INVENTION DISCLOSURE FORM

Details of Invention for better understanding:

1. TITLE

Real-Time Vehicle Tracking System

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2. INTERNAL INVENTOR(S)/ STUDENT(S)

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3. DESCRIPTION OF THE INVENTION

A. PROBLEM ADDRESSED BY THE INVENTION

Modern urban cities face significant challenges in monitoring and managing road transportation effectively. Traditional methods of vehicle tracking depend on manual observation, static CCTV monitoring, or GPS-based supervision without smart analysis. These approaches often fail to identify individual vehicles, track their movement patterns, classify vehicle types, or provide the real-time data needed for traffic management, fleet efficiency, and safety monitoring. As a result, authorities struggle with congestion control, inaccurate vehicle counts, poor logistics planning, and slow responses to traffic situations.

Additionally, existing systems lack machine-learning capabilities that can automatically identify, track, and analyze vehicles from video feeds in real time. They cannot assign unique IDs to vehicles, monitor their movements, or deliver useful insights like flow density, vehicle category distribution, and directional behavior. This limitation hinders decision-making in areas such as smart city planning, toll automation, fleet management, and highway monitoring. Thus, there is a strong need for a fully automated AI-based real-time vehicle tracking solution. This system should be able to detect vehicles, assign lasting identities, track movement across frames, and produce actionable traffic analytics. Such a system will greatly help transportation authorities, researchers, and logistics operators gain accurate insights and improve responsiveness, safety, and operational efficiency across transportation networks.

B. OBJECTIVE OF THE INVENTION

1. This project's main goal is to create an intelligent machine-learning model that can identify, categorize, and track vehicles in real-time from live video feeds. This will allow for automated traffic analysis, vehicle movement monitoring, and improved fleet management effectiveness.

2. Additionally, the project intends to design and implement a fully automated vehicle tracking system that offers users ID-based tracking, real-time visualization, count analytics, and insights into vehicle flow patterns. This will support intelligent transportation planning, congestion assessment, and decision-making for logistics operators and traffic authorities.

3. Additionally, the project seeks to offer a workable and scalable solution that can be expanded for actual smart city applications, such as cloud-based traffic analytics, speed detection, number plate recognition, and CCTV integration.

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4. STATE OF THE ART/ RESEARCH GAP/NOVELTY

Sr. No.	Patent ID	Abstract	Research Gap	Novelty
1	US Patent US7764808B2 — "System and Method for Vehicle Detection and Tracking"	This patent uses a video-based approach to detect and track vehicles in real-time over video streams.	Focuses primarily on detection & tracking — does not assign persistent IDs or analyze movement behavior over frames.	Our system integrates YOLO11 + Bot Sort-style tracking which assigns unique IDs, maintains identity across frames, and trained opensource dataset that is well suited for Indian traffic environment.
2	US Patent US8260533B2 — "Traffic Monitoring System"	System records flow and events using stationary roadside monitoring points.	Uses sensor-based monitoring instead of fully automated vision-based tracking; limited scalability and hardware dependency.	Our system is purely computer-vision based, meaning no external sensors — only video feeds are required. Works on normal CCTV footage, making deployment cheaper and scalable.
3	Research Paper — "Real-Time Vehicle Detection Based on Improved YOLOv5" (ResearchGate, 2022)	Improves accuracy in challenging environments using YOLOv11 variations.	Detection focused — does not handle tracking IDs, event logging or application development.	Our invention introduces a fully automatic identity assignment system where YOLO11 provides only class labels, and BOT-SORT autonomously generates persistent vehicle IDs without any manual configuration.

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5. DETAILED DESCRIPTION

The proposed system consists of three main components:

Data Collection & Preprocessing Module: Vehicle movement data is gathered by this module from a variety of sources, including dashboard cameras, drone footage, CCTV video feeds, and pre-recorded traffic datasets. It carries out crucial preprocessing duties such as Extraction of video frames, Resizing an image, reduction of noise, Object annotation (bounding boxes for cars, bikes, buses, trucks, etc.), Dataset formatting (YOLO dataset structure)

Vehicle Detection & Tracking Model: This module detects and categorizes vehicles in real time using deep learning-based object detection, namely the YOLO (You Only Look Once) algorithm. YOLO, which is based on Convolutional Neural Networks, uses integrated trackers such like SORT (Simple Online Real-time Tracking**)**, BOT SORT (Bounding-box Tracker).

These IDs helps in preventing duplication and tracking every vehicle from frame to frame.

Bounding boxes, confidence values, trajectories, and vehicle identification numbers are all produced by the model.

Monitoring & Visualization Engine: This component displays real-time tracking on video streams.
It overlays: Bounding boxes, Vehicle IDs, Movement paths, Class labels.

The system can be extended for Traffic density estimation, Zone-based vehicle counting, Rule violation alerting.

Technical Implementation: Backend AI processing using Python (YOLO object detection, BOT SORT tracking, OpenCV for video analysis).
Frontend visualization through video overlay or simple UI displaying tracked vehicle IDs and counts.
Optional API layer for data access using Flask/FastAPI.
Local storage or logs used to maintain vehicle counts, tracking results, and system usage history.

