POTHOLE PATROL

Live Pothole detection using ML

Group No: 43

Guided by:
Prof. Nabanita Mandal

Group Members:
Mittul Daswani
Shubham Jaiswal
Tanay Kamath
Vedant Kangde

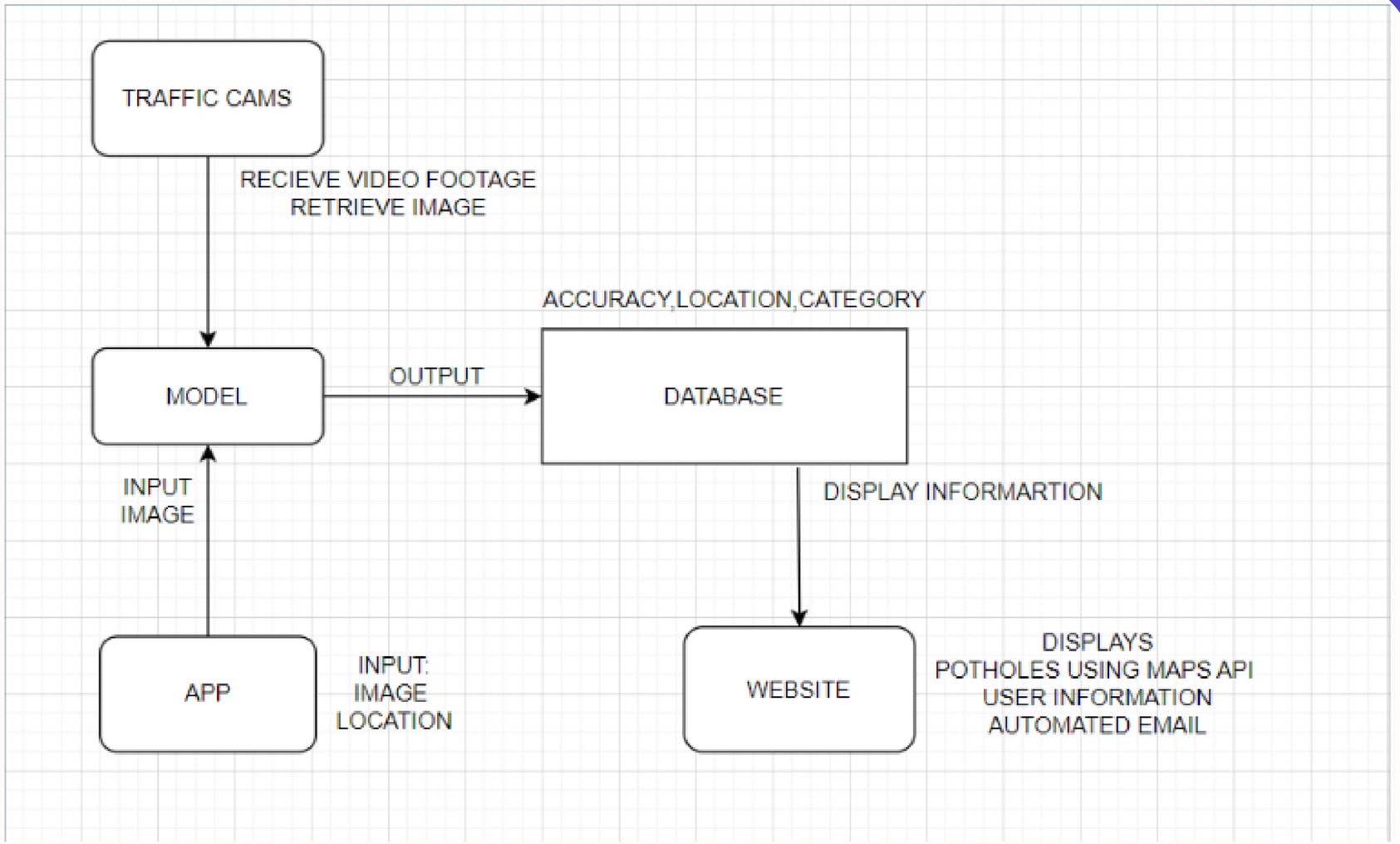
ABSTRACT

Pothole detection is important to decrease accidents across the world. Many researches have been done but they require some specific devices or tools to acquire sensor data. We propose an handy way to implement pothole detection using a smartphone, and classification is performed using Transfer Learning.

