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# SMART POTHOLE DIAGNOSIS

RajivaRanjan Divivedi[1], Jai Chaturvedi[2], Nitin Shaju[3]

[1]*Assistant Professor, Department of CSE, SRM Institute of Science and Technology, Ghaziabad*

[2]*Department of CSE, SRM Institute of Science and Technology, Modinagar, Ghaziabad*

[3]*Department of CSE, SRM Institute of Science and Technology, Modinagar, Ghaziabad*

***ABSTRACT***

**Accurate diagnosis is indeed the most crucial task for making roads and motorways safer worldwide. Potholes cause more than 5000 accidents in India per annum, resulting in quite a big loss of life and massive damage to property and other economic damage. No matter how hard the authorities try to find out and repair them, it is bound to fall short without public and technological support. But major changes can be brought to ways these operations are run and the motorways which are a lifeline of the economy managed. The entire process can be made effective and smooth with computer vision and public feedback. The team looks forward to designing a dashboard where the public can upload pictures and images of such potholes, those images authenticated using image analysis and deep learning for better and accurate reporting and smooth reparations, saving life and property. The strategy is divided in two parts. The first is the dashboard which would connect the database and information with the module. Through this visual dashboard citizens can upload the pictures with their contact information and accurate locations. In the second part, the fine-tuned inception model analyses images, preprocesses the input images and detects the aforementioned image as a distinctive and tangible pothole to be repaired. This information is collected through the dashboard again with the government database so they can act on it promptly.**

**General Terms**

Data Science & Analytics, Machine Learning

***Keywords***-Data Preparation, Descriptive & Inferential Statistics, Feature Selection, CNN Inception wave, Transfer Learning, ImageNet,

## *1. INTRODUCTION*

Diagnosis is mostly about first categorizing and confirming potholes on the basis of some similar properties and grouping them separately to accurately detect. Segmenting input pictures is one of the key aspects in any such detection and diagnosis model and thus focussing on the right craters. We intended our work towards identifying road cavities on the basis of uploaded input pictures.

Accurate Identification is the best way to alert authorities which does not cause hassle . The first input people do is pictures of potholes and the location, location is also cross references from the coordinates in metadata of the image. Every person is concerned that they would have the chance to change something by informing the authorities .

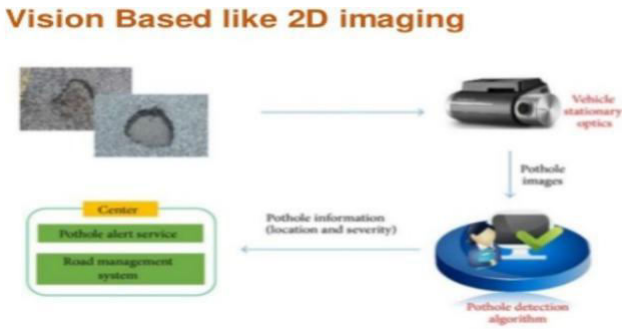
Detection of the potholes can be achieved by building a ML model using Convolutional Neural Networks and Transfer Learning process. We also use Softmax Activation Function fully-connected output layers of the

loaded, allowing a new output layer to be added and trained. The analysis of Data helpsto infer insights and also makes the data more feasible and easy to deal with.

Roads and highways these days are the engines of economy and development. Consistently new highways with different designs are constructed.

Countless roads get damaged on a regular basis. Hence this project is concentrated on finding the efficient way according to the people's needs and ease. This work should be able to reduce cost and time for works which are meant to make travel comfortable and hassle free.

Various feedback from people contribute to better management. The data which is being researched consists of some features of different kinds of roads. Main Goal is to thus classify the actual places where repair is needed with the help of these features.




