Android App for Pothole Detection

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***Abstract*—Road travel is the most used form of transportation worldwide. With this extensive use of road transport, the infrastructure of the road slowly deteriorates and the safety of travelers becomes the significant issue, this analysis gives a system that uses mobile sensors from individuals, as well as image-based equivalents, to detect potholes in real-time using Machine Learning Algorithms. The application then notifies the appropriate authorities about the pothole, allowing them to take the necessary steps. Additionally, location tagging, evaluating the locations, and redirecting current complaints are all included in the solution.**

Keywords— POTHOLE DETECTION, CNN, FLASK, RANDOM FOREST

I. INTRODUCTION

Potholes are inconvenient to drive over, and they can incur billions of dollars in damage to automotive wheels, tires, and suspensions each year. About 1 in 10 drivers in the US have had to repair their car due to the damage caused by potholes. In 2021 the damage caused by potholes was approximately 26.5 Billion. Potholes are an annoyance, particularly in developing countries, and they frequently cause vehicle damage or physical danger to car occupants. Continuously driving across potholes can have a severe effect on your vehicle's suspension system. If potholes are spotted in real time, drivers can be cautioned to take evasive action.

Over the last several years, computer vision and image processing-based solutions have gained popularity due to the availability of cameras that are both affordable and practical, and have proven to be a viable replacement for traditional manual inspection methods for pothole detection. Consequently, image processing-based pothole recognition remains a difficult task due to variable pothole textures, pothole structures, road bumps, manholes, and shadows, among other factors. For this subject, various computer-vision-based techniques to pothole identification and categorization have been investigated.

As a result, our program can detect and classify any new input data as a "pothole" or "not a pothole" with ease. Whenever a pothole appears, we can display the position of the pothole on the map by clicking a button. Smartphones include two types of sensors that may be utilized for pothole detection: microphones and accelerometer, as well as gyroscopes and magnetometers. This project focuses on accelerometer data processing for pothole detection and is built on Android OS with the Flask API.

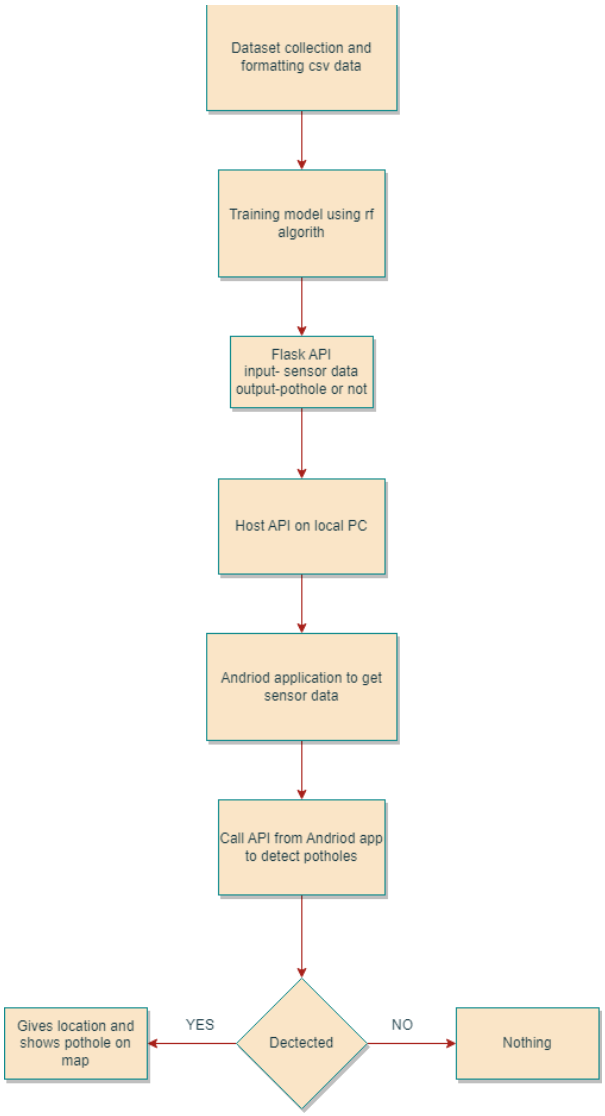

Figure 1: Overall System Architectural Diagram

II. Overall System Architecture

Fig 1 illustrates a schematic diagram of our developed system architecture which consists of four components:

