GH raisoni COLLEGE
Engineering and Management Nagpur

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Introduction to AI-Driven Healthcare Applications

Course Outcomes (CO's)

- **CO1:** Understand foundational AI concepts and their impact on healthcare.
- **CO2:** Apply AI techniques for medical diagnostics and image analysis.
- **CO3:** Illustrate AI for personalized healthcare and treatment optimization
- **CO4:** Analyze AI in healthcare management and administrative tasks.
- **CO5:** Evaluate ethical, legal, and social implications of AI in healthcare.

UNIT: I

Overview of AI in Healthcare

- Artificial Intelligence (AI) enables machines to perform human-like intelligent tasks
- Enhances clinical decision-making
- Supports diagnosis, treatment, monitoring & patient management
- AI is used across radiology, cardiology, oncology, surgery & hospital administration

What is Machine Learning (ML)?

- Subset of AI enabling systems to learn from data

- Improves predictions & decision-making
- Types of ML: Supervised Learning
  Unsupervised Learning
  Reinforcement Learning

- Applications: disease prediction, risk scoring, anomaly detection

Evolution & History of AI in Healthcare

- **1950–1980:** Expert systems (MYCIN for bacterial infections)
- **1990–2000:** Early digital image processing
- **2010 onwards:** Deep learning revolution (CNN, RNN)
- **AI now supports:** Tumor detection
  Personalized treatment
  Robotic surgeries
  Automated hospital workflows

Types of AI Technologies

- **Machine Learning:** Prediction, risk detection, diagnosis
- **Natural Language Processing (NLP):** EHR reading, report summarization
- **Robotics:** Surgical robots, rehabilitation robots
- **Expert Systems:** Clinical decision support
- **Computer Vision:** Medical image analysis

Applications in Diagnostics

- AI detects medical conditions faster & accurately
- Used in: MRI, CT, X-ray analysis
  Cancer detection
  Diabetic retinopathy screening (Deep Learning)
  ECG interpretation
- Reduces human error and improves workflow efficiency

Applications in Treatment & Patient Care

- Predicting treatment outcomes
- Personalized medicine based on patient history
- AI-driven drug discovery
- Wearable health monitoring devices
- Virtual health assistants & chatbots

Key Challenges in Healthcare AI

- Data privacy and security issues
- Lack of quality datasets
- Model interpretability (black box problem)
- Ethical issues – bias, fairness
- Integration with existing hospital systems

Opportunities of AI in Healthcare

- Early diagnosis & preventive healthcare
- Reduction in workload of doctors
- Improved accuracy & efficiency
- Remote patient monitoring
- Reduced cost of treatment

Case Study – AI System for Early Detection of Lung Cancer

- Lung cancer is often diagnosed late due to delayed symptoms.
- Radiologists manually examine CT scans which contain **hundreds of images per patient**, increasing the chance of missing small nodules.
- A healthcare startup developed an AI system using **Deep Learning (3D CNN)** to detect lung nodules automatically.
- The AI model was trained on **50,000+ CT scans** containing labeled benign and malignant nodules
- It highlights suspicious regions and classifies nodules as *low-risk, medium-risk, or high-risk*.
- Accuracy reached **94%**, matching expert radiologists.
- Doctors use AI as a **second reader**, improving diagnosis speed and reducing errors.
- Adopted in hospitals for screening high-risk patients (smokers, elderly)

Case Study Questions

1) Explain the problem faced in conventional lung cancer detection and how AI provides a solution.

2) Describe the machine learning technique used in the case study. Why is 3D CNN suitable for CT scans?

3) Describe the workflow of the AI lung nodule detection system.

UNIT: II
AI in Medical Diagnostics

AI in Medical Imaging

- Medical imaging is used for detecting abnormalities in:
  - Radiology
  - MRI
  - CT Scans

  AI helps in faster interpretation of complex images

  Reduces manual workload of radiologists

- Improves accuracy & early disease detection

Why AI is Needed in Diagnostics?

- Human error due to fatigue
- Increasing number of patients vs limited radiologists
- AI can detect patterns invisible to the human eye
- Consistency in results
- Helps early detection → saves lives

AI Techniques Used in Medical Imaging

1. Machine Learning (ML)
- Feature extraction
- Classification (Normal/Abnormal)

2. Deep Learning (DL)
- CNN – Convolutional Neural Networks
- R-CNN
- U-Net – Image segmentation
- 3D-CNN for volumetric CT/MRI data

Image Processing Pipeline (AI Workflow)

Medical Image (CT/MRI/X-ray)

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Preprocessing (Denoising, Contrast Enhancement)

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Segmentation (Tumor/Organ Boundary Detection)

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Feature Extraction (CNN Layers)

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Classification (Disease/No Disease)

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Report Generation for Clinician

Clinical Validation of AI Tools

To be deployed in hospitals, AI tools must undergo:

- Sensitivity/Specificity testing
- ROC curve evaluation
- FDA approval / Clinical trial certification
- Real-world testing on diverse population
- Bias reduction and fairness assessment

Challenges & Limitations

- Data privacy issues
- Need for large and diverse datasets
- Black-box nature of DL models
- Algorithmic bias concerns
- Integration with hospital systems
- High cost of implementation

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THANK YOU