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Pothole Detection Using Deep Learning for Road Condition Inspection

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ABSTRACT

Potholes in roads constitute a major problem for both citizens and the government. Governments' employee engineers and workers are working to detect damages to roads, distress, etc. This is highly time consuming and requires a lot of manpower. Deep learning with a recent breakthrough has the ability to address such major challenges. we propose a novel deep learning approach that can analyze data and assess road safety and conditions. Propose system automatically perform detection and classification of road potholes with basis of image processing mechanism. System analyze the road condition on road images. Deep Learning algorithm Convolutional Neural Network is used to train, classify the data and to extract the feature. If road condition is bad then our system will send information on Government portal to work on the road. It will be AI system with Deep Learning algorithm.

Keywords: PyQT, NumPy, OpenCV, Road surface image, Potholes, openCV , CNN, Deep Learning.

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I. INTRODUCTION

Potholes in roads constitute a major problem for both citizens and the government. Governments' employee engineers and workers to detect damages to roads, distress, etc. This is highly time consuming and requires a lot of manpower. Government needs accurate information for effective road maintenance at regular intervals. But, road inspection requires enormous of man power every year. This obviously slows down the process due to the distance involved. There need a system which detect damage condition of road and then drivers can change their driving behaviors for improving driving safety, comfort and efficiency.

Propose system automatically perform detection and classification of road potholes with basis of image processing mechanism. System analyze the road condition on road images. Deep Learning algorithm Convolutional Neural Network is used to train, classify the data. If road condition is bad then our system will send information on Government portal to work on the road. It will be AI system with Deep Learning algorithm.

To achieve required result, application is design through python language and using its libraries. So, to design user friendly desktop application, PyQT library method is used in python language. To pre-process datasets of satellite images, we are using OpenCV library method and through pre-processing of image, we converts our input road image into grayscale image, contour image and smoothen image..

II. LITERATURE SURVEY

[1] Road Damage Detection Using Deep Neural Networks with Images Captured Through a Smartphone

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Research on damage detection of road surfaces using image processing techniques has been actively conducted, achieving considerably high detection accuracies. Many studies only focus on the detection of the presence or absence of damage. However, in a real-world scenario, when the road managers from a governing body need to repair such damage, they need to clearly understand the type of damage in order to take effective action. In addition, in many of these previous studies, the researchers acquire their own data using different methods. Hence, there is no uniform road damage dataset available openly, leading to the absence of a benchmark for road damage detection. This study makes three contributions to address these issues. First, to the best of our knowledge, for the first time, a large-

scale road damage dataset is prepared. This dataset is composed of 9,053 road damage images captured with a smartphone installed on a car, with 15,435 instances of road surface damage included in these road images. In order to generate this dataset, we cooperated with 7 municipalities in Japan and acquired road images for more than 40 hours. These images were captured in a wide variety of weather and illuminance conditions

[2] A real-time automatic pavement crack and pothole recognition system for mobile Android-based devices

Due to the rapid growth of vehicles and traffic accidents caused by road pavement defects, road safety has become a pressing concern worldwide. For this reason, Countries and Federal States have started focusing their resources on the analysis of civil infrastructures to assess their safety and serviceability. The analyses are performed by specialized teams of inspectors and structural engineers who manually inspect road infrastructures and provide detailed reports about the detected pavement distresses and their magnitudes. This work aims at providing a new system able to detect the framed distress using solely the computational resources provided by a mobile device To reach this goal, an automatic pavement distress recognition system based on the OpenCV library is developed and embedded in a mobile application, enabling the recognition of three common pavement distresses: Pothole, Longitudinal-Transversal Cracks, and Fatigue Cracks. Our method, tested on several Android mobile platforms, is able recognize the pavement distresses of interest reaching more than 0.7 of Precision, Recall, Accuracy, and F-Measure. This application promises to improve the on-site work of inspectors by decreasing the time required to perform inspections while ensuring, at the same time, a higher level of accuracy.

[3] A Deep Learning-Based Approach for Road Pothole Detection in Timor Leste

This research proposes a low-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.

