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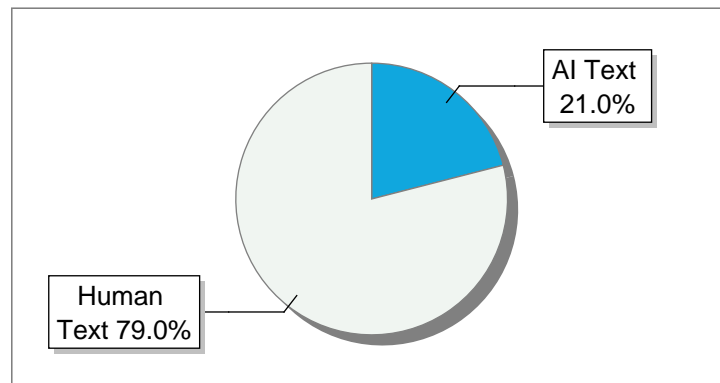
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Lane Vision – Parallel Lane Vehicle Speed Tracking MrL.

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Hemanth Sai Sri Vasavi Engineering College Jawaharlal Nehru Technological University Tadepalligudem, India hemanthsai2277@gmailcom Abstract - The rising number of accidents linked to over speeding presents a critical road safety challenge.

Conventional speed monitoring methods, such as radar guns and manual CCTV verification, often lack accuracy in multi-lane traffic scenarios.

This paper introduces an intelligent Vehicle Speed Detection System designed to accurately detect and calculate the speed of parallel vehicles, automatically flagging any that exceed the speed limit.

The system architecture includes secure email-based user authentication, storage for both original and processed video files, and the capability to generate downloadable CSV reports.

It is designed with cross-platform compatibility for seamless operation on both desktop and mobile devices.

The proposed framework emphasizes reliability, security, flexibility, and portability as a comprehensive solution for modern intelligent transport systems.

Keywords - Vehicle Speed Detection, Overspeed Monitoring, Intelligent Transport System, Computer Vision, Authentication, Road Safety I.

INTRODUCTION Conventional approaches to monitoring vehicle speeds-such as radar technology and manual observation-have served traffic management for many years.

However, these methods struggle with scalability and accuracy, especially in congested environments where multiple vehicles travel side by side.

Although computer vision technologies offer promising alternatives, current implementations typically concentrate on speed measurement alone, neglecting critical operational needs.

Notable deficiencies in existing systems include inadequate compensation for perspective distortion that compromises measurement precision, along with insufficient attention to authentication mechanisms and practical data handling capabilities.

This paper introduces a comprehensive Intelligent Vehicle Speed Detection System designed to overcome these limitations.

The systems core innovation lies in its ability to perform real-time detection and precise speed calculation for vehicles traveling in parallel lanes through sophisticated computer vision algorithms and geometric transformation techniques.

The solution extends beyond mere speed estimation by integrating essential operational features robust user authentication protocols, dependable video storage infrastructure, and automated report generation with download functionality.

Designed for cross-platform compatibility across both desktop and mobile environments, this system represents a complete framework for secure, dependable, and widely accessible traffic enforcement technology.

II LITERATURE SURVEY An examination of existing research demonstrates notable progress in vehicle detection and tracking methodologies.

□ A YOLO modification incorporating RANSAC and interpolation maintains consistent confidence levels between frames, substantially enhancing object tracking precision in video analysis.

□ Research examining the YOLOv3 framework underscores its capability as a high-speed, accurate detection algorithm.

The study emphasizes its essential contribution to building reliable autonomous driving systems and intelligent driver assistance technologies.

- Additional work presents a vision-based technique for calculating vehicle velocities from video sequences in real-time, demonstrating practical utility for traffic monitoring authorities and law enforcement operations.
- A performance evaluation comparing three successive YOLO iterations-versions 3, 4, and 5-for vehicle identification and categorization revealed that the fifth version delivered superior accuracy metrics, though with a slight reduction in computational efficiency.

III EXISTING SYSTEM Traffic speed monitoring relies on error-prone human observation or flawed stationary detection equipment.

Human monitoring fails under dense traffic.

Automated systems have major limitations Radar detects one vehicle per cycle with angle errors; loop detectors are costly (requiring pavement work) and immobile.

Both struggles to simultaneously measure adjacent lanes.

Standard surveillance cameras are too slow for instant enforcement, requiring manual video review.

Functionally, these systems often lack data security for violation records and automatic, standard documentation, diminishing both operational effectiveness and legal admissibility.

IV PROPOSED SYSTEM The system functions as an intelligent, automated framework addressing traditional speed enforcement deficiencies.

Utilizing YOLOv8 architecture for multi- object detection, it enables simultaneous identification and monitoring of vehicles across separate lanes improving upon conventional equipment.

Speed calculation achieves high accuracy through DeepSORT tracking algorithm maintaining object continuity across frames, while frame differential analysis with perspective transformation ensures precise velocity measurements under congested conditions.

Vehicles surpassing configured thresholds are immediately identified as violations.

The system prioritizes security through email-based authentication restricting access to verified personnel.

Raw and processed footage are stored as documentary evidence, with automatic CSV generation containing vehicle identification, speeds, and timestamps.

Compatible with desktop and mobile devices, it provides a comprehensive, secure, and accessible enforcement solution.

V METHODOLOGY Here are three ways to reduce the text while keeping the core meaning, from slightly reduced to most concise Authentication & Upload Access is restricted to verified users via email-based login and mandatory registration, ensuring accountability for both video upload and report access.

