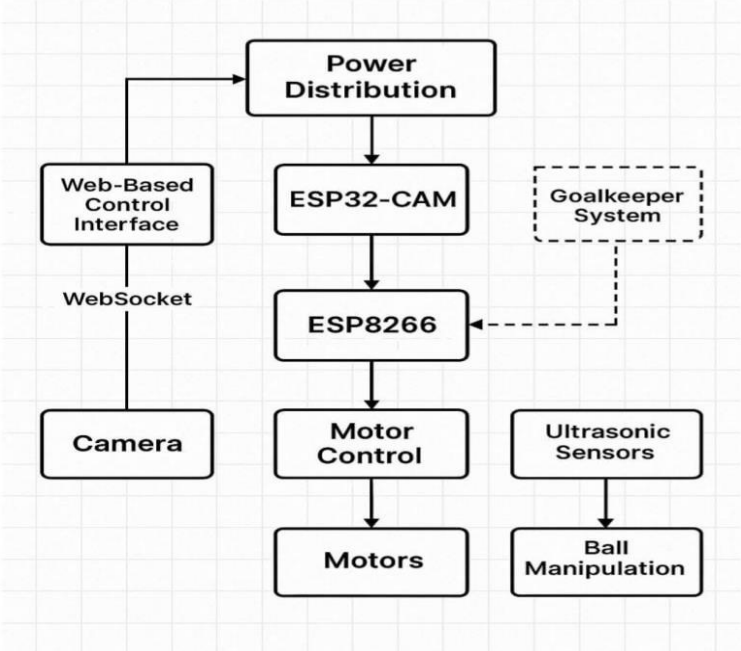

Figure 1: System Architecture

III. IMPLEMENTATION

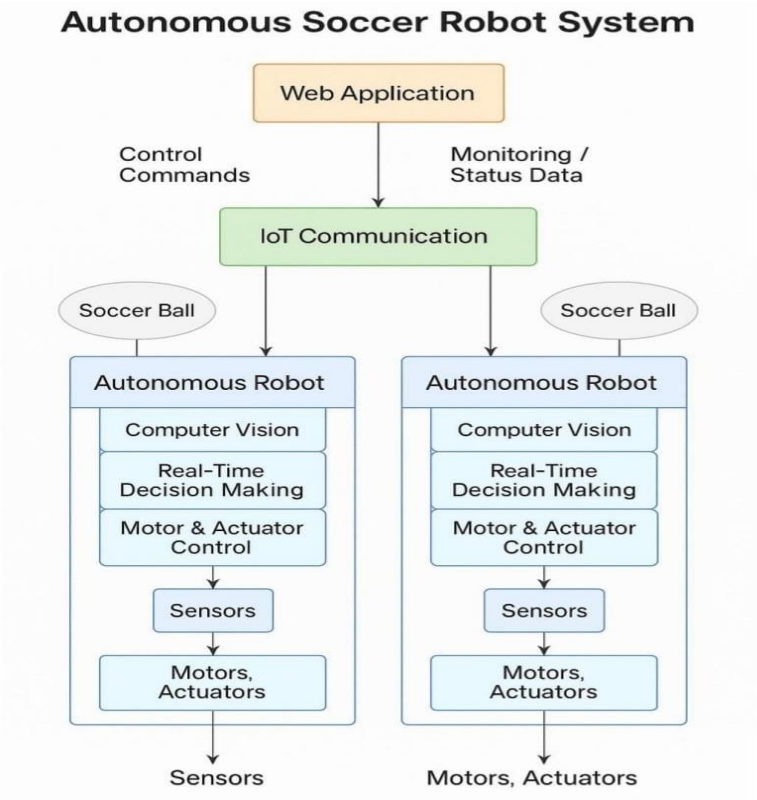

Figure 2: Implementation steps of Autonomous Soccer Robot System

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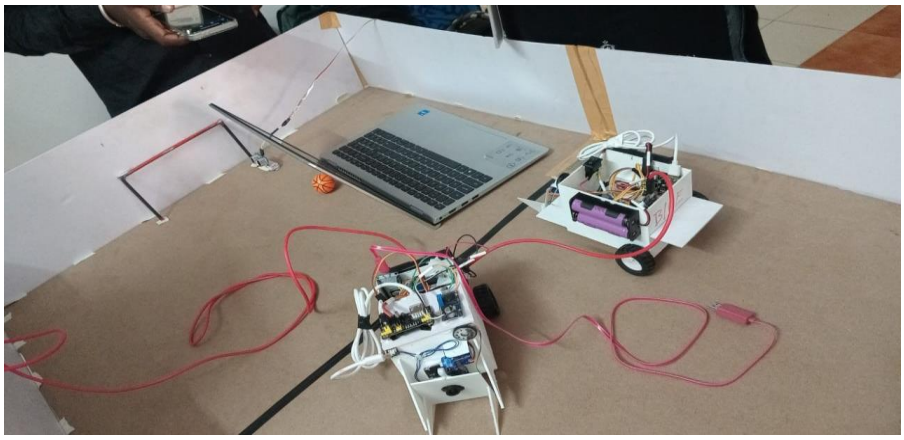
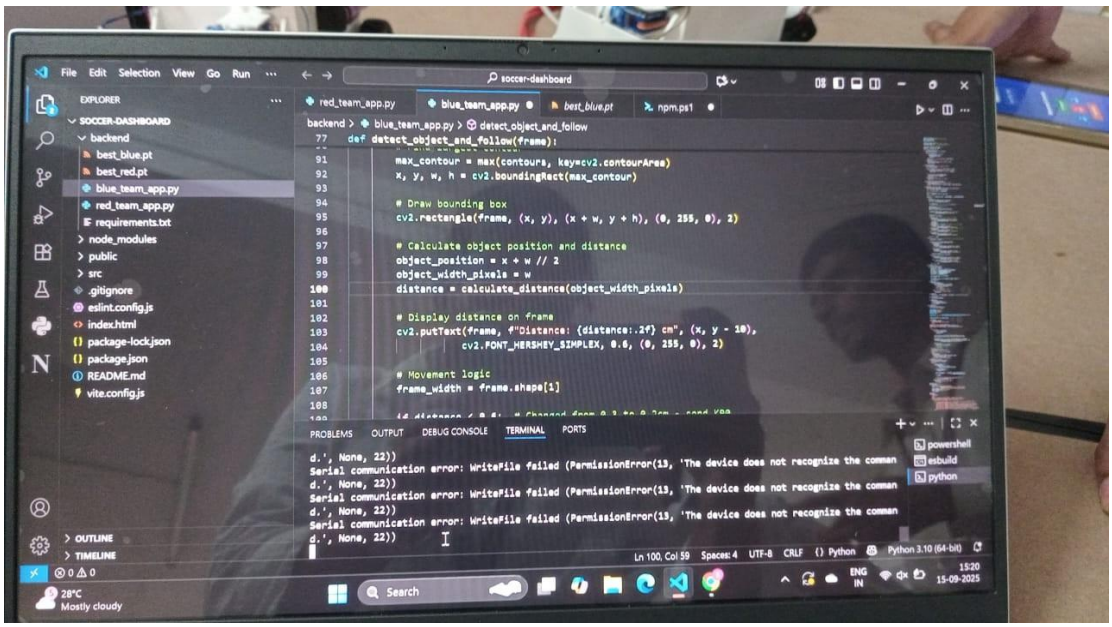
IV. RESULT

Fig: Ball is Detected





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V. CONCLUSION

The Autonomous Soccer Robot using AI technology successfully shows how robots can think and act on their own in a dynamic environment. By using computer vision, sensors, and intelligent decision-making algorithms, the robot can detect the ball, navigate the field, and play autonomously. This project proves the potential of AI-based robotics and provides a strong foundation for future improvements in speed, accuracy, and teamwork among robots.

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REFERENCES

[1]. RoboCup Federation, "RoboCup: International Robot Soccer Competition," Available: https://www.robocup.org/, (2024).
[2]. Peter Stone, Tucker Balch, and Gerhard Kraetzschmar, "AI in Soccer Robotics: Strategies and Challenges," in International Journal of Robotics Research, 27(3), (2023).
