Road Pothole Classification Using Deep Learning Technique And Deployment Using Django

Shijo Shine.D[1], Nirmala Devi.M[2], Jeevitha.K[3], Jansi Rani.S[4]
[1, 2, 3, 4] Dept of Computer science and Engineering
[1, 2, 3, 4] TJS Engineering college

Abstract- *The presence of potholes on the roads is one of the major causes of road accidents as well as wear and tear of vehicles. Recently, with an increase in vehicular traffic and pollution, the roads are getting filled with big and small potholes in almost every city in the country. We present a Convolutional Neural Network in TensorFlow and Keras based road pothole classification. The proposed system based on CNN using road pothole images to classifying the pothole. The pothole detection system using CNN model. It is predicted that the success of the obtained results will increase if the CNN method is supported by adding extra feature extraction methods and classify successfully road potholes. We have demonstrated the efficacy and potential of using deep convolutional neural networks to potholes images. To finally deploy this model to local host django framework.*

Keywords- road pothole, deep learning, Tensor Flow, Keras, CNN

I. INTRODUCTION

GENERAL INTRODUCTION : Potholes are one of the extreme classes of road damage which can not only cause misalignment of the vehicles from their intended path but also damage vehicle structure and components. Both of these can lead to accidents. The damage caused is also dependent on the speed of the vehicle. Therefore it becomes necessary to avoid them which calls for their detection. With the onset of autonomous vehicles employment in passenger travel, the accurate detection is important for taking evasive measures to prevent potential accidents and reduced vehicle life by preventing subjection to unnecessary high stresses. It can also be conducive to road maintenance body in cities.

DOMAIN INTRODUCTION : Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985- 1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

Python is Interpreted − Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP. Python is Interactive − you can actually sit at a Python prompt and interact with the interpreter directly to write your programs. Python is Object-Oriented − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

Python is a Beginner's Language – Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

Python's features include :

Easy-to-learn − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.

Easy-to-read − Python code is more clearly defined and visible to the eyes.

Easy-to-maintain − Python's source code is fairly easy-to-maintain.

A broad standard library − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.

Interactive Mode − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

Portable − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.

Extendable − you can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.

Databases − Python provides interfaces to all major commercial databases.

GUI Programming − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.

Scalable − Python provides a better structure and support for large programs than shell scripting.

PYTHON FEATURES

Python has a big list of good features, few are listed below –

- It supports functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- It provides very high-level dynamic data types and supports dynamic type checking.
- It supports automatic garbage collection.
- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

SCOPE OF THE PROJECT:

- To predict whether the road contains pothole or not in order to avoid road accidents.
- It pays a way to develop web application to avoid road accidents.
- It helps to recognize the road conditions.
- Helps the workers to identify the pothole and rectify it.

so present annotated maps for repair authorities and regular drivers for visual inspection and intelligent navigation

II. LITERATURE SURVEY

Title: Novel Feature Extractions for Reflection, Alligator Cracks and Potholes Road Surface Classification Author: Panop Khumsap, Nalina Phisanbut, Pirawat Watanapongse, Punpiti Piamsa-nga

Road surface inspection for cracks, distortion, and disintegration—together with appropriate surface treatments—are mandatory in maintaining the ride quality and safety of the highways. Due to especially high occurrences of ‘reflection’, ‘alligator cracks’ and ‘potholes’ in Thailand, and the fact that they require markedly different treatment methods, a classifier that can distinguish among those two types of bad surface is most desirable. They proposed two novel feature extractions based on regional profiling and Cartesian profiling of orthogonal axes features which worked well with this particular problem, with added benefit of decoupling feature extraction from the classifiers themselves. Accuracy of road surface detection and classification is important for efficiency of road maintenance. In this research, they designed and developed an algorithm to detect alligator cracks and potholes on asphalt road surfaces. CrackIT, an open-source crack analysis software, is used as input part of system. Besides CrackIT can detect reflection cracks and part of its output provides information that can be used for detecting alligator cracks and potholes.