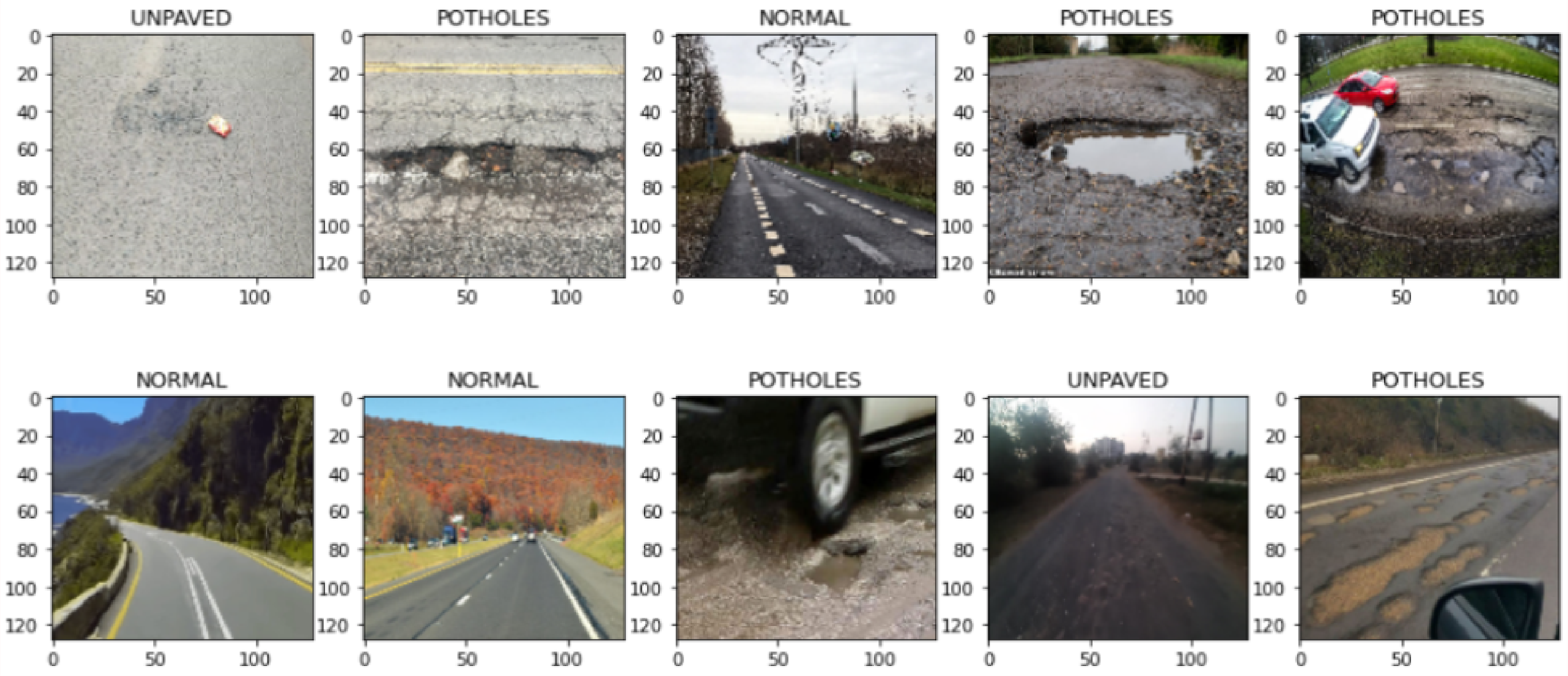
PROBLEM STATEMENT

Potholes pose a grave danger to safe travel on the roads, so to detect and report potholes we are proposing this project as a solution to detect potholes in real time via a video feed as well as manual reporting by users through our app.
Input will be live video feed as well as photos uploaded by user for manual reporting.
Output will be an automated system which reports all the information to the relevant authority of the area by email.

