

APPLICATION OF IMAGE PROCESSING TECHNIQUES FOR POTHOLE DETECTION

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in Computer Science and Engineering

By

BHEEMIREDDYNAGAVIJAYASIVASURYAPRAKASHREDDY (38110081)
AKETI AJAY (38110017)



DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

SCHOOL OF COMPUTING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)
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JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of BHEEMIREDDYNAGAVIJAYASIVASURYAPRAKASHREDDY (38110081), AKETI AJAY(38110017) who carried out the project entitled "APPLICATION OF IMAGE PROCESSING TECHNIQUES FOR POTHOLE DETECTION" under my supervision from November 2021 to May 2022.

Internal Guide

Dr. REVATHY M.E., Ph.D.

Head of the Department

Dr. S. VIGNESHWARI, M.E., Ph.D.,

Submitted for Viva voce Examination held on_____

Internal Examiner

External Examiner

DECLARATION

I, BHEEMIREDDYNAGAVIJAYASIVASURYAPRAKASHREDDY (38110081) Aketi Ajay (38110017) hereby declare that the Project Report entitled “Application of image Processing Techniques for Pothole Detection” done by me under the guidance of Dr.Revathy M.E, Ph.D. is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Computer Science Engineering.

DATE:

PLACE:

SIGNATURE OF THE CANDIDATE

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ABSTRACT

Roads are viewed as the fundamental method of transportation. Nonetheless, because of the substantial gridlock, these roads require framework upkeep. Frequently this support isn't done on the grounds that it is difficult to control anyplace or on account of obliviousness. This prompts a pothole, which leads to and fro and causes a great deal of mishaps. This paper examined how to recognize potholes with the assistance of a camera mounted on a light strip. The picture handling strategy utilized, was informed to BMC authorities without really wasting any time utilizing an electronic framework to diminish difficult work. To test its presentation, the gave framework was carried out in Windows utilizing a CV library. To recognize potholes, straightforward picture handling innovation is utilized, for example, form discovery and Hough changes.

Keywords-Pothole, Open CV, Python, image processing

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CHAPTER 1

INTRODUCTION

1.1 Pothole Detection

Potholes are the biggest problem facing by the people who regularly moves from one place to another for their work purposes or for other reasons using vehicles through roads. Considering the present situation caused by covid-19 the governments are facing challenges to continuously monitor the roads, so it causes the pot holes to go not notified and leads to many accidents. Many analysts regularly use understanding and strolling strategies to recognize potholes. Recognizing and counting potholes utilizing diverse drawing strategies can help separate between various kinds of ways. potholes acknowledgment incorporates an assortment of handling strategies like distinguishing proof, supernatural, picture channels, picture disengagement, and mix techniques like K-Means and Fuzzy C-Means.

In the present technology driven world, the detection of pot holes can be done using many techniques. Few of them are Image processing techniques like considering thresh hold values [2] for the potholes and processing through some steps to detect and Blob analysis[7] also used for detection, where the pot holes ae detected by considering the color of the image and there are some more techniques in image processing like edge detection[9] and considering discolorations[1].Some other methods for finding the pot holes are by using various machine learning algorithm like the SVM[6] and the same can be done by using deep learning algorithms like using CNN , YOLO[11] etc. Some papers showed the use of accelerometer [3], sensors for the detection.

Image processing is a technique which is used to get any useful information if present in the given image. There are various stages in this image processing from enhancement, extracting the shape [13] to image segmentation [10] and detection or recognition. a video footage is taken from an online source of a road containing multiple potholes in it. And then applied image processing techniques using Open CV, in which the video was gone from one stage to another to finally detect whether there are potholes present in the video footage that was taken. The video taken has gone through some techniques used in image processing [12].

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1.2 Image Processing:

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.

There are five main types of image processing:

Visualization - Find objects that are not visible in the image

Recognition - Distinguish or detect objects in the image

Sharpening and restoration - Create an enhanced image from the original image

Pattern recognition - Measure the various patterns around the objects in the image

Retrieval - Browse and search images from a large database of digital images that are similar to the original image

CHAPTER 2

LITERATURE SURVEY

SungWon Lee et al. [1] have implemented a model for detecting pothole by considering the discolorations present in image. It is the image processing method, it shows textures in the image by using a wavelet energy field. The major disadvantage of this model is there can be many discolorations in an image, where every discoloration is not a pothole.

Lokeshwor H et al. [2] have implemented a model for detection of potholes, cracks using the values of threshold which were defined earlier. The detection was done with help of some image processing techniques. The main problem for the system is of the prejudged threshold values because for different potholes or cracks the values will be different.