Title: Pothole Detection Based on Disparity Transformation and Road Surface Modeling Author: Rui Fan, Umar Ozgunalp, Brett Hosking

Pothole detection is one of the most important tasks for road maintenance. Computer vision approaches are generally based on either 2D road image analysis or 3D road surface modeling. However, these two categories are always used independently. Furthermore, the pothole detection accuracy is still far from satisfactory. Therefore, in this paper, they presented a robust pothole detection algorithm that is both accurate and computationally efficient. A dense disparity map is first transformed to better distinguish between damaged and undamaged road areas. To achieve greater disparity transformation efficiency, golden section search and dynamic programming are utilized to estimate the transformation parameters. Otsu’s thresholding method is then used to extract potential undamaged road areas from the transformed disparity map. The disparities in the extracted areas are modeled by a quadratic surface using least squares fitting. To improve disparity map modeling robustness, the surface normal is also integrated into the surface modeling process. Furthermore, random sample consensus is utilized to reduce the effects caused by outliers. By comparing the difference between the actual and modeled disparity maps, the potholes can be detected accurately. The main contributions of this paper are a novel disparity transformation algorithm and a disparity map modeling algorithm. Using our method, undamaged road areas are better distinguishable in the transformed disparity map and can be easily extracted using Otsu’s thresholding method.

Title: Detection of Asphalt Pavement Potholes and Cracks Based on the Unmanned Aerial Vehicle Multispectral Imagery
Author: Yifan Pan , Xianfeng Zhang , Guido Cervone , and Liping Yang

Asphalt roads are the basic component of a land transportation system, and the quality of asphalt roads will decrease during the use stage because of the aging and deterioration of the road surface. In the end, some road pavement distresses may appear on the road surface, such as the most common potholes and cracks. In order to improve the efficiency of pavement inspection, currently some new forms of remote sensing data without destructive effect on the pavement are widely used to detect the pavement distresses, such as digital images, light detection and ranging, and radar. Multispectral imagery presenting spatial and spectral features of objects has been widely used in remote sensing application. In our study, the multispectral pavement images acquired by unmanned aerial vehicle (UAV) were used to distinguish between the normal pavement and pavement damages (e.g., cracks and potholes) using machine learning algorithms, such as support vector machine, artificial neural network, and random forest. Comparison of the performance between different data types and models was conducted and is discussed in this study, and indicates that a UAV remote sensing system offers a new tool for monitoring asphalt road pavement condition, which can be used as decision support for road maintenance practice.

Title: A Novel Processing Methodology for Traffic-Speed Road Surveys Using Point Lasers Author: Wenda Li , Michael Burrow, Nicole Metje, Yueyue Tao, and Gurmel Ghataora

The rapidly increasing traffic volumes using local road networks allied to the implications of climate change drive the demand for cost-effective, reliable and accurate road condition assessment. A particular concern for local road asset managers is the loss of material from the road surface known as fretting which unchecked can lead to potholes. In order to assess the road condition quantitatively and affordably, a system should be designed with low complexity, be capable of operating in a variety of weather conditions and operate at normal traffic speeds. Many different techniques have been developed for road condition assessment such as ground penetrating radar, visual sensors and mobile scanning lasers. In this work, the use of the point laser technique for scanning the road surface is investigated. It has the advantages of being sufficiently accurate, is relatively unaffected by levels of illumination and it produces relatively low volumes of data. In this work, road fretting/surface disintegration was determined using a novel signal processing approach which considers a number of features of reflected laser signals. The proposed methodology was demonstrated using data collected from the UK's local road network. The experimental results indicate that the proposed system can assess road fretting to an accuracy which is comparable to a visual inspection, and at Information Quality Level (IQL) 3 which is sufficient for tactical road asset management whereby road sections requiring treatment are selected and appropriate treatments identified.

Title: A Road Quality Detection Method Based on the Mahalanobis-Taguchi System Author: Huaijun Wang, Na Huo, Junhuai Li, Kan Wang and Zhixiao Wang

As an extremely complicated task, road detection is of vital importance for the traveling comfort and driving safety. While, high-end automobiles are already equipped with road detection function, most mid- range cars can only detect and evaluate road conditions leveraging remodeled or additional hardware devices built on vehicles, thereby constraining the road quality detection. With the growing popularity of smartphones, detections based on built-in sensors emerge. Most detections on built-in sensors, nevertheless, are on the basis of Euclidean distance, thus neglecting the correlation between characteristics in road quality, i.e., the acceleration sensor and gyroscope have obvious fluctuations when the vehicle passes through the larger pothole, and there is a connection between them. In this paper, we propose a novel road detection approach based on MahalanobisTaguchi system (MTS), leveraging smartphones for data collection and involving the correlation between characteristics. a method to detect anomalous regions based on MTS model is proposed. The crowdsourcing method that drivers place the mobile phone in their vehicles can obtain the basic data information to distinguish between different road conditions by the built-in sensor of smart-phones, i.e., acceleration, vibration amplitude, offset data, location data, etc. Meanwhile, a method for data preprocessing using wavelet transform is utilized to improve detection accuracy.

