

Artificial Intelligence in Transportation

Artificial Intelligence (AI) is a tool that *uses data and algorithms to learn, perceive, plan, adapt to change, and perform tasks just like humans.*

BRANCHES OF AI:



MACHINE LEARNING:

Automates the process of identifying patterns and learning from data



NEURAL NETWORKS:

Utilizes the neuron structure in the human brain to recognize patterns in data



NATURAL LANGUAGE PROCESSING:

Interprets and generates human language, both spoken and written



ROBOTICS:

Involves the use of robots to automate physical tasks typically performed by humans



FUZZY LOGIC:

Manages uncertainty by assigning degrees of truth to handle imprecise information



EXPERT SYSTEMS:

Mimics human expertise by applying rules and logic from a knowledge base

APPLICATION OF AI IN TRANSPORTATION

Autonomous Vehicles (AVs): AI powers the core functionalities of AVs, including perception (via sensors and cameras), decision-making, and navigation. This extends beyond autos to other modes.

Traffic Flow: AI models predict and manage traffic, enabling the design of more efficient road networks and dynamically adjusting signals in real time to reduce delays and reduce congestion.

Predictive Maintenance: AI uses machine learning algorithms to analyze patterns in sensor data, weather conditions, and usage levels, continuously monitoring the condition of roads, bridges, and railways.

Travel Personalization: AI personalizes passenger experiences by tailoring travel itineraries, seating preferences, and onboard amenities to individual needs.

Safety: Through pattern recognition, AI can predict potential crash hotspots and suggest preventive measures.

Fraud Detection: AI uses machine learning algorithms to detect anomalies in ticketing systems, identifying unusual purchasing patterns, repeated ticket misuse, and counterfeit attempts.

Aviation: AI enhances flight operations by using real-time data and predictive analytics to optimize scheduling, fuel use, crew management, and maintenance, helping airlines choose efficient routes, cut costs, reduce delays, and enhance safety.

Dynamic Pricing: AI adjusts fares for ride-sharing and public transport in real time based on demand, traffic, and availability, optimizing revenue and balancing supply and demand for greater efficiency.

Smart Parking: AI predicts parking demand, optimizes space allocation, guides drivers to open spots via apps or signage, enables automated payments, and monitors violations.

Security: AI-enhanced machine vision is being leveraged for encroachment and intrusion detection at tunnels, bridges, and other sensitive transportation facilities.

Freight and Logistics: AI optimizes routing, predicts demand, reduces operational costs, and enhances delivery and warehouse efficiency by managing inventory, automating sorting, and enabling real-time decision-making.

Network Operations: AI can optimize multimodal networks, traffic signal systems, utilization of intelligent transportation systems (ITS), variable speed limits, and various warnings.

CASE STUDIES

[Florida](#) became the first state in the US to adopt a statewide AI traffic management solution after Florida DOT approved the implementation of NoTraffic's AI-powered system across the state. The system utilizes a combination of sensors, cameras, and deep learning algorithms to predict and identify traffic incidents and provide real-time feedback to the traffic management center. The system can adjust traffic signals autonomously to reduce delay and risk of accidents.

[New York City's Metropolitan Transportation Authority \(MTA\)](#) uses an AI-powered system by Hayden AI to enforce bus lane violations. This system, which employs cameras mounted on buses to monitor bus lanes, captures vehicles violating bus lanes, double parking, and bus stop rules in real-time. When enforcement cameras are activated, bus lane speeds have increased by 5%, and collisions have decreased by 20%, and up to 10% reduction in emissions on key transit corridors in New York City.

[M-Files](#) has automated data organization and retrieval for Van Rhijn Bouw, a construction company, allowing workers on-site to instantly view the latest versions of important documents via large screens and QR codes. It also automates approval and procurement workflows, providing real-time status updates so team members can act immediately, reducing delays and eliminating manual follow-ups.

[Delaware DOT](#) has developed an AI-based Integrated Transportation Management System, powered by AI-TOMS (AI-Transportation Operations and Management Software), which uses artificial intelligence and machine learning to analyze real-time traffic data, detect incidents, adjust signal timing, and provide alternative routes, all with minimal human intervention. Early testing shows that AI-TOMS can identify a crash on highways like I-95 within 15 minutes with over 80% accuracy and optimize signal timings up to an hour in advance.

[Iowa State University and the Iowa DOT](#) developed TIMELI (Traffic Incident Management Enabled by Large-data Innovations), a smart traffic incident management system that utilizes advanced AI and machine learning to enhance incident detection, response, and risk assessment. Using multiple data streams from cameras and sensors, the system detects traffic anomalies, predicts incident risk, and offers traffic management solutions, all in real-time.

In October 2024, [Tesla unveiled its robotaxi](#), a fully autonomous electric vehicle was designed for ride-hailing services. The robotaxi operates without a steering wheel or pedals, relying entirely on Tesla's Full Self-Driving (FSD) technology to navigate and transport passengers. Tesla's FSD system uses machine learning to process data from cameras, radar, and sensors, enabling the vehicle to interpret surroundings, recognize obstacles, and make driving decisions with minimal human intervention.

[UPS](#) uses ORION (On-Road Integrated Optimization and Navigation), an AI-powered route optimization tool that leverages data from package locations, pickup times, and historical performance to create the most efficient routes for drivers. This proprietary technology combines advanced algorithms, artificial intelligence, and machine learning. Since its deployment, ORION has saved UPS approximately 100 million miles and 10 million gallons of fuel annually.