IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

BRIDGE CRACK DETECTION

Shrusthi Kalbhor [*1], Makarand Nikam[*2], Dnyaneshwari Mhase[*3]

[*1,2,3] Department of Computer Engineering, D Y Patil School of Engineering Academy Ambi, Pune(M.H), India.

(Laxmikant Malphedwar, Department of Computer Engineering, D Y Patil School of Engineering Academy Ambi, Maharashtra, India)

ABSTRACT: Identifying bridge cracks and assessing bridge conditions has historically relied on labor. Bridge scrutiny by human consultants has bound disadvantages, like the failure to in person examine all sections of the bridge and sole reliance on the bridge inspector's specialist experience. Moreover, it necessitates adequate human resource coming up with, and it's not cost effective within the long-standing time. This article proposes an automatic bridge scrutiny technique that uses wavelet-based image options in conjunction with CNN to find cracks in bridge pictures mechanically. A two-stage approach is employed, with the primary stage determinative whether or not an picture are often pre-processed (based on image characteristics), and therefore the second stage extracting wavelet features from the image using a sliding window-based technique. Also on noisy and sophisticated bridge pictures, that they had been capable of achieving an overall accuracy of 92.11%.

Keywords: Convolution Neural Network, Image Processing, Machine Learning, Python

I.INTRODUCTION

Physically monitoring bridge conditions is usually impractical because of variety of reasons, as well as the bridge's physical surroundings, an absence of professional experience, and human resources. The maintenance and rehabilitation of bridges necessitates prompt decision-making. Several bridge authorities use Bridge Management Systems (BMSs) to observe their routine examination information associate degreed verify what repair facilities to supply as an outcome. With the emergence of advanced instruments and powerful computers, there has been a replacement movement to modify bridge examination. Sadly, the urged approaches were unable to adequately solve the difficulties of machine-controlled crack detection. Dynamical lighting conditions, discretional camera/view angles, and random resolution of bridge pictures are the key challenges faced by machine-controlled crack detection strategies. Moreover, we tend to discovered that crack identification becomes rather more tough because the background texture varies spontaneously, rendering segmentation of background and foreground elements unbelievably tough. This essay suggests a non-trivial approach for effectively addressing the on top of issues. It employs a two-stage strategy. At first, this objects are classified as either a 'complex image' or a 'simple image' depending on the characteristics as well as its image pixels within the 'R', 'G', and 'B' channels. If either the element is classed as a "complex image," a pre-processing part is required; otherwise, the image is processed directly with extracting options Texture analysis–based features are derived from of the pixel values under the sliding window using a non-overlapping sliding window. These features are then feed into a CNN classifier, which determines either or not even the area under the sliding window has a crack.

II.MOTIVATION

Cracks in bridges and deciding bridge conditions primarily involve manual labor. Bridge review by human consultants has some drawbacks like the lack to physically examine all elements of the bridge, sole dependency on knowledgeable information of the bridge inspector. To forestall the bridge accident. Image analysis is employed to spot the crack in bridge. We will check the form of Bridge with this method. This project can facilitate to prevent a bridge failure.

III.LITERATURE SURVEY

Youfa Cai1, Xing Fu, Yanna Shang , Jingxin Shi [1] Methods for Long-Distance Crack Location and Detection of Concrete Bridge Structures . A new approach based on computer vision technologies and coordinate map ping is proposed to increase the performance of crack detection of concrete bridge structures. This crack measuring system is

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

used in conjunction with a high magnification image acquisition system, a two-dimensional electric cradle head device, and a laser ranging system in this study. It comes with a set of observation coordinates. To start, the image coordinates of the marking points are mapped to the observation coordinates. Second, the measured crack's coordinates are assigned to almost the same world coordinates defined as the measurement coordinates of the marking points, allowing for the geographical positioning of the measured cracks to be realized independently of varying test periods or instrument configuration locations, which is extremely useful for the review identification of surface cracks in concrete bridge systems. Experiments have also shown that approach is both effective and practical. It will automatically find the measured cracks within just than 16 seconds, with a deviation for less than 0.07 degrees. The measuring accuracy of crack diameter are higher than 0.12 mm at such a distance of 100 m.