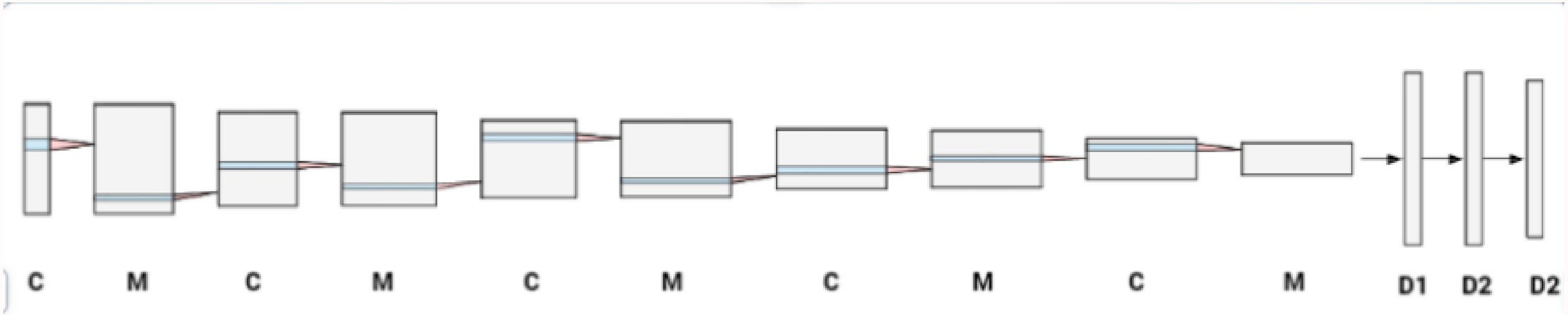
BLOCK DIAGRAM



DATASET


UNPAVED
POTHOLES
NORMAL
POTHOLES
POTHOLES
NORMAL
NORMAL
POTHOLES
UNPAVED
POTHOLES

CNN MODEL



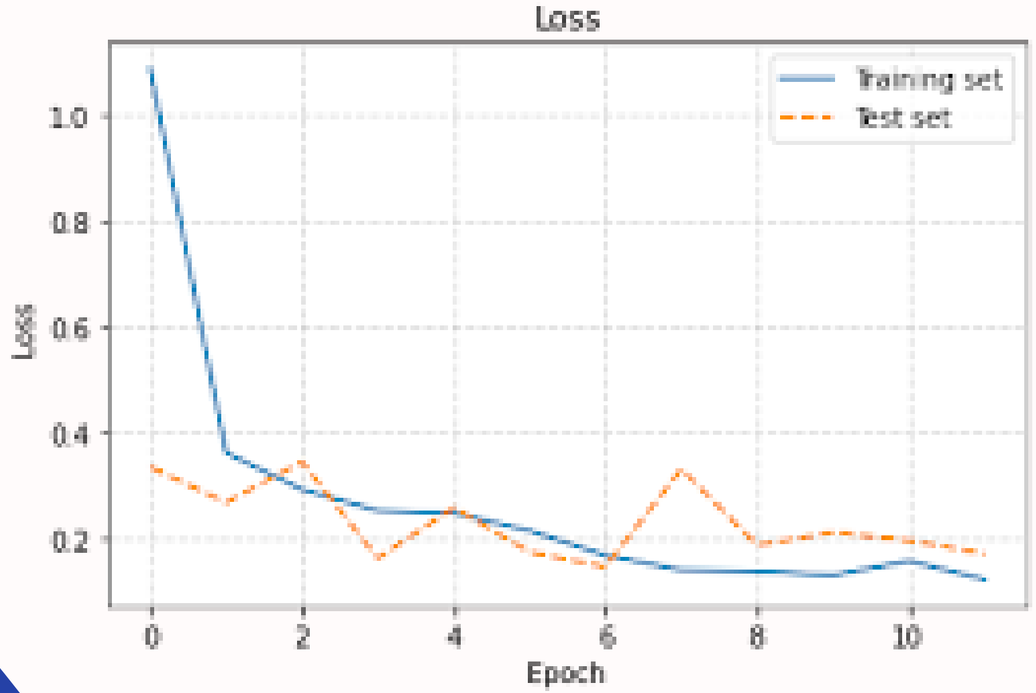
C : Convolution Layer

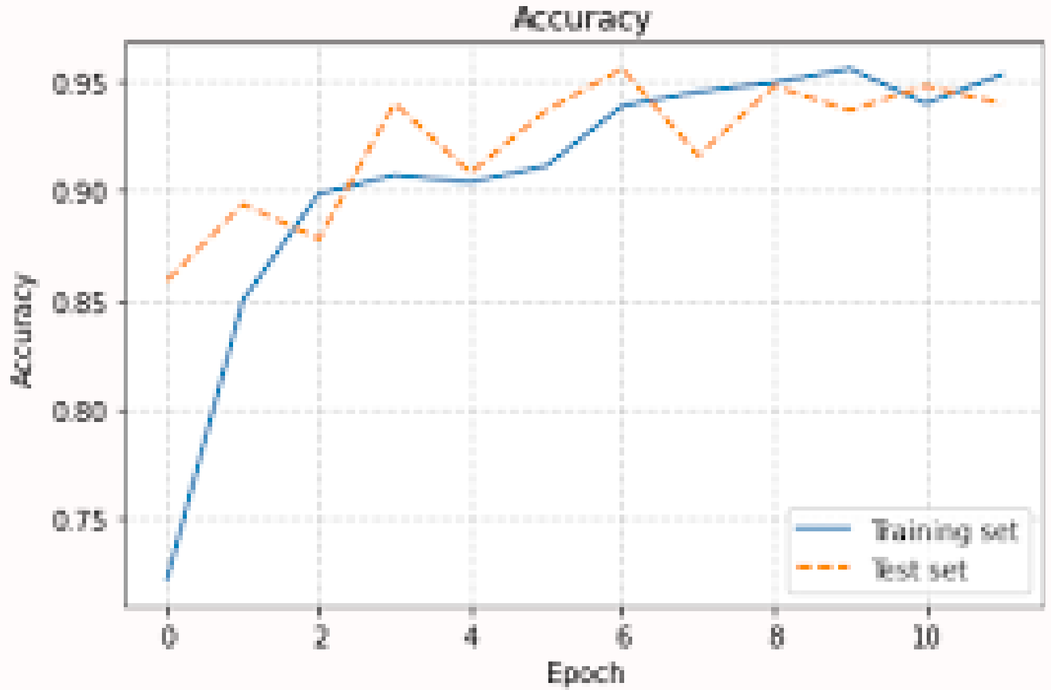