A. *Architecture Model Description*

The main focus of this study is identifying potholes on roadways using various technologies. The goal is to put in place a real-time pothole monitoring system to help with this ,In figure1 a detailed flowchart of project model firstly the dataset is collected and formatted to csv data and then that data is trained using random forest then the model is pickled and api is hosted on the system the data from android app is now given to the prediction model to predict the pothole

B. *Training Model using Random Forest*

we have implemented Random Forest classifier using python from scikit-learn library and got accuracy of 98% with 0.03% of root mean squared error.

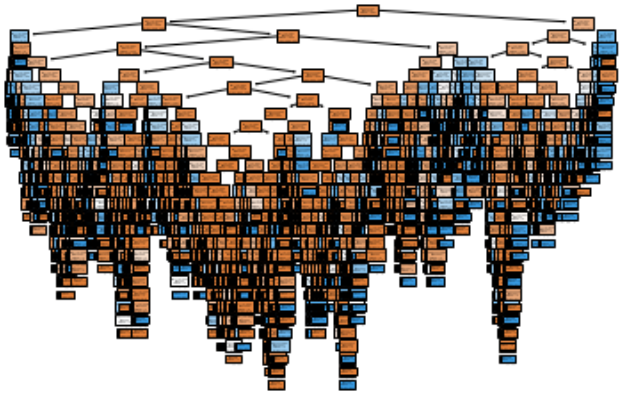

Figure 2: Tree plot of predicted Results

C. *Hosting Flask API*

In this approach we created a machine learning model using random forest classification, in python and created a pkl(pickle) file. We created and hosted an API using flask on the local server so that we can access the url using our android device. then use the api to classify the sensor data in pothole or not a pothole. The app shows the location of the pothole on the map.

D. *Convolutional Neural Network*

Other than random forest another algorithm we implemented with image dataset which had 621 images of potholes of 200x200 size which was given to cnn as input size200x200 with batch size as 3 with ReLU as the activation function trained the model with 10 epochs cnn predicted the model with 97% validation accuracy.

III. Experimental Evaluation

In the implementation phase, we tried to create multiple machine learning models to classify the different sensor data that we got. First, we created a model in python and exported in ONNX format so we can use the model in android. In that approach we faced some fundamental difficulties while using the model in the android app,So we settled on Random Forest and the mobile application is employed to facilitate contact between users and civic authorities about the inquiries submitted by users. Smartphones sensors like accelerometer and GPS are employed for the collecting of the data. The suggested system detects potholes using two methods: accelerometer sensors and photos supplied by users. This data is subjected to detection algorithms, and the coordinates of the potholes are acquired using the Flask API. To enable the classification of potholes and their intensity, we have implemented several machine learning models. Thesemodels take in an input of 9 features Each set of features has a corresponding label which is used for validation in this supervised learning model.

A. *Datasets*

We found different formatted data which we then converted to the format that was suitable for our specific model.
In the collected data we have the X, Y and Z axis sensor data for accelerometer, gyroscope and magnetometer.

B. *Results*

When a pothole appears, we can show the location of the pothole on the map by clicking a button. In figure 4 you can see the pothole prediction on and in figure 3 map is displayed.

Figure 3: Pothole prediction app

Figure 4 : Pap of located pothole

IV. Limitations and Future Works

One of the most significant disadvantages of pothole identification is that the predictive models failed to connect to the Flask API hence only random forest model was successful. data collection is hard and the tools used to collect the data might give biased data, so Better-defined tools would aid in mitigating the consequences of this problem. As future work we can provide the pothole prediction make use potholes and send notification to particular authorities to repair the potholes.

V. Conclusion

Using this app, we can help improve the current pothole situation and potentially prevent damages caused to cars because of potholes. We created a pothole detecting interface that was tested using two datasets and in real-time. While our real-world testing accuracy was surprisingly lower than our testing accuracy, we can enhance our accuracy by using more complicated models, better sampling methods.