Lin Heng, Gao Huarui [2] Analysis of Longitudinal Cracking for Hollow-core Slab Bridges. In order to study the typical disease of longitudinal cracks in the hollow core slab beam of expressway, the stress state and spatial deformation of 13m hollow slab beam bridge are simulated numerically, and the influence of overload and hinge failure on the longitudinal cracks of beam is studied emphatically. The research shows: (1) after the prestressed steel strand is stretched, the longitudinal normal stress of hollow-core slab beam bottom is in the pressure state, when combined with the construction process and the vehicle load , the longitudinal stress of the beam bottom is still in the pressure state. (2) Below the 0.96 times overload factor, the longitudinal direction of the beam bottom will not crack. When the overload factor is between 0.96 and 1.5 times, the beam has a risk of cracking; more than 1.5 times the overload factor, the beam will produce longitudinal cracking. (3) the broken of hinge joint does not have a significant effect on the transverse normal stress of the hollow slab.

Jia Xiaoyuluo wenguang [3] crack damage detection of bridge based on convolutional neural networks. Bridge crack is one of the most prevalent bridge diseases. Established crack detection methods typically only judge whether or not there is a crack, lack sufficient accuracy in Classification performance, and cannot calculate the crack parameter value. This paper introduces a modern method of crack image recognition and parameter measurement that combines optical image analysis with convolutional neural networks. It increases image recognition accuracy by modifying the configuration of the convolutional neural network; by introducing digital image processing as a special layer, constructing a new image by linear regression model with the derived feature graph, the crack length can be determined by counting the number of pixels in the image. The experimental findings reveal that the suggested approach has a crack classification of 95 percent and can accurately calculate the crack duration with an error of less than 4%.

Ye Li and Yong Liu [4] High accuracy crack detection for concrete bridge based on sub-pixel . Crack is the one of the main reason for the damage of concrete bridges. Crack detection is a critical responsibility and essential task the accuracy is crack detection is very important. A high accuracy age detection algorithm at subpixel level is proposed in this work.

Elmer R. Magsino, John Robert b. Chua, Lawrence s. Chua, Carlo m. de Guzman and Jan Vincent l. Gepaya [5] a rapid screening algorithm using a quad rotor for crack detection on bridges. This research study employs the use of a quad rotor for improving the efficiency and safety of civil engineers in the inspection of concrete bridge building columns for probable cracks. At an initial scanning height, the quad rotor hovers vertically at constant height increments and captures the structure image. It communicates, via Wi-Fi, to an android device running the rapid screening algorithm for crack detection. Out of 23 collected images from a bridge structure, the average accuracy achieved was 95.65% with a precision of 91.67% and a recall of 83.33%.

Wang Xuejun, Zhang Yan [6] the detection and recognition of bridges cracks based on deep belief network. Artificial visual identification and identification of bridge fractures poses major threats, so we suggest a system for digital and intelligent bridge fracture detection, incorporating machine vision and Deep Belief Network technology. This technique uses a Raspberry Pi to capture and pre-process images before sending them over GPRS, 3G, or wired networks. It also analyzes images using high-level image servers. This approach selects and develops the best processing algorithm based on the characteristics of bridges cracks videos, as well as identifies and recognizes real bridges cracks. Finally, the Deep Belief Network DBN is used to classify bridge fractures. The machine will find all bridge cracks above the limit and accurately classify the form of fractures by analyzing the experimental results. The identification rate is greater than 90%, which satisfies engineering accuracy standards.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

Gong XingQi1, Li Quan1, Zhou MeiLing1, Jiang HuiFeng [7] analysis and test of concrete surface crack of Railway Bridge based on deep learning. The building of high-speed railways in China has been large-scale and successful in recent years. Bridge fire tracking and control has been an integral aspect of the accounting for train service safety. The characteristics of bridge surface cracks in the previous operating environment are investigated, and the YoloV3 deep learning network is employed to improve, mark, and learn the crack ages. The high-precision detection of bridge surface cracks is realized. Certain weaknesses in this process are also investigated, and a proposal for updating in the next phase is proposed.

Huai Yu, Wen Yang, Heng Zhang, Wanjun He [8] A uav-based crack inspection system for concrete bridge monitoring. Crack inspection is one of the most important tasks for concrete bridge monitoring. Traditionally, human-based inspection systems using people's eyes are unsafe and costly. To overcome this problem, a novel unmanned aerial vehicle (UAV) based inspection system is developed to detect cracks on the lateral sides and underside of bridges. Applying obstacle avoidance modules, UAV can reach bridges' lateral sides and underside within a safe distance. Thus the onboard camera can capture images of bridge surface in a high resolution. To locate the positions of cracks and solve the problem of limited horizon of single image, a fast feature-based stitching algorithm is developed. Then an edge detection method using structured forests is utilized to detect cracks on the large panorama. With image distortion corrected, the positions of cracks can be located on the large panorama. Experimental results validate the applicability and efficiency of the proposed UAV-based crack inspection system.

