AI Case Studies Summary

Experiment 1: Autonomous Vehicles

Objective:

To analyze the development and implementation of autonomous vehicle (AV) technology, focusing on technical challenges and ethical dilemmas.

Introduction:

Autonomous Vehicles use AI, ML, and sensors to drive without human input, aiming to reduce accidents, improve efficiency, and revolutionize transport.

Examples: Tesla Autopilot, Waymo, Cruise.

Key Technologies:

- Sensors (LiDAR, Radar, Cameras)
- AI & Deep Learning for perception and decision-making
- GPS & HD Mapping
- V2X Communication (Vehicle-to-Everything)

Challenges:

- Sensor failures in bad weather
- Legal liability in accidents
- 5G dependency
- Cybersecurity threats

Ethical Considerations:

- Life-and-death decisions (Trolley Problem)
- Bias in object detection
- Data privacy and surveillance
- Job displacement

Advantages:

- Reduced accidents
- 24/7 operation

- Improved traffic management

Disadvantages:

- Expensive infrastructure
- Limited legal framework
- Ethical complexities in decision-making

Experiment 2: AI in Healthcare Diagnosis

Objective:

To explore how AI/ML support medical diagnostics and treatment planning.

Introduction:

AI enhances diagnostic accuracy, processes vast medical data, and supports clinical decisions, reducing human error.

Examples: DeepMind for eye disease, Cardiogram for heart risk, Atomwise for drug discovery.

Key Technologies:

- Deep Learning & Reinforcement Learning
- NLP (analyzing medical notes)
- Computer Vision (X-ray/CT/MRI analysis)
- Big Data & Predictive Analytics

Challenges:

- Bias in training data
- Privacy concerns (patient data protection)
- Reliability & need for human oversight

Ethical Considerations:

- Fairness in AI decisions
- Who's accountable for misdiagnosis
- Trust and transparency in algorithms

Advantages:

- Early disease detection

- Cost-effective diagnostics
- Personalized treatments

Disadvantages:
- Overreliance on automation
- Limited explainability
- Privacy risks with sensitive health data

Experiment 3: Social Media Recommendation Systems

Objective:

To investigate how AI algorithms personalize content recommendations to enhance user engagement.

Introduction:

Social media uses AI to analyze user behavior and recommend personalized content, boosting interaction and platform usage.

Examples: TikTok "For You", YouTube feeds.

Key Technologies:
- Content-Based, Collaborative & Hybrid Filtering
- NLP & Deep Learning (transformers, CNNs)
- Reinforcement Learning for continuous learning

Challenges:
- Filter bubbles and echo chambers
- Real-time model efficiency
- Data overload and system scalability

Ethical Considerations:
- Algorithmic transparency
- Addiction and mental health impact
- Data usage without user awareness

Advantages:
- Enhanced user engagement

- Efficient content delivery
- Increased ad revenue

Disadvantages:
- Potential manipulation
- Privacy invasion
- Reinforced biases and misinformation

Experiment 4: Facial Recognition Technology

Objective:

To analyze the ethical and privacy concerns surrounding facial recognition technology (FRT).

Introduction:

FRT uses AI to map and match facial features to identify individuals, widely used in surveillance, law enforcement, and smartphones.

Example: Clearview AI case.

Key Technologies:
- Neural Networks for facial mapping
- Deep Learning for recognition accuracy
- Biometric data processing

Challenges:
- Accuracy varies with race, gender, and age
- Consent and regulation lacking
- Database security risks

Ethical Considerations:
- Privacy violations
- Consent and data ownership
- Misidentification and racial profiling
- Government overreach in surveillance

Advantages:

- Security enhancement
- Fast identity verification
- Useful in crime detection

Disadvantages:
- Ethical misuse
- Civil rights concerns
- Inaccurate results affecting minorities

Experiment 5: AI in Education

Objective:

To evaluate how AI enhances educational experiences through personalization and automation.

Introduction:

AI supports student-centered learning via adaptive platforms, virtual tutors, automated grading, and predictive analytics.

Examples: Century Tech, Querium.

Key Technologies:
- NLP for chatbots & grading
- Computer Vision for attendance
- Machine Learning for adaptive learning
- Predictive analytics for dropout prevention

Challenges:
- Privacy of student data
- Digital divide in access
- Algorithm bias

Ethical Considerations:
- Equity and access
- Teacher roles and student dependency
- Transparency in algorithm decisions

Advantages:

- Personalized learning
- 24/7 virtual assistance
- Faster grading and feedback

Disadvantages:

- Reduced human interaction
- Technical dependence
- Biased learning paths