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6. RESULTS AND ADVANTAGES

Advantages over Existing Prior Art:

- **High Accuracy:** The ability to detect and track vehicles in real time through the use of machine learning (ML) techniques will require less manual input than traditional methods of tracking.
- **Automation:** Eliminates the need for human counting — vehicle detection, tracking, and counting are fully automated.
- **Better Traffic Analysis & Decision Making:** Helps authorities and researchers analyze road usage, peak traffic flow, and congestion patterns.
- **Scalable:** Can be deployed on multiple intersections, highways, or campuses to monitor high-volume vehicle movement.
- **Educational Value:** Useful for learning ML concepts, computer vision, surveillance automation, and intelligent transport systems.

- **Cost-Effective:** Works with ordinary cameras — no need for expensive sensors or radar-based tracking systems.

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7. EXPANSION

Variables and Extensions Necessary for Complete Coverage:

- Integration with Smart Traffic Signals System can send vehicle count data to traffic lights for automated signal timing and congestion control.
- GPS / IoT Device Integration for Fleet Tracking, Supports live tracking of buses, delivery vehicles, and emergency services
- Track the same vehicle across multiple cameras and junctions.
- Traffic heatmaps, peak usage reports, and predictive congestion analysis.
- Future expansion may include forecasting traffic density using historical patterns (machine learning).

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8. WORKING PROTOTYPE/ FORMULATION/ DESIGN/COMPOSITION

Current Status: A successful functional prototype has been created and tested; this system utilizes the following features:

The ability to detect moving cars from video using YOLO object detector technology.

The individual identification and the use of vehicle tracking algorithms to generate unique IDs for each vehicle.

The capacity to monitor and count vehicles passing through a designated area, as well as visually represent the total number in real-time.

Prototype Images/Data: Available in project repository with graph outputs video showing bounding boxes, IDs, and vehicle count overlay. Screenshots stored in project folder demonstrating detection results.

Timeline for Completion: Core tracking system is already functional.

Integration of advanced modules (LPR, dashboard analytics, multi-camera support) may require an additional 6–10 weeks depending on features.

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9. EXISTING DATA

Comparative Data Supporting the Invention:

- Dataset: Annotated vehicle images and video sequences collected from traffic cameras and open-source repositories
- Model accuracy: YOLO-based detection achieved high precision in identifying cars, bikes, trucks, and buses during tests.
- Tracking Consistency: Object tracking maintained unique IDs with minimal ID switches using BOT SORT.Forecast stability tested across multiple stocks
- Performance of the prototype was validated using multiple video clips in varying traffic densities and lighting conditions, all displaying stable results of tracking and counting.

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10. USE AND DISCLOSURE (IMPORTANT)

Question	Answer
A. Have you described or shown your invention/design to anyone or in any conference?	NO ( )
B. Have you made any attempts to commercialize your invention?	NO ( )
C. Has your invention been described in any printed publication or other media (Internet, etc.)?	NO ( )
D. Do you have any collaboration with any other institute or organization on the same?	NO ( )
E. Name of Regulatory body or any other approvals if required?	NO ( )

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11. Additional Information

Potential Chances of Commercialization: Intelligent traffic monitoring, smart city infrastructure, fleet tracking, and automated surveillance technologies have been experiencing rapid growth across the globe. Councils, transport departments and logistics companies are beginning to use real-time vehicle tracking powered by AI for traffic monitoring, smart city Infrastructure, and for fleet management. Security agencies will benefit from AI-powered vehicle tracking.

List of Companies/Sectors for Commercialization:

- Smart City Mission Projects (Government of India)
- Uber / Ola Fleet Management Divisions
- Smart Highway Agencies & Toll System Contractors
- CCTV & Surveillance Integrators (HikVision, CP-Plus)
- Municipal Corporation Traffic Departments

- Tata Elxsi (Smart Traffic Analytics)

Basic Patents Used: No basic patents requiring royalty payments. All algorithms developed independently.

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12. FILING OPTIONS

Recommended for: Provisional Patent Filing (PROVISIONAL)

The invention uses artificial intelligence (AI)- powered real-time object detection and tracking technology, combined with automated counting and analytics, which has not been previously described in any existing traffic surveillance system; therefore, it may qualify for provisional patent protection.

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13. KEYWORDS

• Real-time vehicle tracking
• YOLOv11-based object detection
• BOT SORT/ ID-based tracking
• Smart traffic analytics
• AI-based surveillance
• Intelligent transportation system
• Fleet management automation
• Automatic vehicle counting
• Smart city monitoring
• Computer vision traffic system

NOTE: Inventor details (Section 2) and signature must be filled by the student submitting this form.

NO OBJECTION CERTIFICATE

This is to certify that University/Organization Name or its associates shall have no objection if Lovely Professional University files an IPR (Patent/Copyright/Design/any other.....) entitled " **Real-Time Vehicle Tracking System**" including the name(s) of, Abhishek Dhidhi, Arihant Pratap Singh, Samarth Shrivas as inventors who are student(s) studying in our University/ organization.

Further Name of the University/Organization shall not provide any financial assistance in respect of said IPR nor shall raise any objection later with respect to filing or commercialization of the said IPR or otherwise claim any right to the patent/invention at any stage.

Abhishek Arihant Samarth

(Authorised Signatory)