Hui Zhang, Jinwen Tan, Li Liu, Q. M. Jonathan Wu, Yaonan Wang and Liu Jie [9] automatic crack inspection for concrete bridge bottom surfaces based on machine vision. Concrete is widely used in construction method because its components are relatively inexpensive and it has a high plasticity. However, there are certain disadvantages of this type of bridge, the most common of which is crack. It is important to inspect bridge buildings on a daily basis in order to keep the cracks from getting worse. As a result, a bridge inspection robot device with machine vision has been developed for the accurate and reliable identification of bridge cracks. A variety of images are gathered and stitched into a high-quality panorama to aid crack analysis, after which the crack-like defects in the panorama are segmented. To begin, a fast and high-quality image stitching method based on the ORB algorithm is used in this article. Then, as a preprocessing step, the local directional proof (LDE) approach is used to improve the crack structures from low contrast images. Finally, using morphological operations and a technique known as Tubularity flow area, the crack-like defects can be conveniently segmented. The experimental findings demonstrated not only the speed and high quality of the applied image stitching process, but also the superior effect of the segmentation method.

Chen Ziqiang, Long Haihui, Zhao Jiankang [10] research of the algorithm calculating the length of bridge crack based on stereo vision. Bridge crack is a common bridge disease. The usual crack detection focuses on the pavement and bottom of bridges, while the intermediate support structures where cracks exist, such as piers, are seldom considered. As well as, when the camera plane is not parallel to the bridge plane, the crack in the image is only the projection of the true crack in the camera plane, leading to errors of the calculated crack size. To this end, this paper proposes a bridge crack detection method based on stereo vision, which calculates the crack length by combining depth information and crack image. Compared with the existing measurement methods, the method proposed in this paper has good experiment effect in the detection process of crack characteristics.

IV. SYSTEM ARCHITECTURE

Modules:

Pre-processing: - Although geometric transformations of images (e.g. rotation, scaling, translation) are known as pre-processing methods, the aim of pre-processing is to optimize the image data by suppressing unwanted irregularities or enhancing any image features necessary for further processing. The use of a digital computer to view digital images using an algorithm is known as image processing. Digital image processing, as a subcategory or field of digital signal processing, has a number of advantages over analog image processing.

1. Read Image
2. Resize Image Resized (220,220, 3)//Resized (width, height, no. RGB channels)

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 8, Issue 5, May 2021
DOI: 10.17148/IARJSET.2021.85103

3. RGB to Gray Scale conversion
4. Segmentation edge detection Noise removal using Gaussian filter

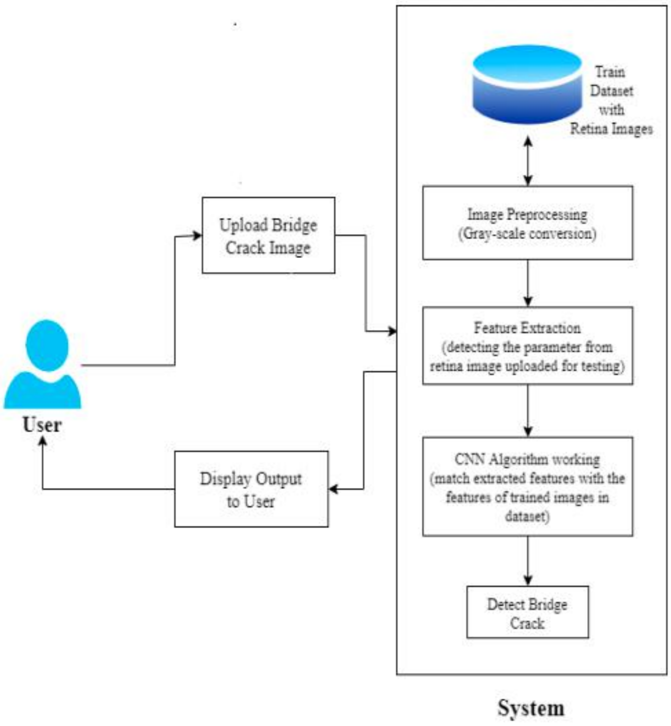


Fig. System Architecture

Segmentation: It entails segmenting a visual signal to make image processing easier. We can split the image up into fragments in which we can perform further processing if we want to remove or identify something from the rest of the image, such as detecting an object from a context. This is referred to as segmentation. Segments are made up of collections of pixels, or "super-pixels," that represent objects or pieces of objects.