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Asphalt roads are the basic component of a land transportation system, and the quality of asphalt roads will decrease during the use stage because of the aging and deterioration of the road surface. In the end, some road pavement distresses may appear on the road surface, such as the most common potholes and cracks. In order to improve the efficiency of pavement inspection, currently some new forms of remote sensing data without destructive effect on the pavement are widely used to detect the pavement distresses, such as digital images, light detection and ranging, and radar. Multispectral imagery presenting spatial and spectral features

of objects has been widely used in remote sensing application. In our study, the multispectral pavement images acquired by unmanned aerial vehicle (UAV) were used to distinguish between the normal pavement and pavement damages (e.g., cracks and potholes) using machine learning algorithms, such as support vector machine, artificial neural network, and random forest. Comparison of the performance between different data types and models was conducted and is discussed in this study, and indicates that a UAV remote sensing system offers a new tool for monitoring asphalt road pavement condition, which can be used as decision support for road maintenance practice.

Title: Computer Vision Based Detection and Localization of Potholes in Asphalt Pavement Images Author: Kanza Azhar , Fiza Murtaza , Muhammad Haroon Yousaf , Hafiz Adnan Habib

Abstract— Asphalt pavement distresses have significant importance in roads and highways. This paper addresses the detection and localization of one of the key pavement distresses, the potholes using computer vision. Different kinds of pothole and nonpothole images from asphalt pavement are considered for experimentation. Considering the appearance-shape based nature of the potholes, Histograms of oriented gradients (HOG) features are computed for the input images. Features are trained and classified using Naïve Bayes classifier resulting in labeling of the input as pothole or non-pothole image. To locate the pothole in the detected pothole images, normalized graph cut segmentation scheme is employed.

Proposed scheme is tested on a dataset having broad range of pavement images. Experimentation results showed 90 % accuracy for the detection of pothole images and high recall for the localization of pothole in the detected images.

Title: A Deep Learning-Based Approach for Road Pothole Detection in Timor Leste Author: Vosco , Satoshi Tamura, Satoru Hayamizu , Hidekazu Fukai

Abstract—This research proposes allow-cost solution for detecting road potholes image by using convolutional neural network (CNN). Our model is trained entirely on the image which collected from several different places and has variation such as in wet, dry and shady conditions. The experiment using the 500 testing images showed that our model can achieve (99.80 %) of Accuracy, Precision (100%), Recall (99.60%), and F-Measure (99.60%) simultaneously.

Title: A Vibratory-based Method for Road Damage Classification Author: Fergyanto E. Gunawan Binus , Yanfi Benfano Soewito Binus

Abstract-Automatic system to monitor the road condition is importance to minimize losses due to traffic accidents. The system is required considering the size of the road network in many modern metropolitan cities. Various monitoring techniques have been proposed and in this work, we evaluate the use of vehicle acceleration data in the longitudinal and lateral directions to detect the road anomalies particularly pothole. This article reports the characteristics of the data obtained from various road anomalies and identifies the statistical variance of the data with regard to the road anomalies.

.Title: Detection and Classification of Potholes in Indian Roads using Wavelet Based Energy Modules
Author: Manjunatha HT , Ajit Danti

Abstract – Maintenance of roads is one the major challenge in the developed countries. The well maintained roads always indicates the economy of the whole country .The heavy use of roads, environmental conditions and maintenance is not performed regularly that leads the formation of potholes which causes the accidents and unwanted traffics .The paper discuss about the detection of potholes based on wavelet energy field .The proposed method mainly includes three phases (A) Wavelet energy filed is constructed in order to detect the image by using geometric criteria and morphological processing (B) Extracting Region of intersect by edge based segmentation technique (C) Classifying the potholes using Neural Network

