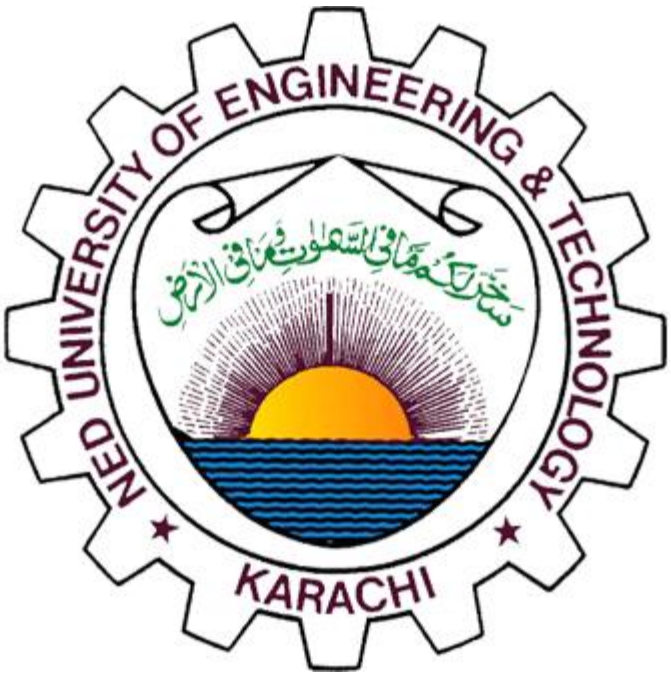
CCP-Proposal

AIES (CT-361)



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Discipline: BCIT (Cyber Security)

Teachers:

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1. Project Title:

Smart Pothole Detection Using Deep Learning

2. Project Description:

This project focuses on developing an AI-powered pothole detection system. Potholes are a common issue in urban infrastructure that can cause accidents, vehicle damage, and traffic inefficiency. The system aims to detect potholes in real-time using camera inputs from images, pre-recorded videos, or live webcam feeds.

The goal is to automate the detection of potholes using a convolutional neural network (CNN) that classifies images as either containing potholes or not, offering a foundation for future integration with municipal road inspection systems or smart city applications.

3. Project Methodology:

3.1 Dataset:

- **Pothole Images:** Collected from various online sources.
- **Non-Pothole Images:** Urban roads without any visible damage.
- All images are resized to 100x100 grayscale format for uniformity and faster training.

3.2 Tools and Technologies:

- **Language:** Python
- **Libraries:** TensorFlow, OpenCV, NumPy, scikit-learn
- **Environment:** Jupyter Notebook / Google Colab / Local Python Environment
- **Hardware:** Laptop with integrated webcam

3.3 Algorithm:

- **Model Type:** Binary classifier using Convolutional Neural Network (CNN)
- **Layers:** Conv2D, MaxPooling, Flatten, Dense, Sigmoid
- **Loss Function:** Binary Cross-Entropy
- **Optimizer:** Adam

3.4 Objectives:

- Train a deep learning model to differentiate between pothole and non-pothole images.
- Detect potholes in real-time via:
- Static images
- Video footage
- Live webcam feed
- Highlight potholes with bounding boxes and confidence scores.

3.5 Timeline:

Week	Task
Day 1	Problem Definition, Dataset Collection
Day 2	Data Preprocessing and Model Design and Training
Day 3	Implementation on Images and Videos and Web Integration
Day 4	Final Testing and Report Preparation

3.6 Expected Outcomes:

- Trained and saved .h5 model for binary pothole classification.
- Working pipeline for pothole detection on image, video, and webcam input.
- Modular, reusable code for future deployment.

3.7 Goals:

- **Achieve at least 90%+ accuracy in pothole detection.**
- Create an easily extensible framework that can later support bounding box localization (e.g., with YOLO).

4. Justification – Why it is a Complex Computing Problem:

This project qualifies as a **complex computing problem** because it involves:

- **Real-time computer vision processing** using live video input.
- **Deep learning model training and evaluation** involving optimization, data balancing, and accuracy tuning.
- **Preprocessing variability** due to lighting conditions, road textures, noise, and resolution.
- **Multi-modal inference** across different input sources (image, video, webcam).

- **System integration challenges** related to hardware compatibility, memory optimization, and scalability.

6. Industrialization/Commercial Product Potential:

This system has **strong industrial application potential**:

- **Smart City Integrations:** Can be mounted on municipal vehicles to automatically detect road damage.
- **Mobile Applications:** Citizens could report potholes by capturing an image, automatically classified by the app.
- **Surveillance Integration:** Add-on feature to traffic cameras for infrastructure monitoring.
- **Maintenance Planning:** Local governments can prioritize road repairs based on automated heatmaps.

With further development, this project can be **transformed into a deployable SaaS (Software as a Service)** for city infrastructure management systems or embedded into **autonomous vehicle systems** for road safety enhancement.