[4] Machine Learning approach for pothole detection

Potholes in roads constitute a major problem for both citizens and the government. Governments' employee engineers and workers to detect damages to roads, distress, etc. This is highly time consuming and requires a lot of manpower. This paper explains the method used in the automatic detection and classification of damages to roads, potholes and cracks. In this process the types of damages like potholes, cracks and subsistent depressions are framed. The captured images of road and preprocess the data have been taken by converting the image into HSV color space, sample patching for image mask and applying contour detection, convex hull calculation and a final extraction of image. Feature selection is done and based on that feature selection and machine learning algorithms are used for classification..

[5] Detecting Potholes Using Simple Image Processing Techniques and Real-World Footage

Potholes are a nuisance, especially in the developing world, and can often result in vehicle damage or physical harm to the vehicle occupants. Drivers can be warned to take evasive action if potholes are detected in real-time. Moreover, their location can be logged and shared to aid other drivers and road maintenance agencies. This paper proposes a vehicle-based computer vision approach to identify potholes using a window-mounted camera. Existing literature on pothole detection uses either theoretically constructed pothole models or footage taken from advantageous vantage points at low speed, rather than footage taken from within a vehicle at speed. A distinguishing feature of the work presented in this paper is that a thorough exercise was performed to create an image library of actual and representative potholes under different conditions, and results are obtained using a part of this library. A model of potholes is constructed using the image library, which is used in an algorithmic approach that combines a road colour model with simple image processing techniques such as a Canny filter and contour detection. Using this approach, it was possible to detect potholes with a precision of 81.8% and recall of 74.4 .%..

[6] Image-Based Pothole Detection System for ITS Service and Road Management System

Potholes can generate damage such as flat tire and wheel damage, impact and damage of lower vehicle, vehicle collision, and major accidents. Thus, accurately and quickly detecting potholes is one of the important tasks for determining proper strategies in ITS (Intelligent Transportation System) service and road management system. Several efforts have been made for developing a technology which can automatically detect and recognize potholes. In this study, a pothole detection method based on two-dimensional (2D) images is proposed for improving the existing method and designing a pothole detection system to be applied to ITS service and road management system. For experiments, 2D road images that were collected by a survey vehicle in Korea were used and the performance of the proposed method was compared with that of the existing method for several conditions such as road, recording, and brightness. The results are promising, and the information extracted using the proposed method can be used, not only in determining the preliminary maintenance for a road management system and in taking immediate action for their repair and maintenance, but also in providing alert information of potholes to drivers as one of ITS services.

[7] Real Time Pothole Detection and Vehicle Accident Detection and Reporting System And Anti theft (Wireless)

One of the increasing problems roads face are worsened road conditions. Many reasons like rains, oil spills, road accidents or wear and tear, make the roads difficult to drive on. Unexpected hurdles on road may cause more accidents. Also because of bad road conditions, fuel consumption of

the vehicle increases, causing wastage of precious fuel. All these reasons urge that it is important to get information of such bad road conditions, collect this information and distribute it to a Government body. It also becomes important to report accidents and accurate location of vehicles for life saving and property security purposes.

III. PROPOSED SYSTEM

In proposed system, we are using Deep Learning algorithm to detect the road condition with basis image processing mechanism.In our system are analyzing the road condition on road images. It will be AI System with Deep Learning algorithm.In future, we will integrate this system with vehicles .If road condition is bad then our system will send information on Government portal to work on that road.

In the diagram Fig.1, there is flow of our project.

[1] The whole architecture is made by PyQT library used in python language. PyQT library gives all the necessary stuff related to GUI design. PyQT provides us display screen, buttons and so on. So, in this way PyQT helps us in design GUI.

[2] After designing of GUI, another task is to authenticate valid user for operating application. To deal with this task, we are using MySQL database to store data of username and password and through this, user can authenticate easily.