Sunil Sharma et al. [3] implemented a model based on accelerometer for potholes detection. In this work they had used Machine learning algorithms, which they put in the data collected by accelerometer pothole detection. The setback of this model is not only potholes, other obstacles also recognized as potholes.

Danti et al. [4] proposed a model in which image processing algorithms are used for detection. The model is implemented to detect road signs, lanes and potholes. This system didn't depend on any neural network to detect a pothole. The drawback of the model is detection of unwanted areas by the algorithm.

Karuppuswamy et al. [5] proposed a model by assuming that every pothole as a circular object and diameter of 2 feet. For detecting the pothole, they used a standard imaging board. For calculating the image threshold that was necessary for detecting the pothole they used image histogram. But they didn't provide any practical proof and it can't be applicable to real world.

Nhat-Duc Hoang [6] proposed a model to pothole detection on machine learning. The algorithm used in this model is Least Square Support Vector Machine. The main set back is it can only predict only certain type of potholes and it requires more time for training the data set.

Dewiani et al. [7] implemented blob detection technique to detect potholes present in the images. This technique in a presented in their research paper might not detect the potholes proper way because of the nature of the technique.

P.Yuvaraj et al.[8] came forward with a setup by using raspberry pi ,image processing to detect the color of the image and developed a mobile application to get notification to the drivers on the presence of the potholes.

Syed Mohammad Abid et al. [9] provided an overview on edge detection and other morphological operations by applying on some images. The main issue of this work was not able to specify the correctness of the methods used.

Dilpreet Kaur [10] paper mainly points various image segmentation techniques for image classification. The main method of our work was taken from this paper as a reference.

E.N. Ukhwah et al. [11] implemented a system in which they used YOLOv3 for the detection of potholes. They took the images from the

camera that was fixed on a survey vehicle. The drawback of their proposed work is there are next versions of the YOLO algorithms which produce better accurate results than the algorithm they used.

Nienaber et al. [12] implemented a system to detect the potholes by taking the image of a road. They applied canny edge detection to detect the edges and convex hull algorithm for the noise removal. They tested this model by attaching the camera to a vehicle which was moving at the speed of 40km/h. The drawback of this system is it faces challenges to detect the potholes which didn't have visible edges.

Chen H et al. [13] provided another method for pothole detection. They collected the data from passenger vehicles. For the extraction of shape, they used spectral clustering which adds Otsu which is a image thresholding for automatically finding the values of threshold.

Pawade et al. [14] presented a model for detecting potholes by using Field programmable Gate Arrays (FPGA). In this model they used three edge detection techniques named canny, Sobel and prewitt. These three techniques are processed by FPGA parallelly. The drawback of this model is it is hard to detect the potholes in real-time.

Koch and Ioannis[15] presented a method to identify the potholes. They used an algorithm that contains three phases named image segmentation, shape and texture extraction. The drawback is it was inefficient for computation because of the detection of potholes repeatedly in an image.

Balasubramanian,[16] presented Convolutional neural networks are very effective in identifying objects, and hence, this approach has been adopted for Potholes Detection on Roads, In Computational Vision and Bio-Inspired Computing

CHAPTER 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM:

To detect the potholes in the real life footage.

3.2 SCOPE:

- To detect the potholes in the given video footage.
- To perform basic image processing technique.

3.3 WORK FLOW DIAGRAM

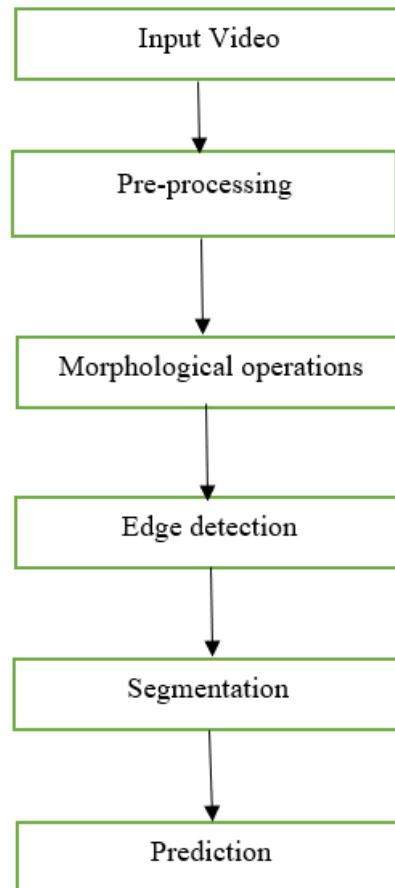


Fig 3.3.1 Work Flow Diagram

CHAPTER 4

ALGORITHMS AND METHODS

4.1 METHODS:

4.1.1 Pre-processing:

Pre-processing is considered as the first part in image processing. The intent of this is to raise the quality of the image by removing the unnecessary parts so that the remaining work can be completed effectively.