Title: Classification of Paved and Unpaved Road Image Using Convolutional Neural Network for Road Condition Inspection System
Author: Vosco Pereira, Satoshi Tamura, Satoru Hayamizu and Hidekazu Fukai

Abstract—Image processing techniques have been actively used for research on road condition inspection and achieving high detection accuracies. Many studies focus on the detection of cracks and potholes of the road. However, in some least developed countries, there are some distances of roads are still unpaved and it escaped the attention of the researchers. Inspired by penetration and success in applying deep learning technic to computer vision and to any other fields and by the existence of the various type of smartphone devices, we proposed a low - cost method for paved and unpaved road images classification using convolutional neural network (CNN). Our model is trained with 13.186 images and validate with 3.186 images which collected using smartphone

device in various conditions of roads such as wet, muddy, dry, dusty and shady conditions and with different types of road surface such as ground, rocks and sands. The experiment using 500 new testing images showed that our model can achieve high Precision (98.0%), Recall (98.4%) and F1 Score (98.2%) simultaneously.

Title: Pothole and Bump detection using Convolution Neural Networks
Author: Sandeep Shah Methods , Chandrakant

Abstract – Potholes along with speed bumps have been a cause of worry for motorist for a long time. Recent reports show that in India there are more than 10,000 accidents due to potholes and bumps. In this paper we attempt to identify the road surface by classifying it into pothole, speed bump and normal road based on image data. The method of classifying the road surface from the images using convolution neural networks, ResNet-50 is discussed. Initially the images are manually classified into the three classes and these are used to train the neural network, we were able to achieve a true positive rate of 88.9%. In the second phase we pass the image to object detection neural network to detect the precise location of the speed bump. This was achieved using the YOLO algorithm for object detection. This work can be extended to alert the driver and tune the suspension to make the ride more comfortable based on road preview using a camera.

Title: Detection and Counting of Pothole using Image Processing Techniques
Author: Vigneshwar.K M. , Hema Kumar.B

Abstract—Pothole are the primary cause of accidents, hence identification and classification using image processing techniques is very important. In this paper image pre-processing based on difference of Gaussian-Filtering and clustering based image segmentation methods are implemented for better results. From the results the K-Means clustering based segmentation was preferred for its fastest computing time and edge detection based segmentation is preferred for its specificity. The main goal of this paper is to identify a better method which is highly efficient and accurate compared to the conventional methods.

Different image pre-processing and segmentation methods for pothole detection where reviewed using performance measures.

Title: Pavement Pothole Detection and Severity Measurement Using Laser Imaging
Author: X. Yu and E. Salari

Abstract— Over the years, Automated Image Analysis Systems (AIAS) have been developed for pavement surface analysis and management. The cameras used by most of the AIAS are based on Charge-Coupled Device (CCD) image sensors where a visible ray is projected. However, the quality of the images captured by the CCD cameras was limited by the inconsistent illumination and shadows caused by sunlight. To enhance the CCD image quality, a high-power artificial lighting system has been used, which requires a complicated lighting system and a significant power source. In this paper, we will introduce an efficient and more economical approach for pavement distress inspection by using laser imaging. After the pavement images are captured, regions corresponding to potholes are represented by a matrix of square tiles and the estimated shape of the pothole is determined. The vertical, horizontal distress measures, the total number of distress tiles and the depth index information are calculated providing input to a three-layer feed- forward neural network for pothole severity and crack type classification. The proposed analysis algorithm is capable of enhancing the pavement image, extracting the pothole from background and analyzing its severity. To validate the system, actual pavement pictures were taken from pavements both in highway and local roads. The experimental results demonstrated that the proposed model works well for pothole and crack detection.