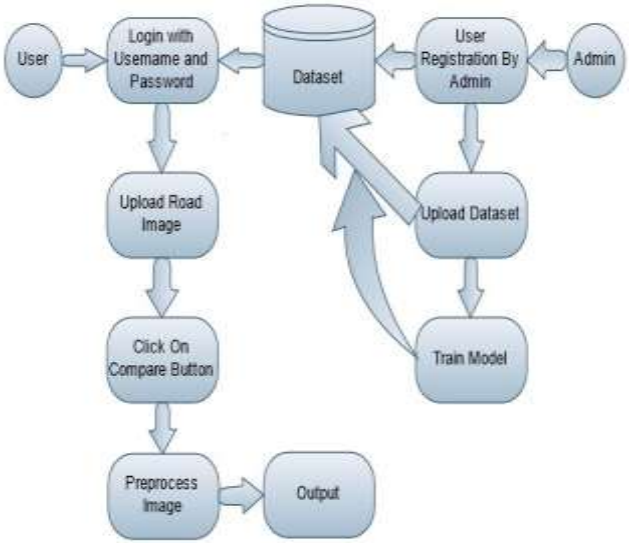

Fig.1:- System Architecture

[3] Another task is to pre-process the input image which can be done by OpenCV library of python. By using this library, image is converted into grayscale image, contour image and smoothen image.

[4] The major task of this survey paper is to collect datasets of road image and to achieve this result

METHODOLOGY (CNN):

Convolutional neural network (CNN, or ConvNet) is a form deep learning and most commonly applied to analysing visual imagery. CNNs use a variation of multilayer perceptron designed to require minimal pre-processing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics. Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field.

The receptive fields of different neurons partially overlap such that they cover the entire visual field. CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage. They have applications in image and video recognition, recommender systems, image classification, medical image analysis, and natural language processing. A CNN consists of an input and an output layer, as well as multiple hidden layers. The hidden layers of a CNN typically consist of convolutional layers, pooling layers, fully connected layers and normalization layers**.**

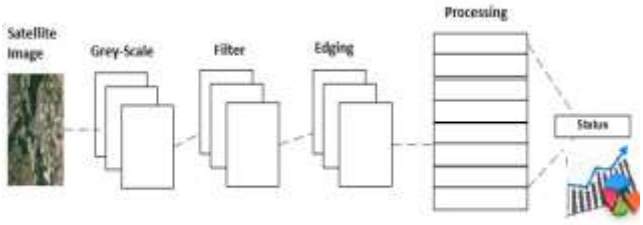

Fig2. Simple ConvNet

The Convolutional Neural Network in Fig. is similar in architecture to the original LeNet and classifies an input image into four categories: dog, cat, boat or bird. There are four main operations in the ConvNet shown in fig. above:

1. Convolution
2. Non Linearity (ReLU)
3. Pooling or Sub Sampling
4. Classification (Fully Connected Layer)

An Image is a matrix of pixel values. Essentially, every image can be represented as a matrix of pixel value Channel is a conventional term used to refer to a certain component of an image. An image from a standard digital camera will have three channels – red, green and blue – you can imagine those as three 2d-matrices stacked over each other (one for each color), each having pixel values in the range 0 to 255.

IV. RESULT AND DISCUSSION

In the proposed system, we will be using supervised CNN approach which further will improves the accuracy of the prediction. CNN is proved for better accuracies with supporting to the deep learning methods. It is also complemented with the light weight library in python for image processing as OpenCV which help us to classify the image and improves the speed of execution. System has used various parameter likes good road, bad road, pothole, not a pothole..

Following images are pre-process images of road image.

Fig. Image Pre-processing

Comparative results of existing and proposed system is as follow,

Parameters	Existing System	Proposed System
AI based approach	No	Yes
Use of road image	No	Yes
Use of OpenCV	No	Yes
CNN	No	Yes
Improved speed	No	Yes

Table 1. Comparative Table

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VI. CONCLUSION

Prediction of road status by using road image. In this type of application, we have first collect datasets of road image and after that make a desktop application so that user can able to predict socio-economic status. To predict status of a road image, we have use pre-processing of an input image so that features can be easily detected from input mage and to achieve this we are using opencv library. In this way, we are successfully implement all the tasks of the survey paper.

VII. REFERENCE

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