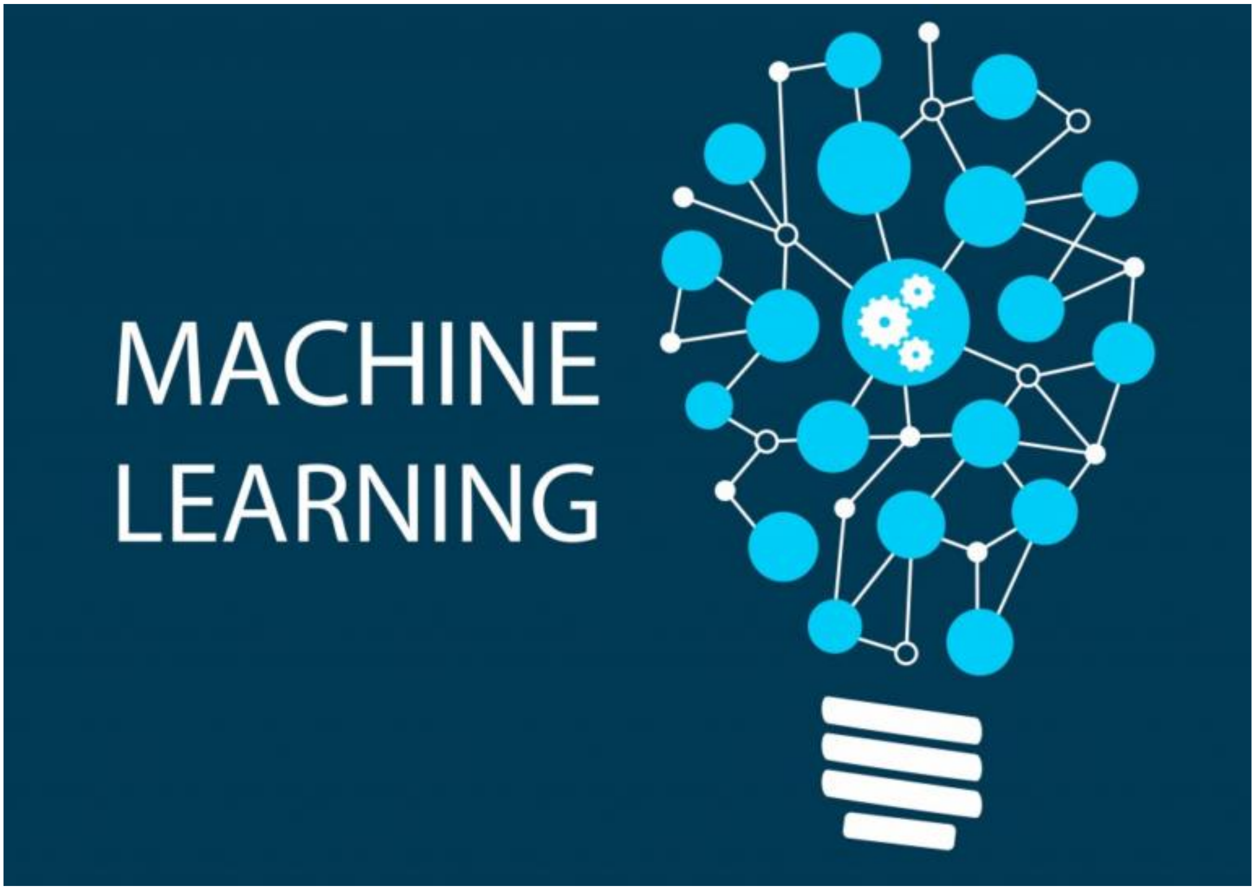
Name: Mohamed mohamuud



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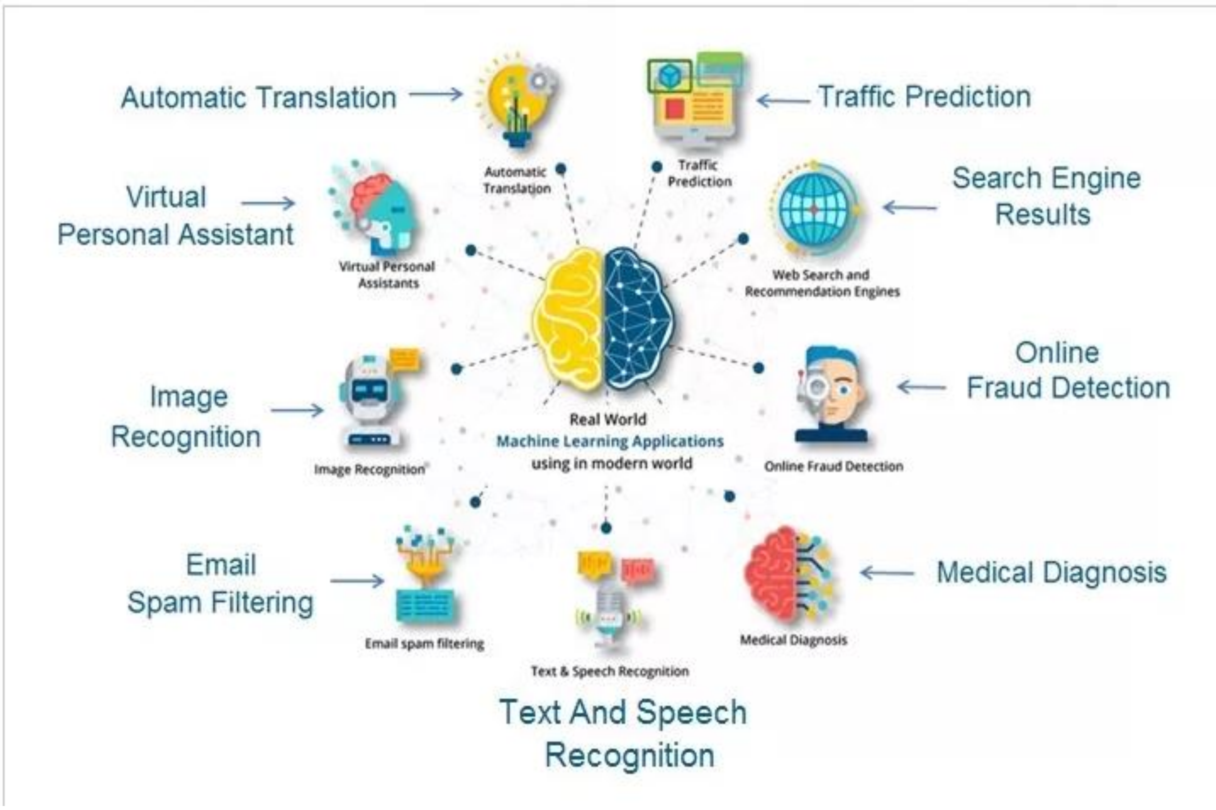
1. Define Machine Learning using real-life example ?

Machine learning is the process of optimizing the model so that it can predict the correct response based on the training data samples

Machine learning is the subset of artificial intelligence (AI) focused on algorithms that can "learn" the patterns of training data and, subsequently, make accurate *inferences* about new data

This pattern recognition ability enables machine learning models to make decisions or predictions without explicit, hard-coded instructions