M:Maxpooling Layer

D1:Dropout Layer

D2:Dense Layer

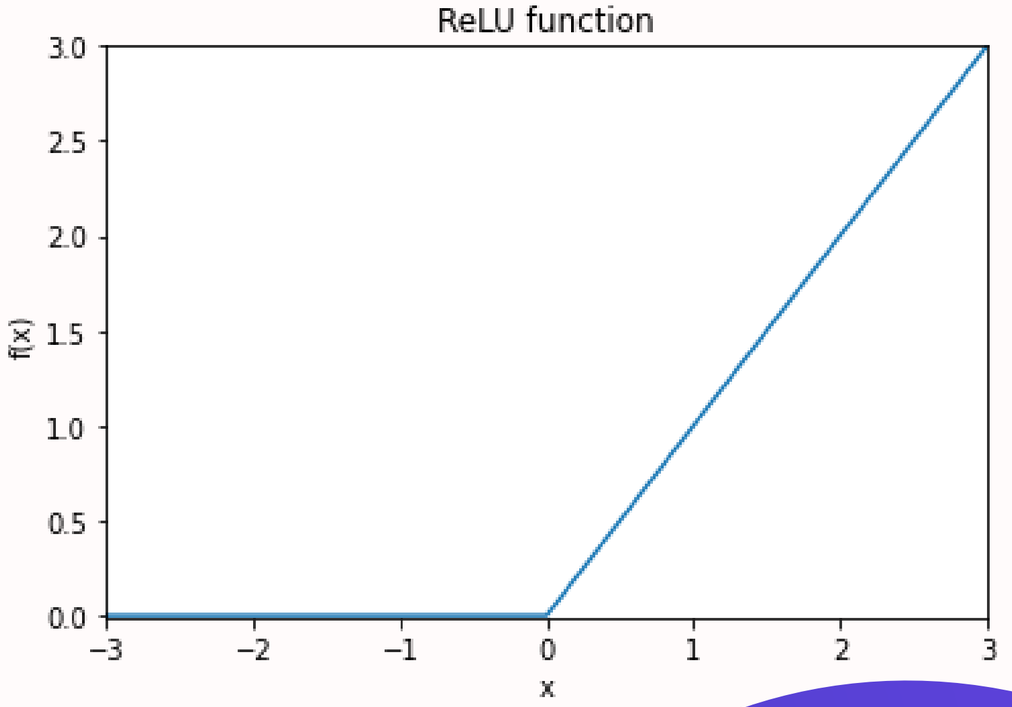
ACCURACY AND LOSS FUNCTION GRAPHS





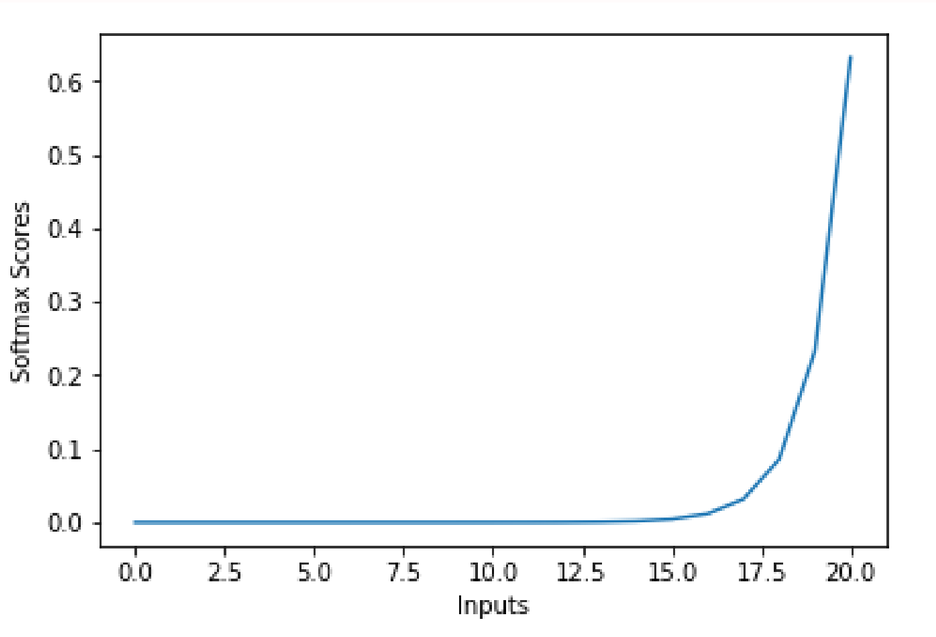
ACTIVATION FUNCTIONS:

ReLU Function:There are a number of widely used activation functions in deep learning today. One of the simplest is the rectified linear unit, or ReLU function, which is a piecewise linear function that outputs zero if its input is negative, and directly outputs the input otherwise.