Enhancement & Detection Upon upload, footage is enhanced (brightness/contrast normalization) using OpenCV.

The YOLOv8 architecture then scans frames to identify and locate vehicles.

Tracking & Velocity The DeepSORT algorithm tracks vehicles by assigning unique, persistent tags.

Velocity is computed by measuring inter-frame movement, converting it to physical distance (using perspective correction), and dividing by frame time.

Speeds exceeding the limit automatically generate violation records.

Storage & Documentation Raw and processed videos are systematically archived.

Violation data, including vehicle tags, speeds, and timestamps, is formatted into CSV files for retrieval by authorized desktop users.

VI SYSTEM ARCHITECTURE The system employs a modular, service-based framework dividing operations into discrete communicating modules for clear workflow progression, maintenance, and future expansion.

User Interface and Data Entry □ Authentication Module Controls system entry through email verification with One-Time Password protocols for secure user validation.

□ Application Module (Dashboard) Centralized interface supporting video uploads, live processing updates, and displaying analysis outcomes.

□ Upload Module Handles video file validation, stores raw recordings securely, and activates analytical workflow.

Processing Engine □ Frame Decomposition Separates video into sequential frames.

□ Detection & Tracking YOLOv8 identifies vehicles while DeepSORT tracks them across frames using unique persistent identifiers.

□ Velocity Computation & Violation Identification Converts pixel movement to physical distance through calibration; vehicles exceeding speed thresholds are designated as infractions.

□ Visual Enhancement Overlays boundary boxes, tracking identifiers, and velocities onto frames.

Output Module Records structured data including vehicle identifiers, velocities, and violations into database storage; produces automated CSV files; preserves processed annotated video accessible via dashboard interface.

Figure1 System Architecture VII.

SYSTEM OVERVIEW Initial User Engagement Figure2 Public Landing Interface The systems homepage is the entry point, featuring visual demonstrations of its advanced real-time vehicle tracking and speed measurement capabilities to engage potential users.

Secure User Authentication Figure3 Login Security Gateway Users access the platform through a credential-based authentication screen requiring username and password input, with password recovery functionality ensuring controlled system entry.

Centralized Video Management Dashboard Figure4 Video Management Control Panel The central dashboard provides comprehensive oversight of all uploaded and analyzed videos, displaying processing status, enabling result downloads (video/CSV formats), and facilitating content management.

Initiating Video Upload Process Figure5 Video Submission Initiation Users begin the analysis workflow by selecting video files from their local storage through an intuitive upload interface.

Confirming Video Upload Selection Figure6 Upload Verification The system displays selected file details including name and size before final submission, confirming user selection accuracy.

Monitoring Pending Processing Tasks Figure7 Processing Queue Display Newly uploaded videos appear on the dashboard as Pending Users can then initiate analysis or remove the queued entries.

Processing Progress Pop-up (High Percentage) Figure8 Advanced Progress Tracking The progress modal continues displaying completion percentages (eg, 94%) and current frame counts as analysis nears completion.

Backend Processing Log Figure9 System Processing Console Backend logs provide technical details like frame processing rates (eg, 54 FPS) and confirm the data export to CSV format.

Web Interface - Detection Results Table Figure10 Tabular Detection Data A web table shows detailed detection data (IDs, speeds, timestamps) and highlights speed violations.

10 Annotated Video Playback Figure11 Annotated Video Playback 1 Figure12 Annotated Video Playback 2 Processed footage features overlay graphics (tracking boxes, IDs, and speeds) to provide visual validation of detection accuracy.

11 Processed Video Details with Overspeed Detection Figure13 Violation Summary Display Results pages explicitly show violation counts (eg, 1 Overspeed) and total statistics, proving effective speed threshold enforcement.

12 Generated CSV Report in Spreadsheet Software Figure14 Exportable CSV Documentation The generated CSV reports provide structured data (IDs, speeds, timestamps, confidence scores) and violation indicators for administrative use.

VIII RESULTS The system underwent rigorous testing with authentic traffic recordings across diverse environmental conditions, confirming reliable performance across all operational capabilities including simultaneous multi-vehicle identification in parallel lanes, consistent tracking with unique identifiers maintained throughout video sequences, highly accurate velocity measurement with minimal false positives in violation detection, secure archival of raw and analyzed video content, automated CSV documentation fully aligned with processed videos containing vehicle tags, speeds, and violation indicators, error-free email- authenticated access control restricting entry to verified users only, and full cross-platform compatibility with smooth operation on both desktop and mobile devices, validating the systems dependability, precision, and user- focused architecture.

IX CONCLUSION Rigorous testing validated the systems success across key areas accurate multi-vehicle detection in parallel lanes, precise speed measurement, consistent tracking, secure data storage (with automated CSV documentation), and seamless cross-platform functionality.

By addressing traditional limits like low capacity, human error, and poor security, this advanced system is now ready for immediate deployment within existing Intelligent Transportation Systems (ITS) infrastructure to enable consistent, efficient speed enforcement and reliable, data-driven traffic management.

X LIMITATIONS AND FUTURE WORK The Intelligent Vehicle Speed Detection System reliably finds parallel vehicle violations in standard conditions but is limited by reduced accuracy in adverse weather, hardware-dependent speed, lack of ANPR, local storage, and poor system integration.

Future development will address this with six key enhancements implementing ANPR, integrating Cloud/IoT for

scalability and real-time sharing, developing all-weather algorithms, adding instant alerts, optimizing for heavy congestion, and including automatic fine calculation/online payments.

These upgrades aim to create a comprehensive solution for modern smart transportation.

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