## 2. LITERATURE SURVEY

[1] Yu and Salari proposed a pothole detection approach based on laser imaging procedures to collect road details. Then the artificial neural network algorithm (ANN) was used to probe the road information and detect potholes .[2] Lin and Liu used the support vector machine algorithm (SVM) to scrutinize pictures about road data for pothole detection . [3] Real Time Pothole Detection march 2015 International Journal of Engineering Trends and Technologies [4] Feature based potholes detection in two dimensional images Seung-kiRyu, TaehyeongKim,Young-rokim 2019. [5] Pothole diagnosis in asphalt pavement images Koch - Brilakis ,2011. [6]. Satellite based detection will cost low for the Government agencies with help of Space agencies, but difficult for non Governmental efforts Advanced satellite data needs to be used which can give details, the details would need to be covered with layers of different colors to detect potholes No interactive information with residents on the ground Cannot cover covered areas or areas with roof or under trees which are most prone for having potholes Cannot cover areas with multiple detectable features without a state of the art satellite which will increase permissions and incurring costs.

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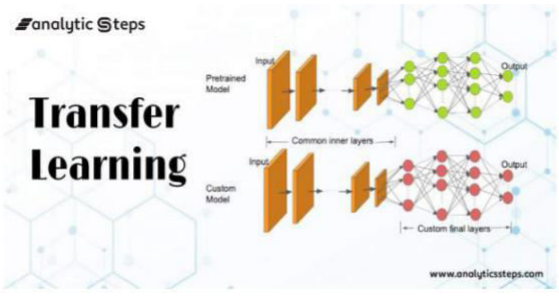
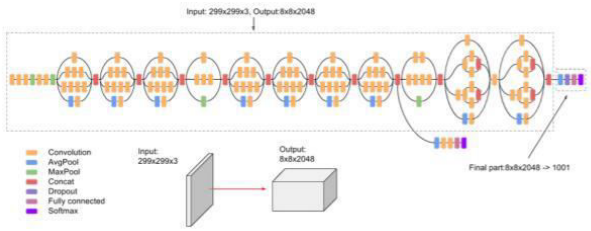
## 3. METHODOLOGY

1) Transfer learning is a machine learning technique in which a model designed for a particular work is reused as the beginning position for a model on a subsequent or secondary piece or work.



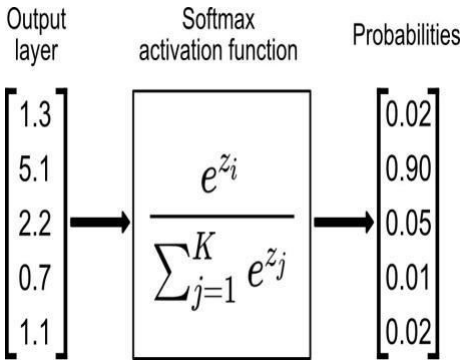
2) A Pre-existing Transfer Learning model known as Inception wave model is applied. It's outcomes are used to train this model.




3) Softmax Activation Function

The softmax function is being used as the activation function in the output layer of neural network models that predict a multinomial probability distribution. That is, softmax is used as the activation function for multi-class classification problems where class membership is required on more than two class labels.

It is often used as the final activation function of a neural network to regularize the output of a network to a probability distribution over predicted output classes.




4) Many pre-trained architectures are accessible in the Keras library. Imagenet data set has been extensively used to generate many different architectures since it is quite substantial( 1.2M images) to develop a generalized model. The requirement is to train a model that can accurately segregate the images into 1000 separate object groupings. These around 1000 image categories represent object classes that are visible in daily life, such as pets, utensils and cars ,etc.

These pre-trained networks illustrate a robust capability to generalize to images outside the ImageNet dataset via transfer learning. Modifications are generally made in pre-existing models by fine-tuning the model.

5) Fine Tuning the model

Using Architecture of the pre-trained model- Using architecture of the model while initializing all the weights randomly and training the model according to the dataset again.

Training some layers while freezing other layers- Another way to fine tune a pre-trained model is to train it partially. Some higher or initial layers can be selectively included or excluded while training the model and others can be frozen.

