Autonomous Agents (INF 412) 2023-2024

Project presentation

Compliance with the Road Traffic Code in an Autonomous Driving Agent

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Contents

This project focuses on enhancing an already implemented autonomous driving system by integrating functionalities for stop sign detection and traffic light recognition.

The aim is to ensure compliance with road traffic regulations, thereby enhancing safety and legal adherence.

Leveraging the WeBots R2023b simulator and the "city.wbt" world environment, controllers were developed to enable these functionalities.

Despite challenges in implementation, innovative solutions were devised to overcome obstacles.

This presentation provides an overview of the project's objectives, methodology, challenges faced, and outcomes achieved.

Simulator Selection: We opted for the WeBots R2023b simulator due to its compatibility and comprehensive features, choosing the "city.wbt" world environment for realistic testing.

Controller Enhancement: Building upon existing functionality for lane keeping and obstacle avoidance, a C-based controller was further developed to incorporate stop sign detection and traffic light recognition capabilities, enhancing overall vehicle behavior management.

Stop Sign Detection

The stop sign recognition system utilizes the camera sensor to detect stop signs, with the "testStpRecognition" function analyzing recognition data. Once detected, the system determines the stop sign's distance and initiates appropriate responses based on the vehicle's speed.

- If a stop sign is within the calculated stopping distance plus an extra meter and an obstacle is present, a full emergency stop is initiated
- Otherwise, the vehicle decelerates for an anticipated intersection stop but continues cautiously without halting completely.

Traffic Light Recognition

Traffic light functionality in autonomous driving involves three steps: detection, state determination, and response execution.

Initially, the "testTrLightRecognition" function identifies traffic lights and extracts bounding box information.

Subsequently, the "detect traffic light" function analyzes image data to classify the light's color state.

Responses are then executed based on the detected color, ensuring compliance and safe navigation through intersections.

03 Demonstration
of Stop Sign Detection

Full emergency stop in the presence of a passing car (video)
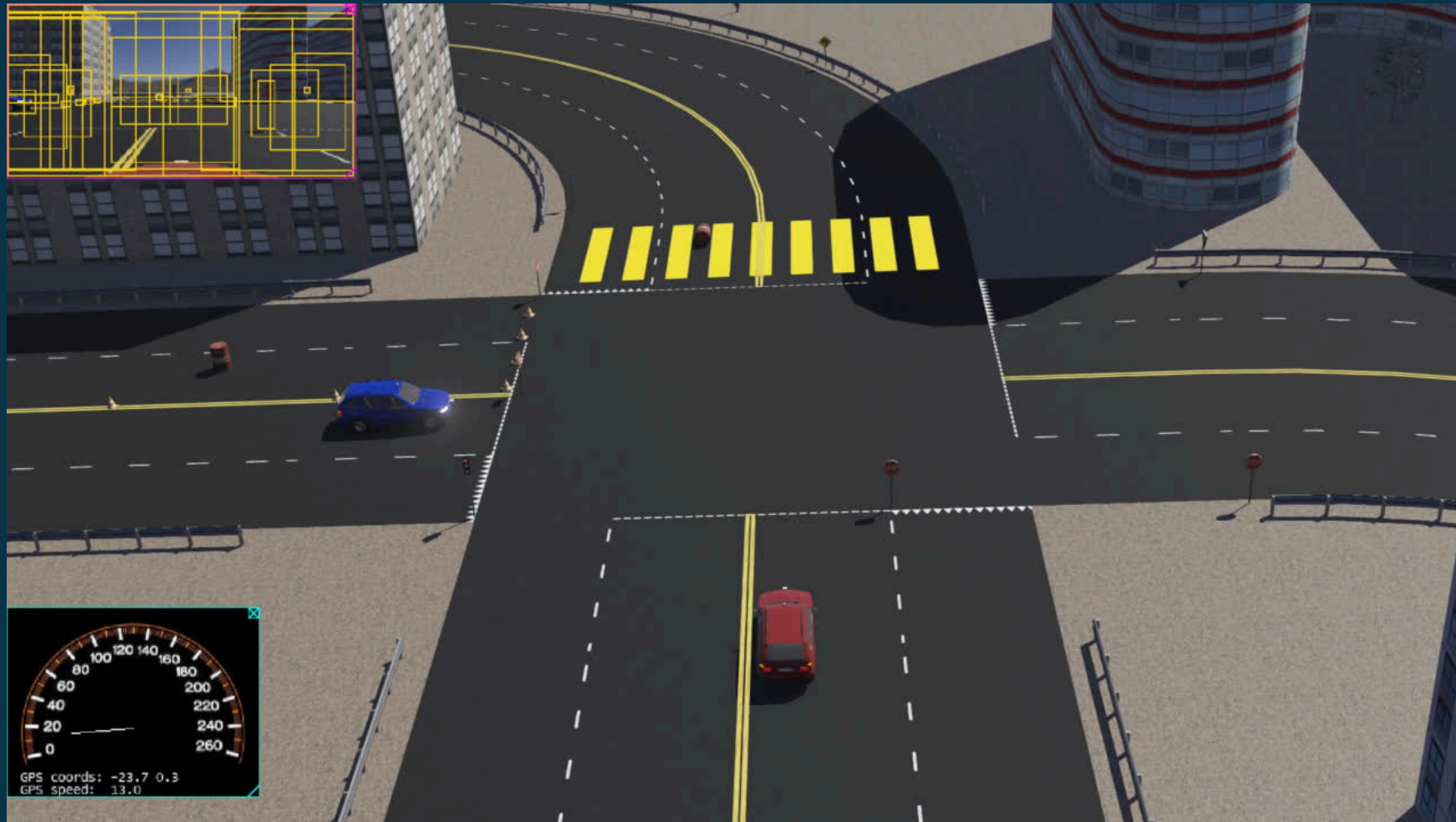
Deceleration of the car in the absence of moving obstacle and cautious driving (video)