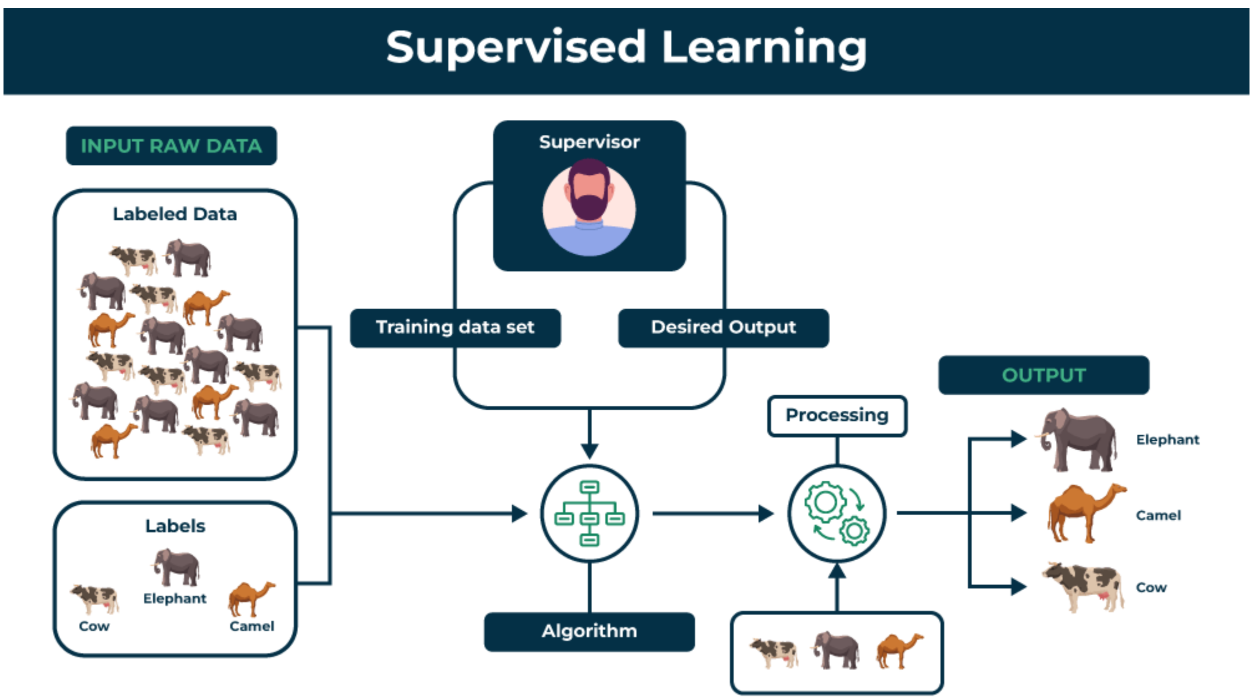


Machine learning works by training algorithms on sets of data to achieve an expected outcome such as identifying a pattern or recognizing an object.

2. Compare Supervised Learning and Un Supervised Learning give me example of each ?

Supervised Learning: it is like a teacher or supervisor guiding the machine, In this approach we teach or train the machine using the labelled data(correct answers or classifications) which means each input has the correct output in the form of answer or category attached to it, After that machine is provided with a new set of examples (data) so that it can analyses the training data and produces a correct outcome from labeled data.

example, a labeled dataset of images of Elephant, Camel and Cow would have each image tagged with either "Maroodi, "Geel" or "Sac."



Types of Supervised Learning

1. Regression

A regression is used to predict continuous values such as stock prices or temperature, house prices Regression algorithms learn how to connect input data to a specific number or value

Some common regression algorithms:

1. Linear Regression
2. Polynomial Regression
3. Lasso Regression
4. Ridge Regression

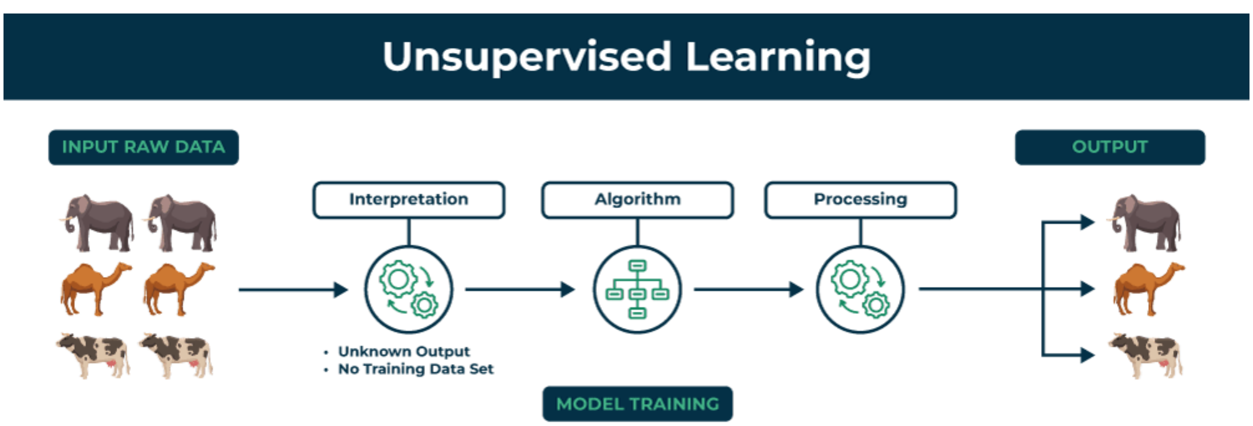
2. Classification

A classification is used to predict categorical values such as whether a customer will buy or not, whether an email is spam or not or whether a medical image shows a tumor or not

Some of the most common classification algorithms:

1. Logistic Regression
2. Support Vector Machines
3. Decision Trees
4. Random Forests
5. Naive Baye

Un Supervised Learning: In this approach the machine is given with data that has no labels or categories, It analyzes the data on its own to find patterns, groups or relationships without any prior knowledge,   Example, unsupervised learning can analyze animal data and group the animals by their traits and behavior



Types of Unsupervised Learning

Unsupervised learning is divided into two categories of algorithms:

1. Clustering

A clustering is used to group similar data points together, Clustering algorithms work by repeatedly moving data points closer to to the center of their group (cluster) and farther from points in other groups. This helps the algorithm to create clear and meaningful clusters.

Some popular clustering algorithms:

1. K-means clustering
2. Hierarchical clustering
3. Principal Component Analysis (PCA)

2. Association rule learning

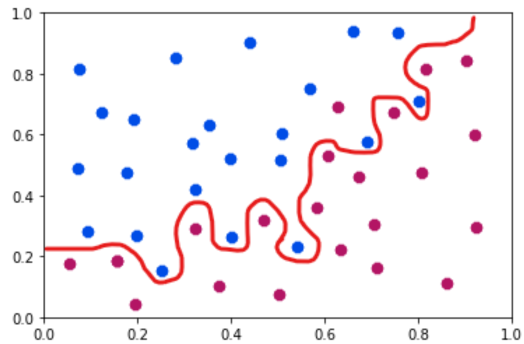
An association rule learning used to find patterns and relationships between different items in a dataset It looks for rules like “people who buy X often also buy Y”

Some common Association rule learning algorithms:

1. Apriori Algorithm
2. Eclat Algorithm
3. FP-Growth Algorithm

3. what causes overfitting? How can it prevented?

Overfitting is an undesirable machine learning behavior that occurs when the machine learning model gives accurate predictions for training data but not for new data When data scientists use machine learning models for making predictions, they first train the model on a known data set. Then, based on this information, the model tries to predict outcomes for new data sets. An overfit model can give inaccurate predictions and cannot perform well for all types of new data.



It's prevented

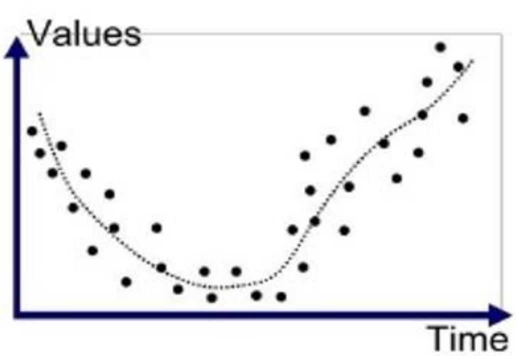
1: Early stopping: Stops training before the model starts learning noise, preventing overfitting

2: Pruning (Feature selection): Keeps only the most important features and removes irrelevant ones

