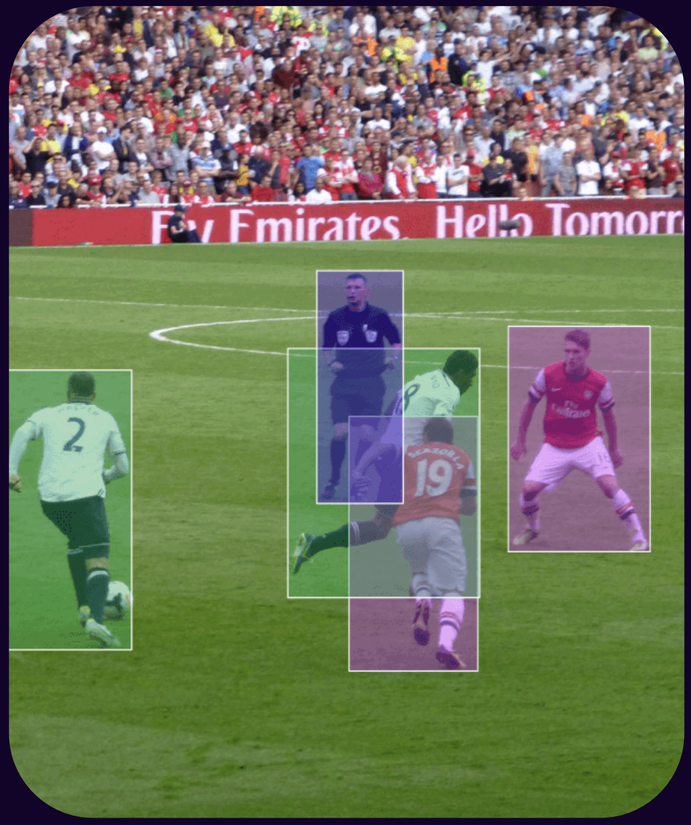
MACHINE PROBLEM 1

Exploring the Role of Computer Vision and Image Processing in AI

CSST 106 | Perception and Computer Vision



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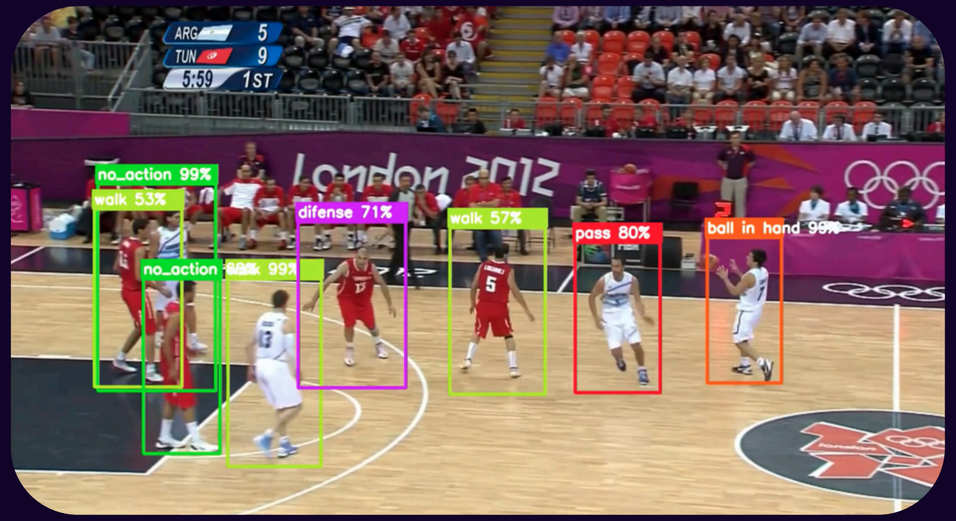
Introduction to Computer Vision and Image Processing



Computer Vision (CV) is a field that helps computers understand and make sense of images and videos, just like humans do. It uses cameras and advanced software to "see" and recognize objects, people, and actions. Before computers can analyze these visuals, the images need to be processed. Image processing involves improving and preparing these images by converting them into a digital format and enhancing their quality. This step is essential because it helps AI systems learn from the images more accurately. AI, especially machine learning, then uses this processed information to recognize patterns and make decisions based on what it sees, enabling computers to understand and interact with the visual world.

Types of Image Processing Techniques

1

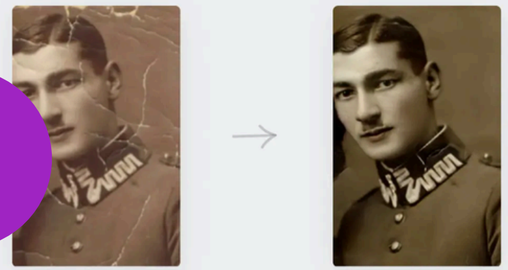
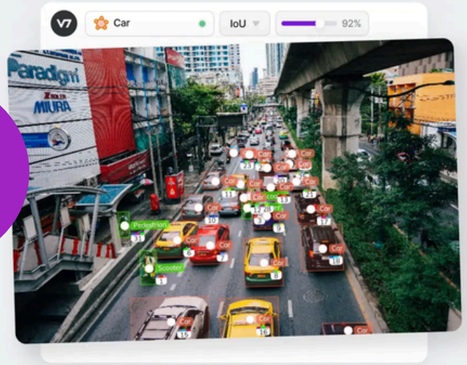


Image Restoration

2



Object Detection

3

Image-to-Image Translation

Case Study Overview

SPORT ANALYTICS

A Data-Centric Approach to Computer Vision

In sports analytics, image processing detects and tracks key elements like players and the ball in sports videos. Techniques like object detection, identify these elements in each frame and track their movements over time, allowing for detailed analysis of player positions, ball trajectories, and key events like shots or fouls. These methods help solve visual problems such as recognizing small or fast-moving objects, which may be challenging due to data imbalance or poor labeling quality. The effectiveness of these techniques in sports analytics is enhanced by improving data quality and addressing issues like false negatives and mispredictions.

Image Processing Implementation Overview

Player Detection and Tracking in Soccer Matches

This image-processing implementation aims to develop an image-processing model that detects and tracks players in soccer match videos. By converting video frames to grayscale, applying background subtraction, and using object detection algorithms like YOLO, the model will identify and follow players throughout the game. A tracking algorithm will then monitor each player’s movement, providing insights into team formations, player positioning, and tactical strategies, ultimately enhancing sports analytics and game analysis.

Conclusion

Effective image processing is key to making AI systems work well, especially in areas like sports analytics where accurately finding and tracking players and the ball is important for understanding the game. By processing images correctly, separating important parts, and using detection and tracking methods, AI can gather useful insights for better decision-making. This activity taught me how different image processing techniques must be combined to solve specific problems and how these steps help AI models perform better and provide more reliable analysis.

Extension Activity

Edge Computing and Lightweight Architecture

The growing focus on edge computing in computer vision is set to have a major impact on future AI systems. By processing visual data directly on devices like smartphones, drones, and IoT sensors, edge computing reduces delays and allows for real-time data processing. This is especially important for applications in industries like manufacturing and security. As a result, we will likely see more development of small, efficient AI applications that can run on low-power devices. To support this, lightweight AI models like YOLO and SSD, which require fewer resources than traditional models like R-CNN, will become increasingly important. These models will enable AI to function effectively on devices with limited power and memory, paving the way for more widespread use of AI in various real-time, on-the-go applications.