03 Demostration
of Traffic Light Recognition

Green Light (video)

Green to Orange Light (No time to stop) (video)

03 Demostration
of Traffic Light Recognition

Green to Orange to Red Light (video)

Red to Green Light (video)
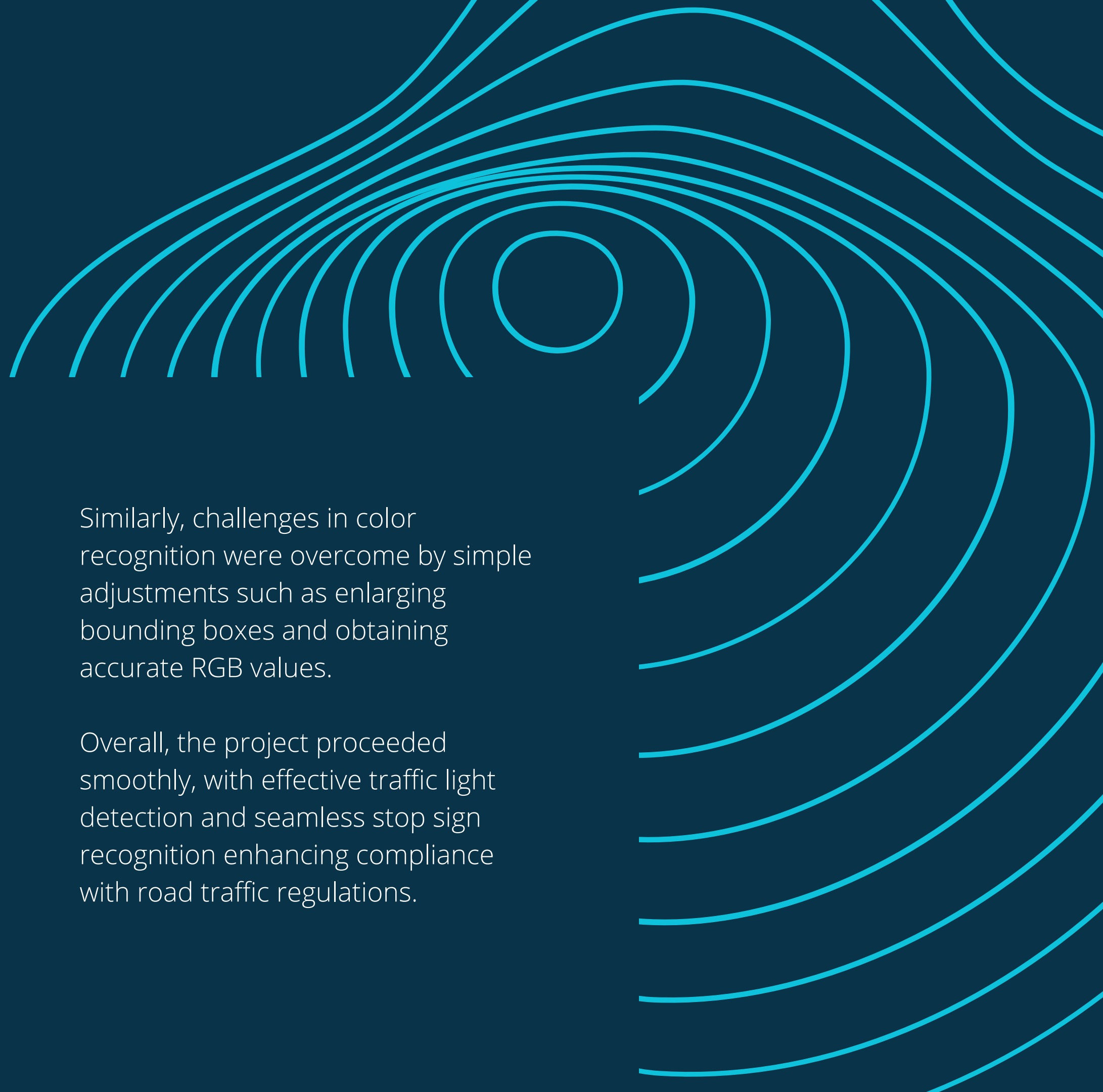
Transitioning from an earlier version of WeBots to WeBots R2023b presented some minor challenges due to differences in library functions. However, these issues were quickly resolved with the help of the comprehensive WeBots reference manual.

While there were some initial difficulties in detecting and recognizing traffic lights, these were addressed by converting the robot to a base node for improved detection.

Similarly, challenges in color recognition were overcome by simple adjustments such as enlarging bounding boxes and obtaining accurate RGB values.

Overall, the project proceeded smoothly, with effective traffic light detection and seamless stop sign recognition enhancing compliance with road traffic regulations.

Thank you!