4.1.2 Morphological Operations:

These operations normally used on images on the root of their shapes. The widely applied operations are dilation and erosion. Dilation used to add additional pixels to the boundaries in an image. Whereas erosion slightly do in the opposite way compared to dilation. Whatever changes applied to the image will always depend on the dimensions and mould the image.

4.1.3 Gaussian Blur:

Gaussian blur is the technique that used to reduce the noise of the image and reduce detail, the road image extracted will undergo into gaussian blur and reduce the noise in the road image to find the pothole spots in the image, thus the edge detection will be done in the next step to find the pothole present on the road.

1. Gaussian Blurring=cv2.GaussianBlur()

2. Median Blurring=cv2.medianBlur()

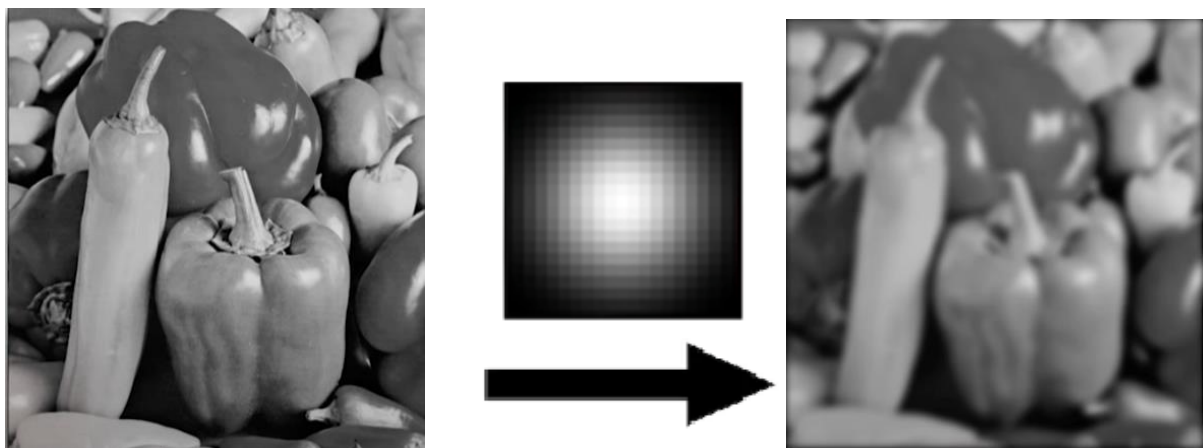


Fig 4.1.3 Gaussian Blur

4.1.4 Edge Detection:

Edge detection is technique that used to detect the edges of particular object in the image, it is used in the image segmentation and also used for the data extraction from an image. Gaussian operator is the operator

that computes second order derivation and also uses the canny edge detection to find the edges of the potholes present on the road, by applying gaussian operator and the canny edge detection, potholes present on the road will be identified.

Canny edge detection is used in the edge detection to find out the potholes on road, It is a multi-stage algorithm, OpenCV functions for that is cv2.Canny()

Finding Intensity Gradient of the Image

$$\text{Edge_Gradient}(G)=G2x+G2y$$

$$\sqrt{\text{Angle}(\theta)=\tan^{-1}(Gy/Gx)}$$



Fig 4.1.4 Edge Detection

4.1.5 Segmentation:

Image segmentation is a technique that digital image splits into different images, it helps in the decreasing the complexity of image to the further processing, the input image of road containing potholes can be made into various sub groups after applying edge detection and segmentation the pothole can be detected.

4.2 ALGORITHM:

STEP 1: In first step collecting the video and going to pre-processing it. In pre-processing the video can be covert into frames and it will convert into gray scale. Picture handling is the innovation to upgrade crude

pictures got by satellite, aeronautical gadgets, cameras/cameras, or pictures taken in different exercises in day-to-day existence

STEP 2: In second step adding filtering techniques, this module can be able to get the input image, by using filters and morphological techniques.

STEP 3: In third step, detect the potholes. In this module for detecting the pothole, by using the edge detection. Prior to handling with a standard activity name and pictures with a low download rate, both information and result.

