

Pothole Detection System using Artificial Intelligence

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Abstract - The importance of road infrastructure for society could be compared with the importance of blood vessels for humans. To ensure road surface quality it should be monitored continuously and repaired as necessary. One of the major problems in developing countries is the maintenance of roads. Well maintained roads contribute a major portion to the country's economy. India is the vast country in the world that does not have proper maintenance of the road, over 95% of the people use road transportation. Due to this peak usage of road transports, there are many possibilities of potholes on roads which lead to accidents. Other major reasons for accidents are due to the head on head collisions. Potholes are an unavoidable obstacle that every motorist in India faces mainly during the rains, To solve this problem, various techniques have been implemented ranging from manual reporting to authorities to the use of vibration-based sensors. But all these techniques have some drawbacks such as the high setup cost, risk while detection, or no provision for night vision. Hence, we have come up with a project that could help people most conveniently. The main idea is to detect and notify the potholes possibly without human intervention. To achieve our goal we are using AI-enabled cameras and object detection API that help in detecting the potholes. This collected data can be used by the motorist to avoid accidents.

Keyword's: Pothole, Artificial intelligence, API, Road, WHO, Motorist

1. INTRODUCTION

As we know, India is the fastest developing country after china. Although India is doing exceptionally well in certain fields, we majorly lack in roadways. Roads are the dominant means of transportation in India today. However, roads here are narrow and congested with poor quality and are not appropriately maintained. This road condition is a boosting factor for traffic congestion and a number of road accidents. Hence, these conditions gave me a reason to make an effective system to make transportation more safe and healthy in my country.

The vehicle population has tremendously increased over the last two decades. Nowadays, traffic congestion and road accidents are increasing mainly due to the proliferation of vehicles. Roads make up to the majority of means of transportation used as of today in India, regular maintenance of these roads is crucial as they are filled with

unexpected hurdles such as potholes and humps. Potholes are basically areas of road surface that have ruptured, worn away, or eventually formed a hole. Potholes lead to unbalance while driving, which can eventually lead to an accident. According to the report of Global Road Safety, released by the World Health Organization (WHO), India reports for more than 200,000 deaths because of road accidents. These accidents can be due to over speeding, drunk and driving, jumping traffic signals, and also due to humps, speed-breakers, and potholes.

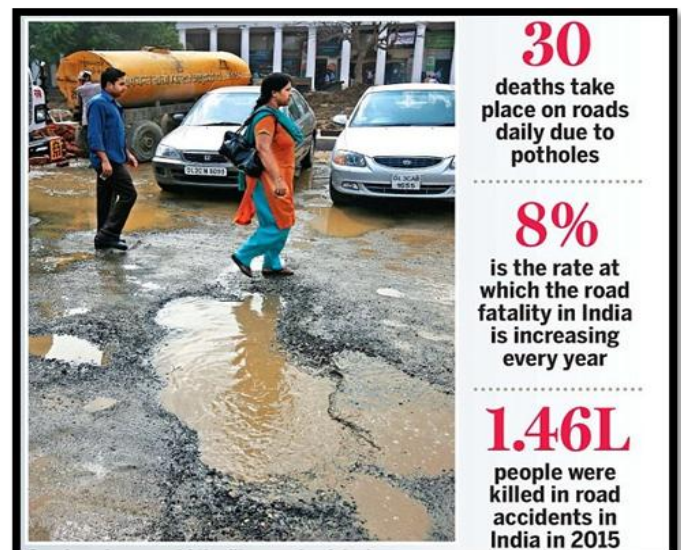


image -1: Death's caused due to potholes

The solution to this problem must be designed wherein it ensures the systematic and safe flow of traffic on Indian roadways. This can be achieved by maintaining the equality of roads. The regular monitoring of these roads will help the government to be aware of the possible threats of fatal accidents on the road. To achieve this, we wish to have a government vehicle that runs through the entire paths and collects the information about potholes at different locations. Depending upon the depth and the soil structure below the pothole, the emergency to fill the hole can be derived. The motive behind this project is to notify the Municipal Cooperation regarding potholes which will avoid accidents and make roads a better place to ride.

1.1 Existing system

In developing countries, the pavement pothole is often detected manually by inspectors of the municipal corporation during periodic field surveys. Although this conventional method can help to acquire an accurate evaluation of potholes, it also features low productivity in both data collection and data processing. The reason is that one pavement inspector can only inspect less than 10 km per day. With a large number of road sections needed to be inspected routinely, the automation of the pothole detection becomes a pressing need for transportation agencies. The simplest method might be to collect photos of road damage and hazards taken by the participants and to upload them to a central server. However, this requires strong participation and interaction from the users as well as manual image analysis. We believe that an automated approach for detecting potholes with little or no human interaction is more promising. This would ensure more comprehensive survey data with fewer errors caused by human factors than generated by the mere enthusiasm of participants. Moreover, the productive pavement surveying process significantly leads to economic gain. It is because, if the rehabilitation process is performed timely, pavement restoration cost can be saved by up to 80%.