**3.1**

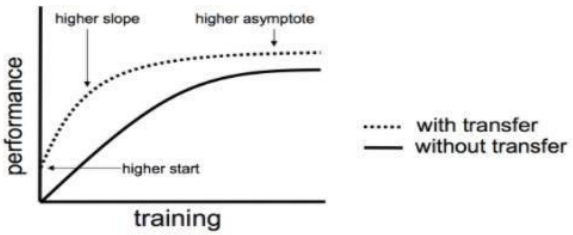
Transfer learning is a machine learning method where a model developed for a task is reused as the initial point for a model on a secondary task. Keras ships Convolutional Neural Networks have been pre-trained on the ImageNet dataset. ImageNet is a project aimed at labeling and categorizing images into almost 22,000 different object categories for the motive of computer vision analysis and exploration.

Pre-trained Model Approach:

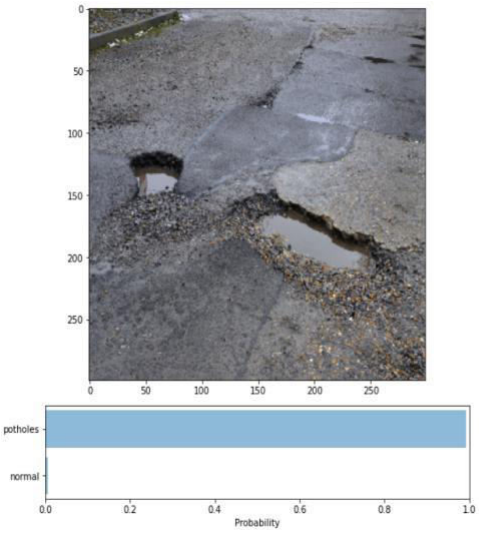
- Select Source Model: A pre-trained

source model is selected from available models. Many research institutes and organizations train and release models on huge and exacting datasets that may be encompassed in the collection of selected models to choose from different models.

- Reuse Model: The pre-trained model is then used as the initial point for a model on the next task of requirement . This requires using all or some parts of the model, depending on the technique used for modeling.
- Tune Model: The model may require to adapt or refine the input-output pair information available for the task of interest.




## 4.RESULTS


**Detection of Potholes is achieved with the help of image analysis:**

In the first picture here, we have potholes and a huge percentage of detection probability that it is a pothole confirming our result. The same goes for the second picture with the picture of a regular highway taken as our input showing accurately it is a normal and regular road.

These obtained results are later sent to authorities databases for them to immediately act on them.

## 5. CONCLUSION

As there is a requirement of big computing power for image recognition techniques, various resources are allocated for this technique to be an accurate and efficient mobile device. Consequently, mobile sensing techniques are more appropriate to detect potholes for mobile devices. Though, prior pothole detection approaches based on mobile sensing only considered one threshold to detect pothole, and large amounts of false-positives are obtained from these approaches. As a result, this study considers a different kind of approach and proposes an interactive and feedback based pothole

detection method to enhance the accuracy of the pothole detection method.

## 6. FUTURE POSSIBILITIES

Satellite based detection is the future for smart pothole diagnosis but the Satellite based detection will cost low for the Government agencies with help of Space agencies, but difficult for non governmental efforts, advanced satellite data needs to be used which can give details, the details would need to be covered with layers of different colors to detect potholes. In this approach there is no interactive information with residents on the ground. It cannot cover covered areas or areas with roofs or under trees which are most prone for having potholes. It may not be able to cover areas with multiple detectable features without a state of the art satellite which will increase permissions and incurring costs. Numerous further advancements can be made to improve the scope and implementation of the technology. Classifying speed bumps would be a significant addition to the existing system. Mapping road conditions along with mapping potholes would significantly help drivers. More refinement can be brought by detecting the severity of potholes. Assigning priorities after differentiating between deep and shallow potholes would save a lot of resources and money.

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