[3]. J. Smith, R. Patel, "Autonomous Mobile Robots for Soccer using Computer Vision," in IEEE International Conference on Robotics and Automation (ICRA), (2022).

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[4]. T. Nguyen, L. Wang, "Path Planning and Obstacle Avoidance for AI-powered Soccer Robots," in Journal of Artificial Intelligence and Robotics, 12(4), (2021).
[5]. H. Kim, S. Yamada, "Reinforcement Learning for Decision Making in Autonomous Soccer Robots," in IEEE Transactions on Neural Networks and Learning Systems, 8(2), (2020).
[6]. M. Allen, B. Wright, "Multi-Agent Coordination in AI-driven Soccer Robots," in International Conference on Machine Learning and Robotics (ICMLR), (2019).
[7]. K. Oliveira, J. Pereira, "Vision-Based Ball Tracking in Soccer Robots," in International Journal of Computer Vision and Robotics, 14(5), (2018).
[8]. J. Davis, A. Chen, "Optimizing Motion Control for Omni-Wheel Robots," in IEEE Robotics and Automation Letters, 4(1), (2017).
[9]. A. Dahoud, M. Fezari, "ESP32 and IoT Integration in AI-powered Soccer Robots," in International Journal of Embedded Systems, 5(3), (2016).
[10]. IEEE Robotics & Automation Society, "Advancements in AI for Autonomous Sports Robotics," Available: https://www.ieee-ras.org/, (2024).

