Surface crack detection by using machine learing

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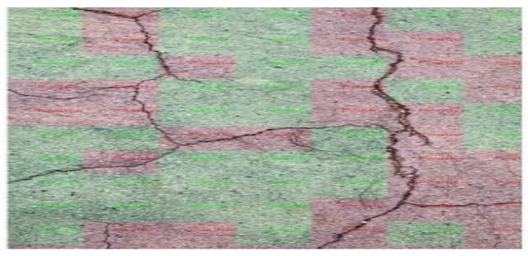
Abstract

This work aims at developing a machine learning based model to detect cracks on concrete surfaces. Such model is intended to increase the level of automation on concrete infrastructure inspection when combined to unmanned aerial vehicles (UAV). The developed crack detection model relies on a deep learning convolutional neural network (CNN) image classification algorithm. Provided a relatively heterogeneous dataset, the use of deep learning enables the development of a concrete cracks detection system that can account for several conditions, e.g., different light, surface finish and humidity that a concrete surface might exhibit. These conditions are a limiting factor when working with computer vision systems based on conventional digital image processing methods. For this work, a dataset with 40000 images of concrete surfaces balanced between images with and without cracks was used.Crack detection has vital importance for structural health monitoring and inspection of buildings.

Introduction

Architectural artefacts and civil infrastructures are exposed to loss of structural performance due to both deterioration of materials in time and structural challenges such as natural disasters. Structural monitoring and assessment of buildings have utmost importance for both sustaining the life span of structures and predict possible failures.Visual crack inspection and detection is a widely used method for gaining insight into the condition of the architectural artefacts and structures. While the majority of the inspection is conducted by means of manual observations, several disadvantages of manual observation process are documented in literature such as being time-consuming and subjectivity of the evaluation.Advancements in robotics and image capturing hardware make autonomous data capturing possible while machine learning methods and deep learning algorithms in image processing show promise in the fully autonomous inspection of structures. Utilization of deep learning in these tasks not only provides reduction of computational time but also enables precise measurement of features to be inspected without human error



Objective

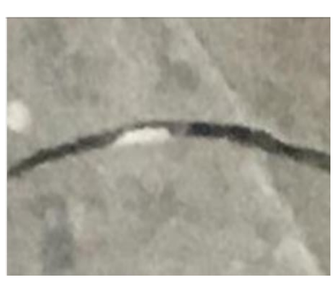
This project facilitates:

- To identified surface is crack or not
- It can be modified to see other parameter on the surface
- It can used to determine cracked and non-cracked concrete bridge decks, walls, and pavements.
- It can be used in manufacturing process like casting,welding, forging,etc to find the surface crack or other parameter

Dataset

In this dataset we have used 40000 image of sueface with crack and non crack

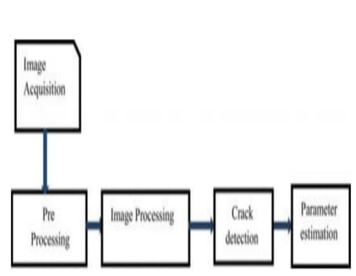
- In which number of crack images: 20000

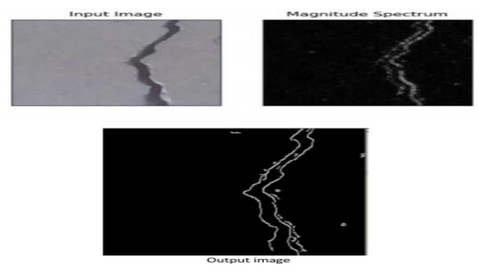


- And number of no crack images: 20000

Working and Accuracy of the model

- Cracks on the concrete surfaces are captured by using high resolution cameras, those images are analysed which is a field of Image Processing. There are several steps involved in the image processing.Acoording to the input image having rack or non-crack the model give the output as shown in the figure

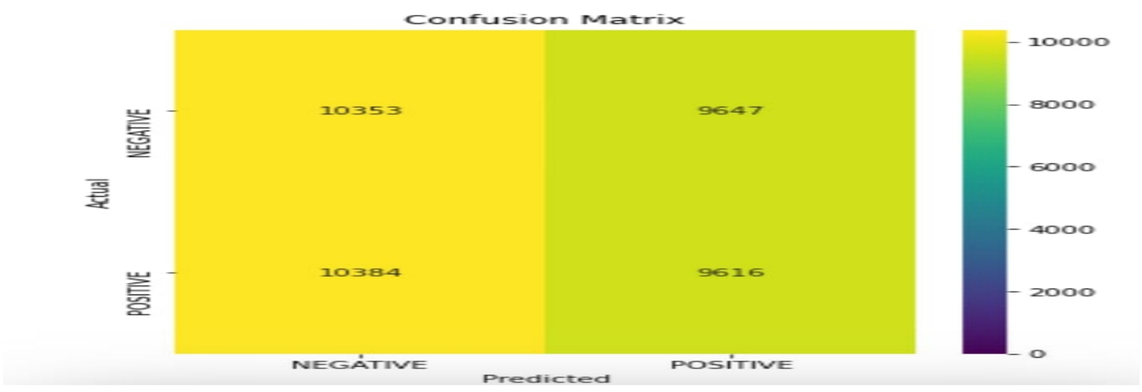




- Accuracy is 97.91% and test loss is 0.05720

Results

We got 11749 correct predictions out of 12000 records in test set.



Advantages & Disadvantages

Advantages:

- Automation of Everything,Wide Range of Applications,Scope of Improvement,Efficient handling of data

Disadvantages:

- Data Acquisition,Time and Resources,Interpretation of Results,Possibility of High Error,Requred a skill operator to used it

Future scope

- This model can be used to find crack and non crack of various surface like bridge,decks,walls to prevent accident to take placeit can also be used in machining process and this model can be modified to find other parameter like surface roughness,surface smoothness,etc

Bibliography

Dataset:https://www.kaggle.com/zeynel7/detection-of-surface-crack-using-cnn

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