Dis-advantages

- It requires more workforce.
- Manual inspection in large cities will be complicated.
- It is more time consuming.

2. Proposed system

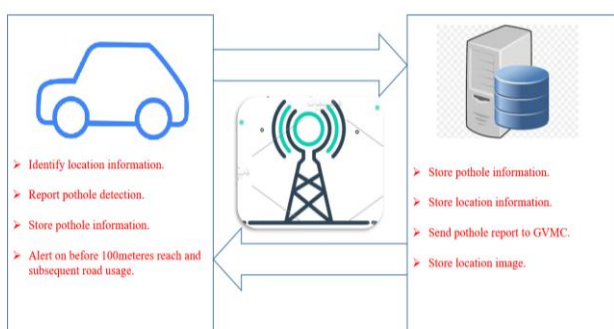


Image -2: proposed system

2.1 Methodology

The location of the vehicle is tracked using GPS. The camera captures the image of the road continuously through Open CV, and the captured images then are compared with the trained data set of potholes. If the image matches with the dataset, then it sends an email to the municipal authorities along with the image and the location of the pothole. Object detection is also used in industrial processes to identify

products. Finding a specific object through visual inspection is a basic task that is involved in multiple industrial processes like sorting, inventory management, machining, quality management, packaging, etc. To train the dataset, we started by cloning TensorFlow object detection repository on GitHub. The API is an open-source framework built on TensorFlow, making it easy to construct, train, and deploy object detection models.

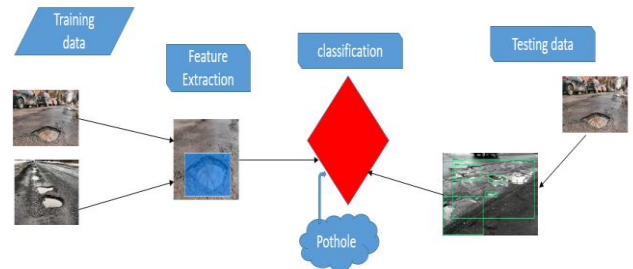


Image -3: Pothole detection workflow

This model is trained to detect and differentiate 2 different classes namely

1. Pothole
2. Pothole Group (Having more than 2 potholes on the image or a Big Pothole)

We had labelled and trained the model in such way that detecting Pothole and Pothole group is the main priority.

2.2 Implementation

1. Gather required images and label them.

We had got the Pothole images dataset from Kaggle we had used LabelImg which is an open tool for labelling images.

2. Model used: Faster-RCNN-Inception-V2-COCO model from TensorFlow's model zoo

TensorFlow provides several object detection models (pre-trained classifiers with specific neural network architectures) in its model zoo, we had used faster_rcnn_inception_v2_coco_2018_01_28

3. Training and exporting the Inference graph.

We had trained this model on my machine (8GB RAM) for like 15 hours. The more time training the dataset results in high accuracy.

Advantages

- It doesn't require more workforce as complete work will be done by Ai.

- Accidents due to pothole can be avoided.
- Driver will be intimated about potholes.
- GPS tracks the location of pothole and sends it to GVMC so as to repair the road.
- Enhanced safety and security provided.

2.3 Final results



Image -2: Screenshot of e-mail

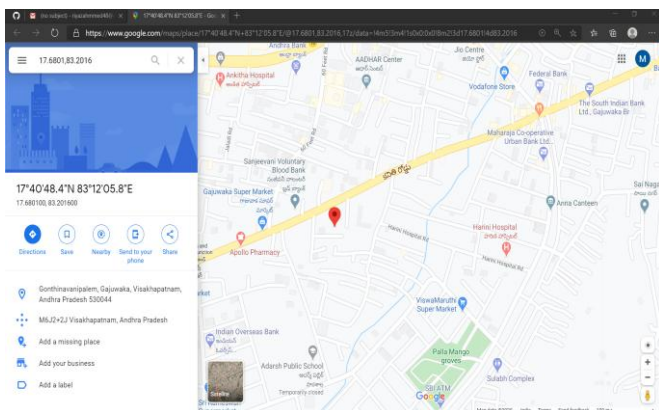


Image -3: location on Google maps

3. CONCLUSION

The main aim of the model is to detect potholes on the roads and notify them without any human interference. No manual intervention is required to spot and report the potholes. It can be detected automatically with the help of AI, therefore our pothole detection system helps the society in promoting road safety and reduces the difficulties in detecting the pothole and also reduces the usage of human power and hence saves time. Therefore, by filling the pothole accidents which occur on the road may be reduced. The image captured and the geographic location that is longitude and latitude of the pothole detected will be sent to the concerned government authorities mail. The authorities can see the image and if they click on the link sent through e-mail, they

can check out the location of the pothole detected in the google maps.

4. Future scope

The collected data can and used to provide real-time pothole updates in Google maps. This will be beneficial such that it will simultaneously show the existing features of Google maps and maps the collected potholes.

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