Project Title	Automated Road Damage Classification Using Deep Learning and Cloud Deployment
Skills take away From This Project	• Image preprocessing and augmentation for real-world outdoor images • Building and training CNN and transfer learning models (ResNet, EfficientNet, VGG16, MobileNet) • Handling class imbalance in multi-class classification problems • Model evaluation using Accuracy, Precision, Recall, F1-score, Confusion Matrix • Explainable AI using Grad-CAM for model interpretability • Building and deploying an interactive web application using Streamlit / Flask
Domain	Computer Vision | Deep Learning | Smart Cities | Infrastructure Analytics

Problem Statement:

Road infrastructure plays a critical role in transportation safety and economic development. Manual road inspections are time-consuming, expensive, and prone to human error. Poor road conditions such as potholes, cracks, and surface wear can lead to accidents and vehicle damage.

The objective of this project is to develop a **deep learning-based web application** that can automatically classify road surface images into different damage categories. The system should be **lightweight, user-friendly, and capable of providing real-time predictions** from images captured in real-world conditions.

Business Use Cases:

- Municipal Authorities: Prioritize road maintenance and repair activities
- Smart City Platforms: Automated road condition monitoring
- Transportation Departments: Safety assessment and reporting
- Educational Use: Demonstrate AI applications in infrastructure management
- Public Users: Report road damage using mobile-captured images

Approach:

1. **Data Preparation**

- Dataset: Road Damage Dataset (RDD2020 / RDD2022 – Kaggle)
- Images captured from smartphones and vehicle-mounted cameras
- Preprocessed steps:
    - Resize images to a fixed input size (e.g., 224×224)
    - Normalize pixel values (0–1)
    - Apply data augmentation (rotation, flips, brightness adjustment, blur)
- Handle class imbalance using class weights or data augmentation

2. **Model Development**

- Build a baseline CNN model for multi-class classification
- Apply transfer learning using pre-trained models such as:
    - ResNet50
    - EfficientNet
    - MobileNet (for lightweight deployment)
        - Fine-tune selected layers to improve performance
        - Save the trained model for inference

3. **Model Evaluation**

- Evaluation Metrics:
    - Accuracy
    - Precision
    - Recall
    - F1-score
        - Generate confusion matrix and classification report
        - Use Grad-CAM to visualize damaged regions influencing model predictions

4. **Web Application Development**

Build a Streamlit or Flask-based web application with the following features:

- Image upload for road surface photos
- Real-time damage classification
- Confidence score for predictions
- Grad-CAM heatmap visualization
- Damage-specific recommendation message (e.g., *"Detected: Pothole → Recommended Action: Schedule immediate repair"*)

Results:

- A functional AI-powered web application capable of classifying road damage in real-tim
- Trained CNN / transfer learning models achieving high classification accuracy
- Explainable predictions through visual heatmaps
- Cloud-hosted application accessible via browser

Project Evaluation metrics:

- **Model Metrics:** Accuracy, Precision, Recall, F1-score
- **System Metrics:** Prediction latency, app responsiveness
- **Usability Metrics:** Ease of image upload, Clarity of Prediction results and User-friendly interface design.

Technical Tags:

Python | TensorFlow | Keras | PyTorch | CNN | ResNet | EfficientNet | MobileNet | Streamlit | Flask | Grad-CAM | Computer Vision

Data Set:

- Dataset Link: https://drive.google.com/file/d/1RpeVtqFiyIzYwr6Gwa3ZVXhpH3wzrcIA/view?usp=drive_link

- Real-world Road images under varying lighting and weather conditions
- Multiple damage categories (potholes, cracks and Manholes)

Data Set Explanation:

- Features: Road surface images captured in real-world environments
- Labels: Road damage type (potholes, cracks and Manhole)
    - Class 0 – Pothole
    - Class 1 – Crack and
    - Class 2 - Manhole
- Preprocessing:
    - Image resizing and normalization
    - Data augmentation for robustness

Project Deliverables:

1. **Source Code –** Python scripts for preprocessing, training, evaluation, and web app.
2. **Trained Model –** Saved CNN/transfer learning model file (.h5 / .pt).
3. **Web Application –** Streamlit / Flask-based road damage classification app.
4. **Project Report –** Documentation of dataset, methodology, evaluation, and results.
5. **Visualization Outputs –** Confusion matrix and Grad-CAM visualizations.

Project Guidelines:

- Use transfer learning to improve performance on limited data
- Store trained models separately from training script
- Ensure the web application is lightweight and user-friendly
- Provide clear documentation for dataset usage and model training

Timeline:

Define the project timeline, including milestones and deadlines.

PROJECT DOUBT CLARIFICATION SESSION (PROJECT AND CLASS DOUBTS)

About Session: The Project Doubt Clarification Session is a helpful resource for resolving questions and concerns about projects and class topics. It provides support in understanding project requirements, addressing code issues, and clarifying class concepts. The session aims to enhance comprehension and provide guidance to overcome challenges effectively.
Note: Book the slot at least before 12:00 Pm on the same day

Timing: Monday-Saturday (4:00PM to 5:00PM)

Booking link :https://forms.gle/XC553oSbMJ2Gcfug9

For DE/BADM project/class topic doubt slot clarification session:

Booking link : https://forms.gle/NtkQ4UV9cBV7Ac3C8

Session timing:

For DE: 04:00 pm to 5:00 pm every saturday
For BADM 05:00 to 07:00 pm every saturday

LIVE EVALUATION SESSION (CAPSTONE AND FINAL PROJECT)

About Session: The Live Evaluation Session for Capstone and Final Projects allows participants to showcase their projects and receive real-time feedback for improvement. It assesses project quality and provides an opportunity for discussion and evaluation.
Note: This form will Open only on Saturday (after 2 PM) and Sunday on Every Week

Timing:

For BADM and DE
Monday-Saturday (11:30AM to 1:00PM)

For DS and AIML
Monday-Saturday (05:30PM to 07:00PM)

Booking link : https://forms.gle/1m2Gsro41fLtZurRA