# POTHOLE DETECTION USING DEEP LEARNING

Prepared for


**CSCI6505 – Machine Learning**

Project Proposal

Prepared by

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# 1. Introduction

The number of vehicles on roads has increased a lot in this modern era and so as the count of accidents. Some of the accidents in roads happens due to the existence of potholes in the road. This project deals with identifying the potholes in the road and thereby alerting the drivers to reduce the speed in advance. It is even possible in future to invent a new technology which automatically reduces the speed based on the existence of potholes on the road. The algorithm will be trained with large amount of data images of roads with potholes and normal roads without potholes. When the algorithm achieves high accuracy then they can be used in vehicle in which the data from senor which captures the images of the road will be fed. Then those data are processed to identify the potholes on the road. This will be very helpful in reducing the road accidents.

# 2. Dataset

Dataset needed for this project are collection of images which can be used to detect potholes. We found few interesting datasets as below:

- https://www.kaggle.com/virenbr11/pothole-and-plain-rode-images
- https://www.kaggle.com/atulyakumar98/pothole-detection-dataset
- https://www.kaggle.com/sovitrath/road-pothole-images-for-pothole-detection

These datasets will be processed to generate uniform dataset with required features for the project. The above datasets will be split into two segments as training data and test data and later they will be fed to algorithm to fine tune it.

# 3. Implementation Plan

## Initial Implementation:

The initial implementation will focus on Understanding the data and processing it to generate a data set useful for the project.

The steps involved in this are:

**1. Image selection**: Depending on the number of grayscale images already in the dataset, we will

a) Delete the grayscale images - if the percentage of such images is low enough (3%)

b) Convert RGB images to grayscale - if the percentage of grayscale images is significant.

**2. Image labeling**: We will first take the image set and create a dataset where we will have the image name and if that image has a pothole or not. If the image contains a pothole, the corresponding value will be 1. If it does not have a pothole, the value will be 0.

**3. Image resize (dimensions) fixing**: In this step we will set the dimensions of each image. Since we will be using a simple Multilayer Perceptron, the number of inputs will be fixed. Therefore, it is required that all images have the same dimensions (m by n for example), we will modify the images (crop, stretch, resize etc) so that all of them have the same dimensionality.

**4. Image to numerical data conversion**: In this step we will convert the image to numerical data. Depending on the 1st step

a) Since all the images are colored, they will have three channels (R,G,B) with each pixel in a channel having a value in range [0,255]. We will read the pixels row-by-row and channel-by-channel, giving us a list with m*n*3 values. These 3*m*n values will then be the input to our multilayer perceptron.

b) Since all the images are grayscale, they will have only one channel with each pixel a value in range [0,255]. We will read the pixels row-by-row and channel-by-channel, giving us a list with m*n values. These m*n values will then be the input to our multilayer perceptron.

Using the above data we will train our model to detect whether the road has a pothole or not.

### Final Implementation:

The final implementation will be a Trained model using MLP and CNN neural network which will be capable of detecting potholes and if possible tag potholes on image using boundary or heatmap.

## 4. Anticipated Challenges

The challenges involved in this project are Data Pre-processing, Training Model, and Visualization and Analysis of results.

Currently, the collection and pre-processing of data are an easy part of the project as a significant source of the data is from Kaggle, and pre-processing needs only a few transformations. The major challenge for us is choosing neural network for our training model. We are currently only familiar with Multi-Layer Perceptron and are aware there are advanced neural networks available such as CNN, AlexNet, VGG, etc. As a backup plan, we wish to train our model using CNN neural network if MLP results lack accuracy.

Once the model is trained, it is straightforward to detect if an image has a pothole or not. Still, visualizing the results and detecting the location of the pothole on image and tagging it is which

we are less confident about. We also don't know if we could tag the pothole's location using boundary or heatmap as this depends on the results from previous tasks.

## 5. Timeline and Milestones

The details are attached as a A**nnexure I: Gannt Chart** along with this report

## 6. Roles and Responsibilities

Every person will be responsible for the completion of the project but responsibilities of major tasks are divided are as follow:

| Responsibility | Janvi.P | Jeyanth.R | Robinder.D | Vishal.S |
|---|---|---|---|---|
| **Data gathering and Formatting** | | | | Yes |
| **Data cleaning and sampling** | Yes | | | |
| **Data transformation** | | Yes | | |
| **Data Splitting** | | | Yes | |
| **PCA** | Yes | | | Yes |
| **LDA** | | Yes | Yes | |
| **MLP: Model Training** | | Yes | Yes | |
| **CNN: Model Training** | Yes | | | Yes |
| **MLP: Analysis and Visualization** | | Yes | Yes | |
| **CNN: Analysis and Visualization** | Yes | | | Yes |

## 7. Immediate Tasks:

Currently during the time waiting for approval of the project, we planned to create a boilerplate code for image detection. We will do various research for image identification and converting them into data that could be fed to the algorithm. This would be the primary step required for the project. We will further do analysis on various papers published in this topic to get an overview of what is to be done and what new things could be implemented apart from the existing technologies.

# 8. Bibliography

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