STEP 4: Morphological imaging is an assortment of non-direct exercises identified with morphology or morphology in imaging. Morphological capacities depend on a direct guess of the worth of the pixel and are not founded on their numbers, bringing about its utilization in picture handling.

STEP 5: To kill the glitches in the shooting framework, the picture of the dim region was eliminated and the picture of the ordinary area was typical. The dull picture (or foundation picture) of each run was caught preceding the laser worked.

STEP 6: Edge show is a picture handling procedure intended to track down the limits of items in pictures It works by knowing how to wind down the lights. Recognize parts of picture partition and information extraction in some areas, for example, picture handling, machine vision, and pc vision. Recognize the edges that permit clients to see picture ascribes to change key highlights on the web.

STEP 7: The plan part is the way to diminish the computerized picture in various gatherings called picture areas, which assists with decreasing the picture size and make it more straightforward to process and dissect.

More or less, some portion of it is giving pixels. All pictures or pixels of a similar class have a typical logo.

STEP 8: In this step get the alerts from mail. In this module pothole can detected by our system it will send mail alerts to the higher authorities.

CHAPTER 5

RESULTS AND DISCUSSION

This section shows the work done by us. At the beginning a video of a road that containing potholes has taken. After that a frame from the video has been extracted and used as the image on which the algorithm was going to work as shown in the below Fig.5.1.

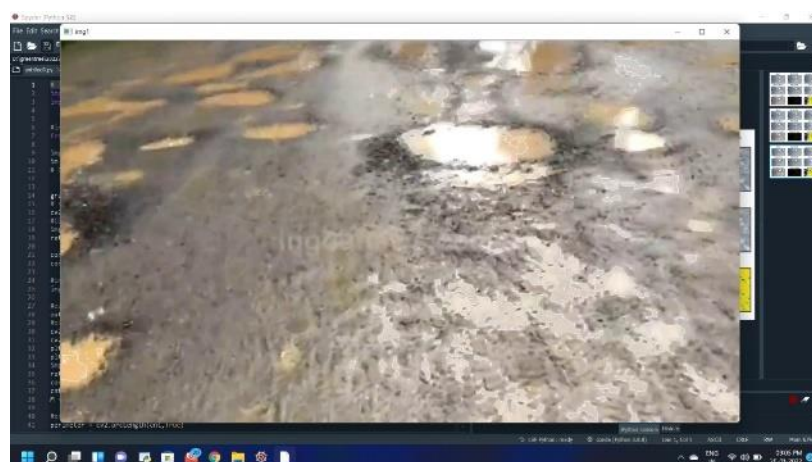


Fig 5.1 Pothole Image

The color image which was taken as input was converted into gray scale image because to process easily as shown below.

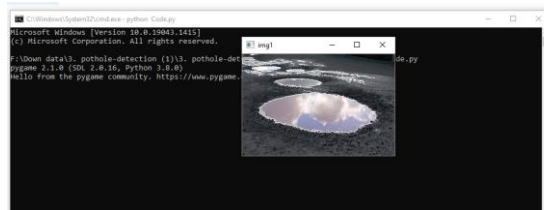


Fig 5.2 Gray scale Image

The Fig.5.3 below represents the edges of potholes present in the input image, by applying the edge detection

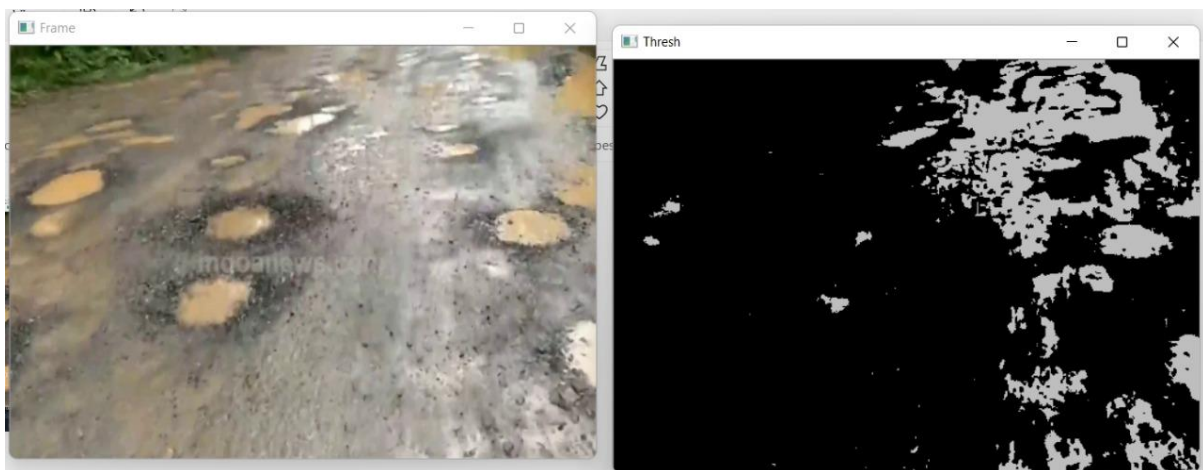


Fig 5.3 pothole detection using Edge detection

The Fig.5.4 below shows the image after applying the segmentation and edge detection the potholes are detected from the input image.