III. EXISTING AND PROPOSED SYSTEM

Existing System:

A dense disparity map is first transformed to better distinguish between damaged and undamaged road areas. To achieve greater disparity transformation efficiency, golden section search and dynamic programming are utilized to estimate the transformation parameters. Otsu's thresholding method is then used to extract potential undamaged road areas from the transformed disparity map.The main contributions of this paper are a novel disparity transformation algorithm and a disparity map modeling algorithm. Using our method, undamaged road areas are better distinguishable in the transformed disparity map and can be easily extracted using Otsu's thresholding method. This greatly improves the robustness of disparity map modeling. To achieve greater processing efficiency, GSS and DP were utilized to estimate the transformation parameters. Furthermore, the disparities, whose normal vectors differ greatly from the optimal one, were also discarded in the process of disparity map modeling, which further improves the accuracy of the modeled disparity map.2D Image Analysis-Based Pothole Detection Algorithms: There are typically four main steps used in 2D image analysis-based pothole detection algorithms: a) image preprocessing; b)

image segmentation; c) shape extraction; d) object recognition [5]. A color or gray-scale road image is first preprocessed, e.g., using morphological filters, to reduce image noise and enhance the pothole outline The preprocessed road image is then segmented using histogram-based thresholding methods, such as Otsu's or the triangle method. Otsu's method minimizes the intra-class variance and performs better in terms of separating damaged and undamaged road areas [9]. The extracted region is then modeled by an ellipse. Finally, the image texture within the ellipse is compared with the undamaged road area texture. If the former is coarser than the latter, the ellipse is considered to be a pothole. The main contributions of this paper are a novel disparity transformation algorithm and a disparity map modeling algorithm. Using our method, undamaged road areas are better distinguishable in the transformed disparity map and can be easily extracted using Otsu's thresholding method. This greatly improves the robustness of disparity map modeling. To achieve greater processing efficiency, GSS and DP were utilized to estimate the transformation parameters. Furthermore, the disparities, whose normal vectors differ greatly from the optimal one, were alsodiscarded in the process of disparity map modeling, which further improves the accuracy of the modeled disparity map.Finally, the potholes were detected by comparing the difference between the actual and modeled disparity maps. The point clouds of the detected potholes were then extracted from the reconstructed 3D road surface. In addition, we also created three datasets to contribute to stereo vision-based pothole detection research

Drawback:

- It has not used on Deep Neural network in keras and TensorFlow as classifier.
- They are not using CNN and OpenCV computer vision technique
- It has not focused on increasing the recognition rate and classification of road pothole.

Proposed System:

- We are proposing road pothole using Deep CNN(convolutional neural network) for deep learning technique. After collecting a suitable amount of data containing the images of potholes under various conditions and weather, and implementing CNN approach of deep learning has been adopted, that is a new approach in this problem domain using pothole imaging. Also, a comparison between the self-built convolutional neural model and some of the pre-rained models has been done.
- the proposed method for this project is to train a Deep Learning algorithm capable of road pothole classification, This particular classification problem can be useful for road pothole detection. The using Deep Learning with the help of Convolution Neural Networks based on TensorFlow and Keras.
- we proposed a deep learning (dl) based road pothole dataset to build classification method to prevent the pothole. the deep learning method used in the study is the Convolutional neural network (CNN). it is predicted that the success of the obtained results will increase if the CNN method is supported by adding extra feature extraction methods and classify successfully road pothole.

Advantages:

- To classify road pothole image used on artificial neural network.
- It is best model for deep learning technique to easily road pothole

These are the requirements for doing the project. Without using these tools and software's we can't do the project. So we have two requirements to do the project. They are

1. Hardware Requirements.
2. Software Requirements.

Software Requirements:

The software requirements document is the specification of the system. It should include both a definition and a specification of requirements. It is a set of what the system should do rather than how it should do it. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating cost, planning team activities, performing tasks and tracking the teams and tracking the team's progress throughout the development activity.

Operating system: window

- Simulation Tool : Anaconda with Jupyter Notebook

Hardware requirements:

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete and consistent specification of the whole system. They are used by software engineers as the starting point for the system design. It shows what the system does and not how it should be implemented.

- Processor : Pentium IV/III
- Hard disk : minimum 80 GB
- RAM : minimum 2 GB

IV. CONCLUSION

We have demonstrated and tested the pothole and non-pothole detection using using various deep learning classifier algorithms. The performance of these models are measured and compared using various parameters like accuracy, precision, and recall. We have used Lenet and Alexnet, which is higher as compared to other models. Using CNN model in keras and Tensorflow based road pothole classification is the main advantage if the CNN method is supported by adding extra features extraction methods and classify successfully road pothole. In future work results of prediction may not only use for road maintenance survey but it can also be used in the navigation of vehicle robot in order to drive automatically on the road more safely and more conveniently.

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