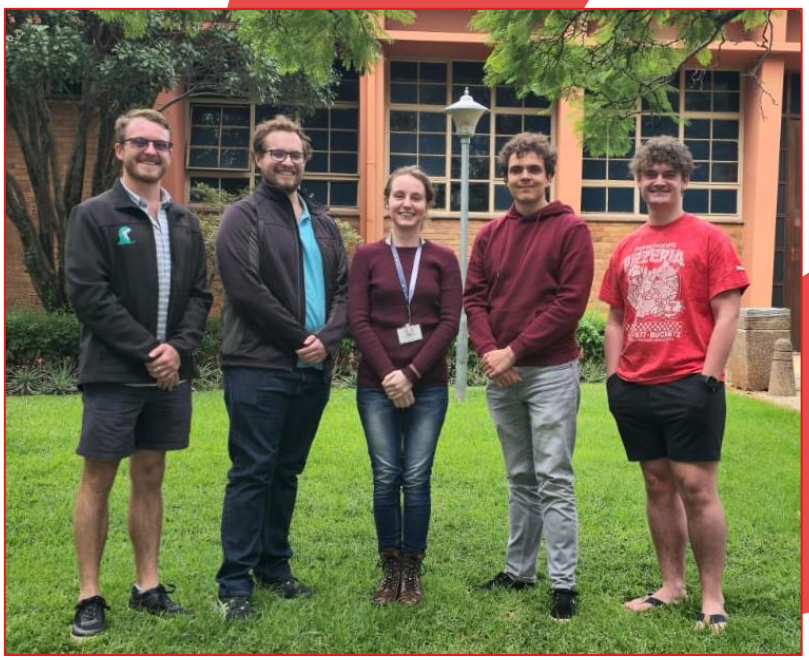
SuperLap Racing Line Optimization System

EPI-USE



Quintessential

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Requirements

Functional Requirements

R1: Track Image Processing

R1.1: Image Conversion

- The system will convert top-down racetrack images into binary maps for AI analysis.
- The system will load data from saved csv files for comparison.

R1.2: Boundary Detection

- The system will accurately detect and distinguish track boundaries from off-track areas.
- The system will store this information for future use.

R2: Racing Line Optimization

R2.1: Reinforcement Learning

- The system will apply Reinforcement Learning (RL) to simulate and refine racing lines.
- The system will use data saved as .csv files to train the AI.

R2.2: Path Evaluation

- The system will iterate through multiple paths to determine the fastest racing line.

R3: AI Training and Simulation

R3.1: Training Data Input

- The system will train AI agents using simulated or game-based datasets.

R3.2: Physics Modelling

- The system will incorporate physics-based models to ensure realistic performance.

R4: Result Visualization

R4.1: Line Overlay

- The system will overlay the optimized racing line on the track image.

- The system will allow for adjustments to the overlay.

R4.2: Performance Metrics

- The system will display key performance indicators such as estimated lap time and braking zones.

R5: Infrastructure Integration

R5.1: Computation Support

- The system will support GPU-accelerated or equivalent computational resources for efficient RL training.

R5.2: Cloud Compatibility

- The system will optionally integrate with cloud services to allow for scalability and extended computation.

R6: Adaptive AI Strategies

R6.1: Dynamic Track Conditions

- The system will adjust racing lines based on simulated track conditions (e.g: wet/dry surfaces).

Wow Factors

R7: Enhanced Visualization & User Interaction

R7.1: Interactive 3D Simulation (Optional)

- The system will provide optional 3D visualization of the track and racing line for enhanced user insight.

R7.2: Dynamic Line Adjustment

- The system will allow users to manually adjust the racing line and re-simulate performance with sliders and input areas.

R7.3: Heatmap of Speed/Acceleration Zones

- The system will generate a speed/acceleration ‘heatmap’ overlay for performance analysis.
- The system will allow users to provide feedback on AI-generated lines for iterative improvement.

Domain Model