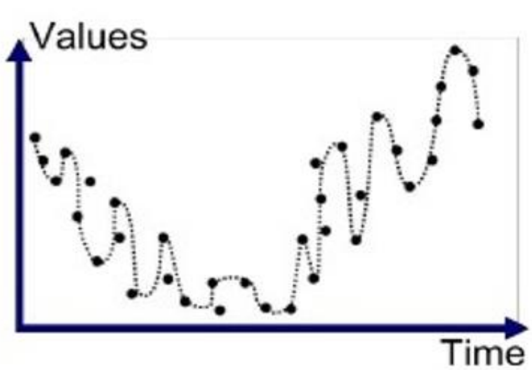
3: Regularization: Adds penalties to less useful features to reduce overfitting.

4: Ensembling: Combines results from multiple models (bagging = parallel, boosting = sequential) for better accuracy

5: Data augmentation: Slightly alters training data (e.g., flipping, rotating images) to create variety and prevent overfitting



Good Fit/Robust



Overfitted

overfitting causes the model to predict very poorly on new data points.

4. Explain how training data and test data are split, and why this process is necessary?

Splitting datasets in this manner aims to ensure that the model not only focuses on learning from a specific data set but also performs well when faced with new and unseen data. This is a critical strategy for ensuring that the model provides more general and consistent results.

Proper management of datasets is key to the success of machine learning models in real-world applications, and therefore, every step of this process must be carefully planned.

- Training Set
- Validation Set
- Test Set
- Data Splitting Ratio

5. Find one Case Study (research paper or article) that explains how machine Learning has been applied in Healthcare business, or transportation Summarize it's finding ?

ML Healthcare:

Machine Learning (ML) is transforming healthcare by enhancing clinical operations, drug development, surgery, and data management, It's enabling more efficient management and interpretation of complex medical data.

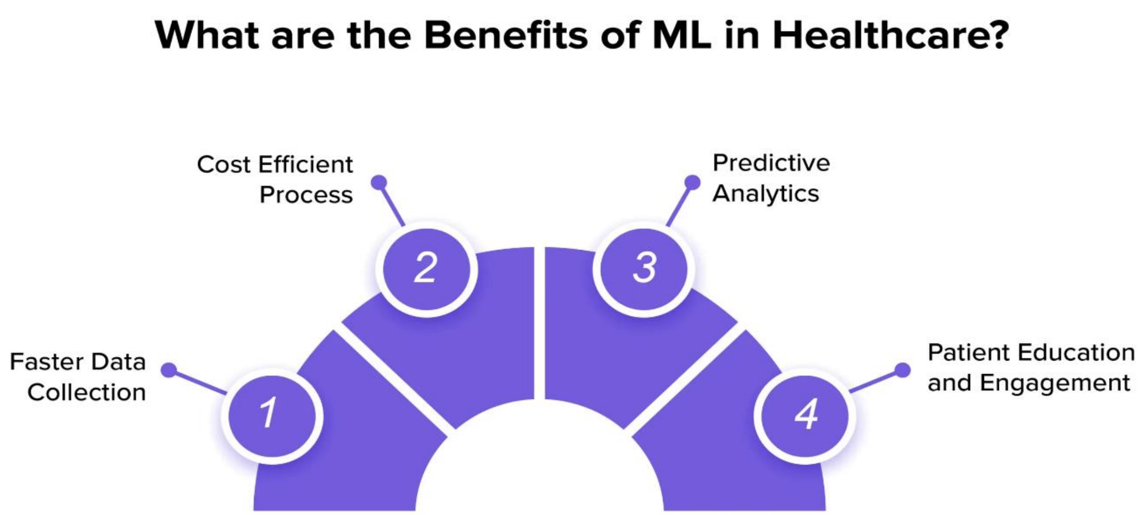
Applications of ML in Healthcare

1. Early disease detection & predictive insights: ML helps identify early signs of illness more accurately, reducing hospital admissions and readmissions.
2. Clinical operations & data analysis: ML analyzes diverse data sources—like satellite imagery, media, and video—to predict disease progression and support decision-making