Feature Extraction: Relevant structures in the image, such as points, edges, or objects, may be used as features. Feature Extraction is a technique for reducing the dimensionality in a dataset by generating new ones from old ones (and then discarding the original features). The original package of features should be able to summarize the majority of the details in the current reduced feature set.

Feature extraction begins from a collection of calculated data and creates extracted values (attributes) which are meant to be descriptive and non-redundant, allowing for faster learning and generalization and, in certain cases, improved human understanding. Dimensionality reduction is similar to extracting features.

Classification: Because of their high precision, CNNs can be used for image detection and identification. Each collection of neuron in a classification cnn analyzes a particular region or "function" of the picture in a three-dimensional structure. A group of neuron in some kind of a CNN focuses on a different area of the image. Our final result is a vector of probability, which predicts how likely each feature also in image is to belong to a class or group with each feature mostly in pixel.

V. ALGORITHM

Convolutional Neural Network (CNN): The cnn, also defined as CNN, is a form of deep learning neural network. In a nutshell, consider CNN to also be a machine classification method that can take an input image, attach value (learnable weights and biases) to various aspects/objects in the image, and distinguish between them. CNN extracts information from photographs by removing attributes.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

Any CNN consists of the following:

1. The input layer which is a gray scale image

2. The Output layer which is a binary or multi-class labels

3. Hidden layers consisting of convolution layers, Re LU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network.

It is important to understand that Artificial Neural Networks (ANNs), which are made up of numerous neurons, are incapable of extracting features from images. This is where a convolutional and pooling layer mix comes into play. Likewise, the convolution and pooling layers are incapable of sorting, necessitating the use of a fully linked Neural Network. Let's take a look at each of these segments individually before diving further into the definitions.

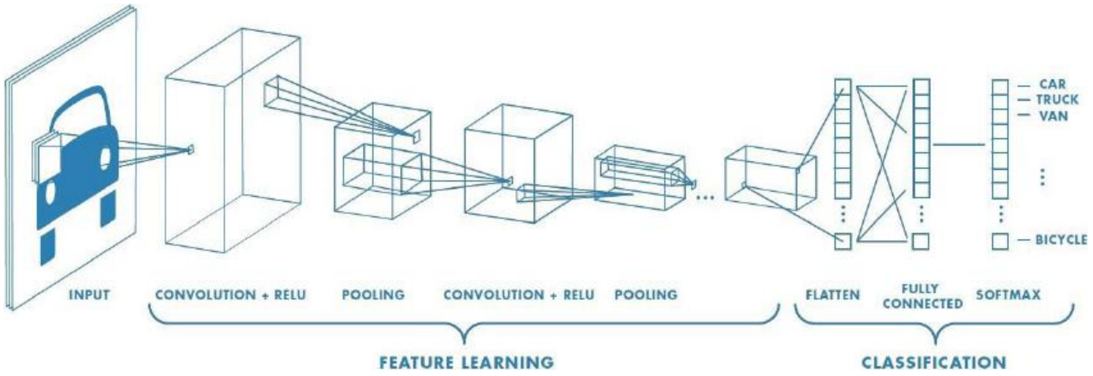
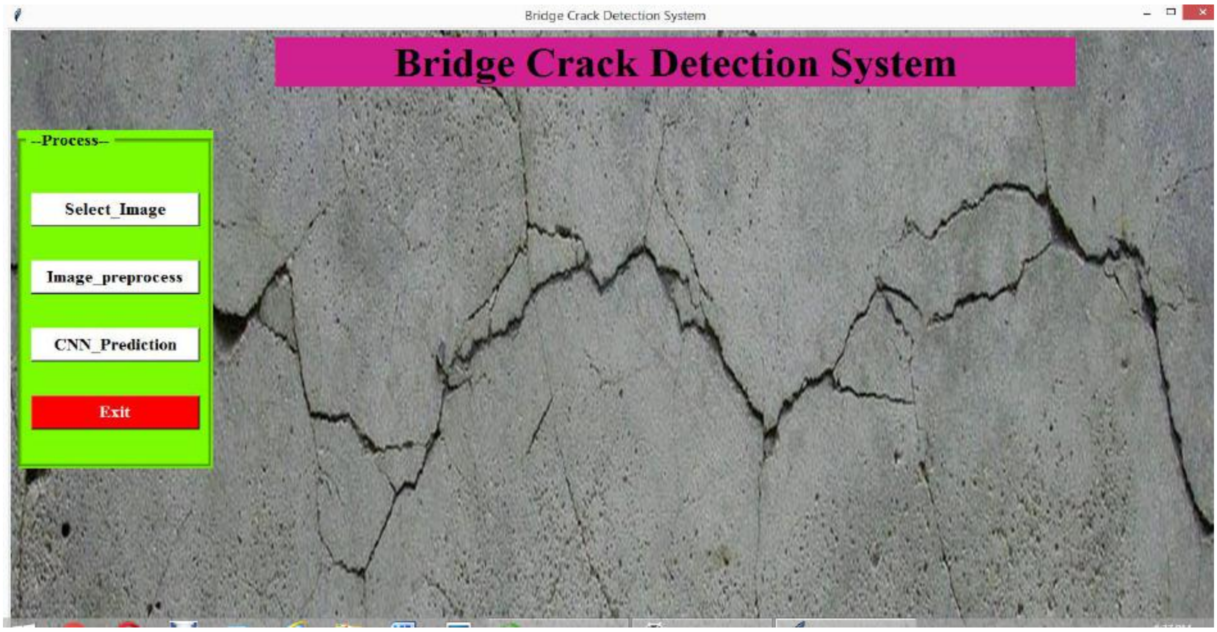