SOFTMAX:

The softmax function is commonly found in the output layer of image classification problems.The softmax function would squeeze the outputs for each class between 0 and 1 and would also divide by the sum of the outputs.



PERFORMANCE METRICS

$$\text{Accuracy} = \frac{tp + tn}{tp + tn + fp + fn}$$

$$\text{Precision} = \frac{tp}{tp + fp}$$

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y^{(i)} - \hat{y}^{(i)})^2$$

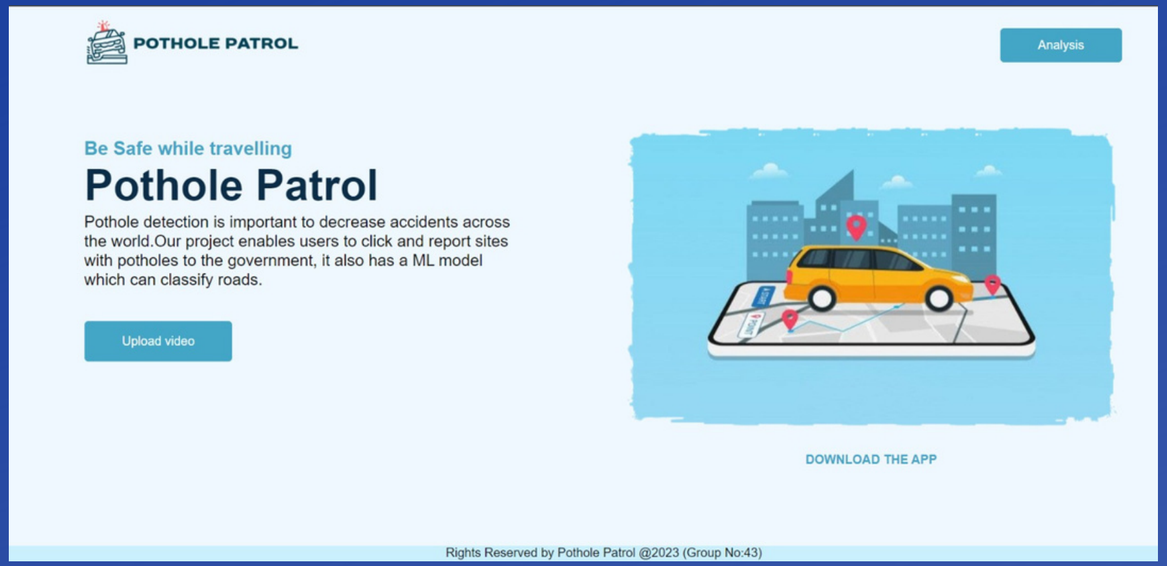
$$\text{Recall} = \frac{tp}{tp + fn}$$

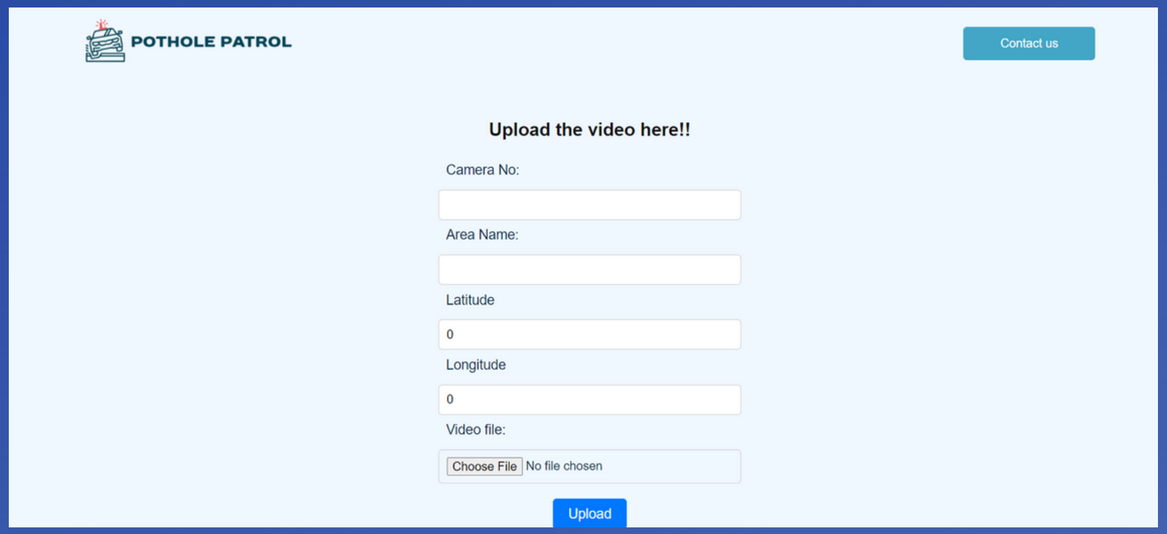
$$F_1 = 2 \cdot \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}} = \frac{\text{TP}}{\text{TP} + \frac{1}{2}(\text{FP} + \text{FN})}$$