Key Challenges

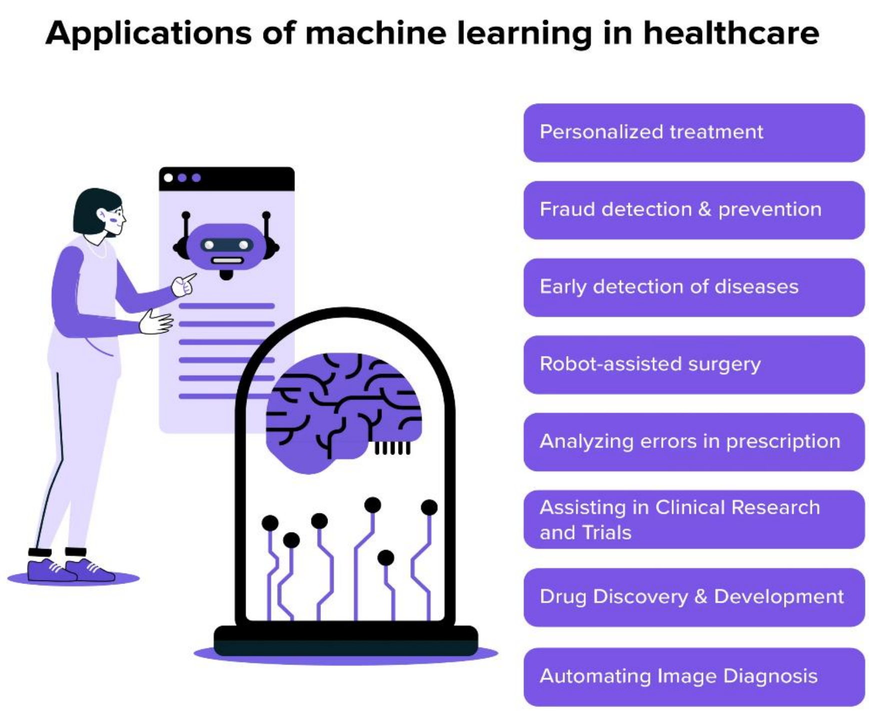
These issues can be mitigated through thoughtful implementation strategies

1. Patient safety
2. Bias in datasets
3. Privacy concerns



Advantages of ML in Healthcare

1. Faster data collection & cost-efficiency: ML speeds up gathering and interpreting data while reducing operational costs
2. Predictive analytics & diagnostic accuracy: ML enables proactive, data-driven healthcare and improves the precision of diagnoses