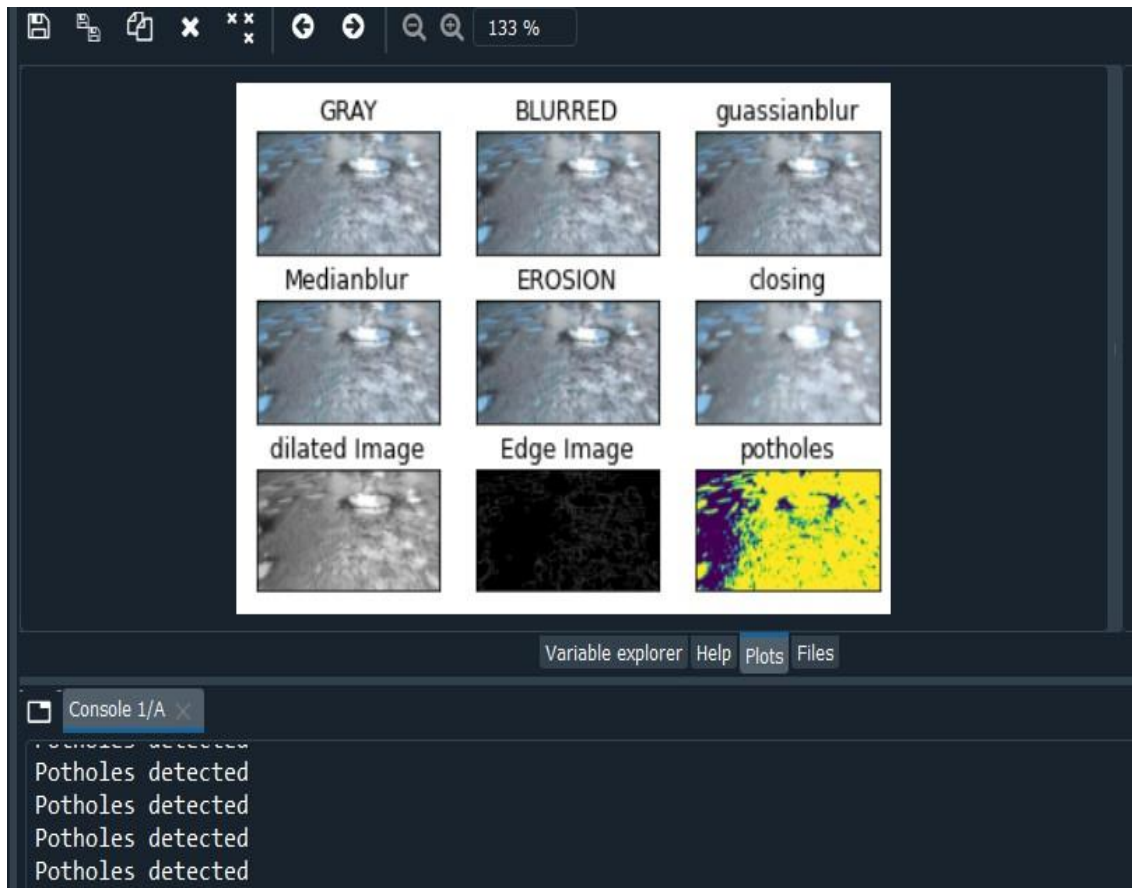


Fig 5.4 Pothole detection

CHAPTER 6

CONCLUSION

This paper shows the simple and yet easy ways to detect potholes if present in the given video by applying simple image processing techniques. The first phase is to collect the video and get some frames extracted from the video . convert the images into grayscale image. Apply image processing techniques like canny edge detection and contour detection. The proposed work was tested on more than 50 images that contains both potholes and do not contain potholes. The accuracy for this model is calculated based on the results of those 50

images manually with an accuracy of 77%. As the method got reasonable accuracy it can be used for estimation of potholes. This model is very low of cost. The future work will be focused on increasing the accuracy and implementing the model on more images with different categories that contains cracks, humps etc.

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