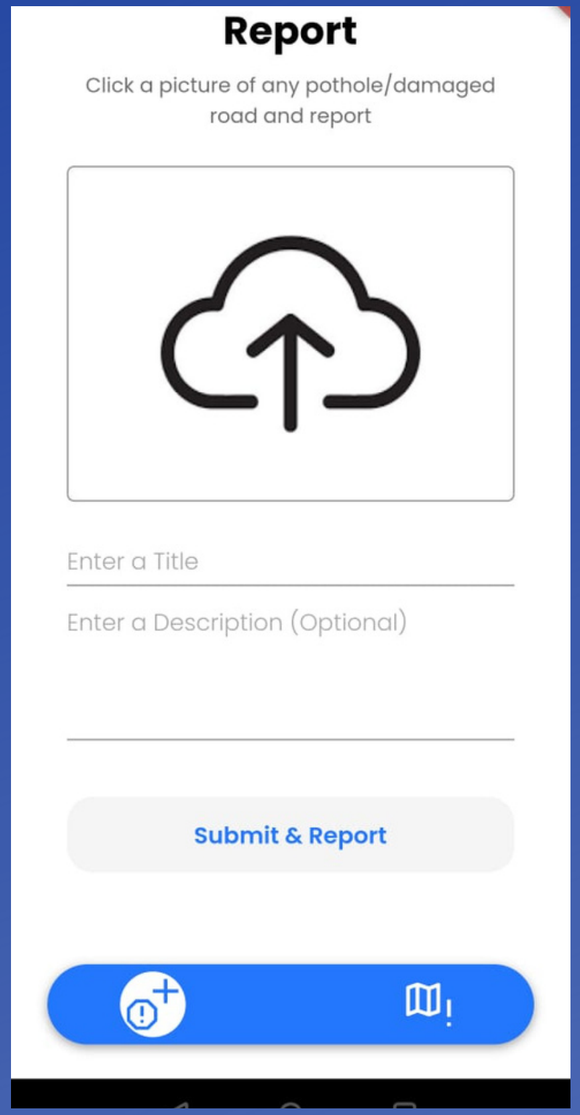
COMPARATIVE STUDY

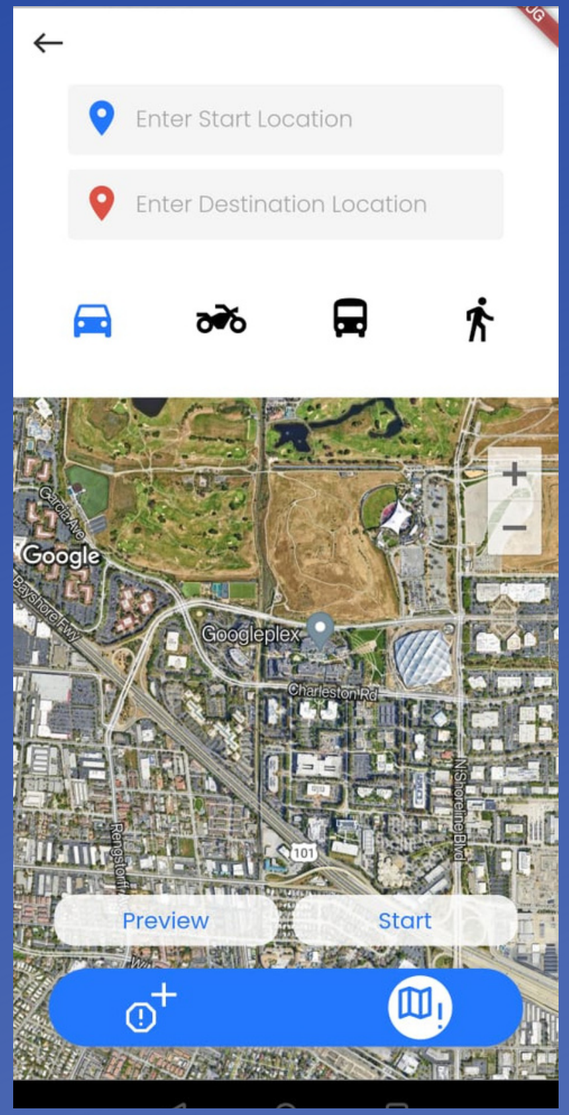
NAME	ACCURACY(%)	AUC(%)	LOSS(%)	PRECISION(%)	RECALL(%)
1 CONVOLUTION 1 MAX POOLING	74.07	73.81	91.97	61.11	61.11
2 CONVOLUTION 2 MAX POOLING	85.24	90.11	18.02	84.94	84.13
3 CONVOLUTION 3 MAX POOLING	89.74	87.44	18.70	94.91	94.76
4 CONVOLUTION 4 MAX POOLING	94.92	98.53	23.05	92.38	92.38
5 CONVOLUTION 5 MAX POOLING	96.56	98.87	18.70	94.91	94.76

IMPLEMENTATION









CONCLUSION

The proposed approach can help road maintenance authorities to formulate rapid and optimized actions for road infrastructure repairs. A more sophisticated solution with the help of the global position system (GPS) can detect and point out the location of pavement failures. Our comparative study revealed that the CNN model with 5 Convolution and 5 Max Pooling layers gives the best accuracy at 96.56%. We also see a significant jump in recall between 1 and 2 Convolution, Max Pooling layer models which shot up by 23.02%

FUTURE PLANS

- Adding depth perception, quality of road as parameters for classification
- Getting live video feed from traffic cams
- Making an iOS application
- Contractors listing with quotations for road maintenance

REFERENCES

RESEARCH PAPERS

1. Sukhad Anand ,Gunjan Chugh, Divya Bansal and Sanjeev Sofat, “Road Condition Detection Using Smartphone Sensor: A Survey”, International Journal of Electronic and Electrical Engineering
2. Jin Lin and Yayu Liu Ajit Danti, Jyoti Y. Kulkarni, and P. S. Hiremath, “An Image Processing Approach to Detect Lanes, Potholes and recognize road Signs in Indian Roads”, International Journal of Modeling and Optimization, Vol. 2, No. 6, December2012

ARTICLES:

1. https://towardsdatascience.com/building-a-realtime-pothole-detection-system-using-machine-learning-and-computer-vision-2e5fb2e5e746
2. https://towardsdatascience.com/automl-for-object-detection-how-to-train-a-model-to-identify-potholes-e22c3f4b774

THANK YOU!

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