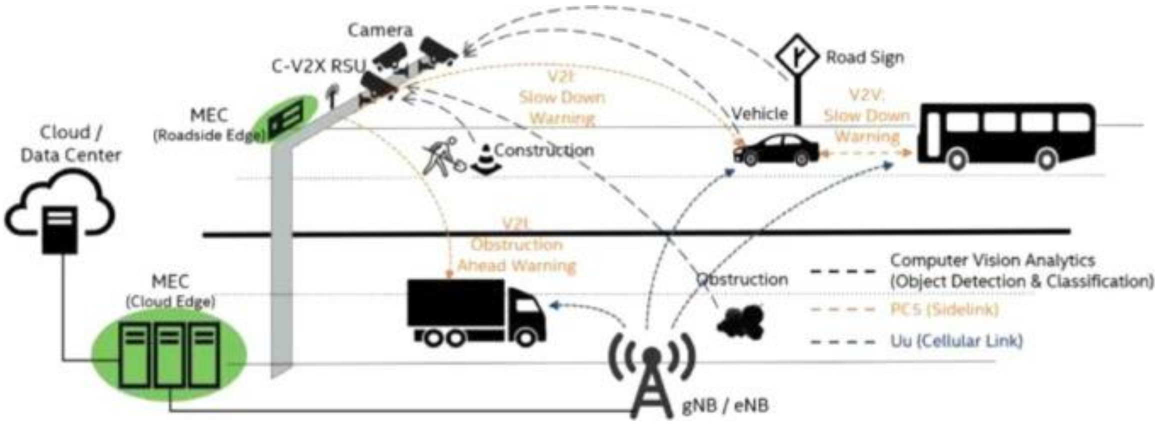
ML Transportation

Abstract & Introduction

AI, ML, and DL are transforming transportation by solving congestion, inefficiency, safety, Applications include traffic management, autonomous vehicles, smart parking, logistics, public transit, infrastructure monitoring, and safety systems

Key Applications

1. Traffic Management – Real-time monitoring, adaptive traffic lights, dynamic rerouting, and congestion pricing to reduce delays and emissions.
2. Autonomous Vehicles (CAVs) – AI enables perception, navigation, decision-making, and V2V/V2I communication, though challenges exist in bad weather and safety validation.
3. Smart Parking – IoT sensors and DL detect available spaces, forecast demand, and apply dynamic pricing.
4. Public Transit – AI improves scheduling, predicts demand, manages fleets, and gives passengers personalized travel suggestions.
5. Freight & Logistics – AI optimizes delivery routes, predictive maintenance, and warehouse automation.
6. Sustainability – AI reduces emissions, supports EV charging infrastructure, and enables multimodal eco-friendly transport.
7. Safety & Security – ADAS, hazard detection, predictive accident analytics, and cybersecurity for connected systems.
8. Infrastructure Monitoring – AI and drones for inspection, predictive maintenance, and anomaly detection.

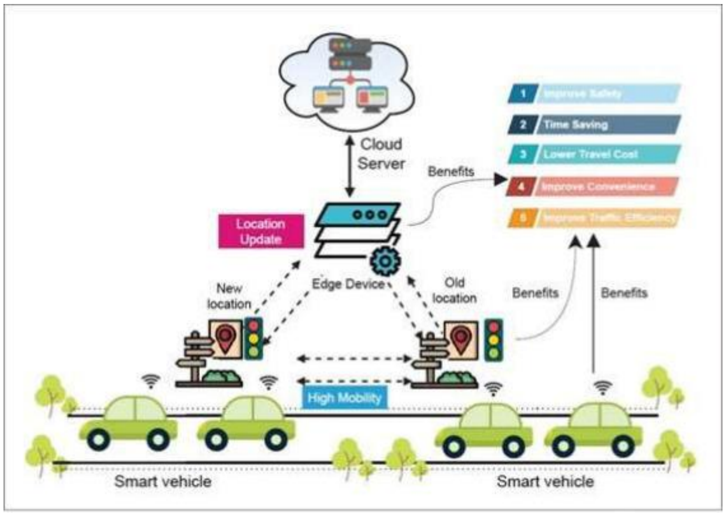


Case Studies (Real-World Examples)

1. Singapore: AI traffic system reduced congestion
2. Pittsburgh: Adaptive signals cut travel delays by 25%
3. Tesla & Waymo: Autonomous driving trials
4. San Francisco (SFpark): Smart parking with IoT sensors and pricing
5. Amazon & DHL: AI-driven logistics optimization
6. Los Angeles: AI-managed traffic reduced emissions

Challenges & Limitations

1. Technical: Data quality, generalization issues, heavy computing needs
2. Operational: High costs, scalability issues, public skepticism
3. Ethical/Social: Bias, accountability, job displacement
4. Regulatory: Lack of clear policies, uneven global frameworks



Future Research Directions

1. Federated learning for privacy-preserving AI
2. Integration with IoT, 5G, blockchain, quantum computing
3. Adaptive and context-aware AI models
4. Explainable AI (XAI) for transparency and trust
5. AI for sustainability and green mobility
6. Human-centered AI for inclusivity
7. Predictive maintenance with digital twins
8. AI-assisted policy simulation for decision-making
9. Cross-sector collaboration and ethical deployment.