Fig - Illustrates the CNN process from input to Output Data.

VI.RESULTS

Step-1: Main window of GUI will contains following Modules: 1) Label - (Project Title), 2) Frame (Process). Bridge Crack Detection System is project title. Frame Display Four Buttons. Button_1 - Select_Image, Button_2 - Image_Preprocess, Button_3 - CNN_Predication, Button_4 - Exit.



IARJSET

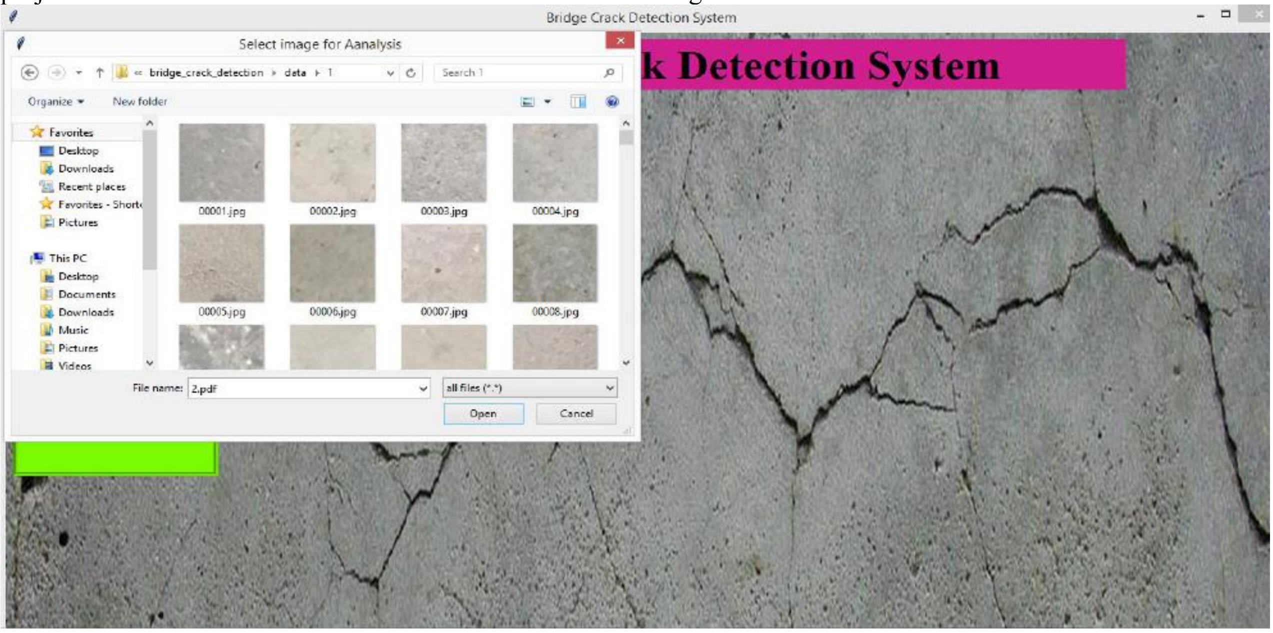
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

Step-2: Click on Button named as Select Image. Then display File manager window. Select the bridge image from project's testing file.



Step-3: After selecting image from testing file the image will display on the screen.

Step-4: By clicking on Button named image processing. There will be two processes: Second frame display the RGB to Gray conversion image. Third Frame display Gray to Binary Conversion image. Output will Display on screen.

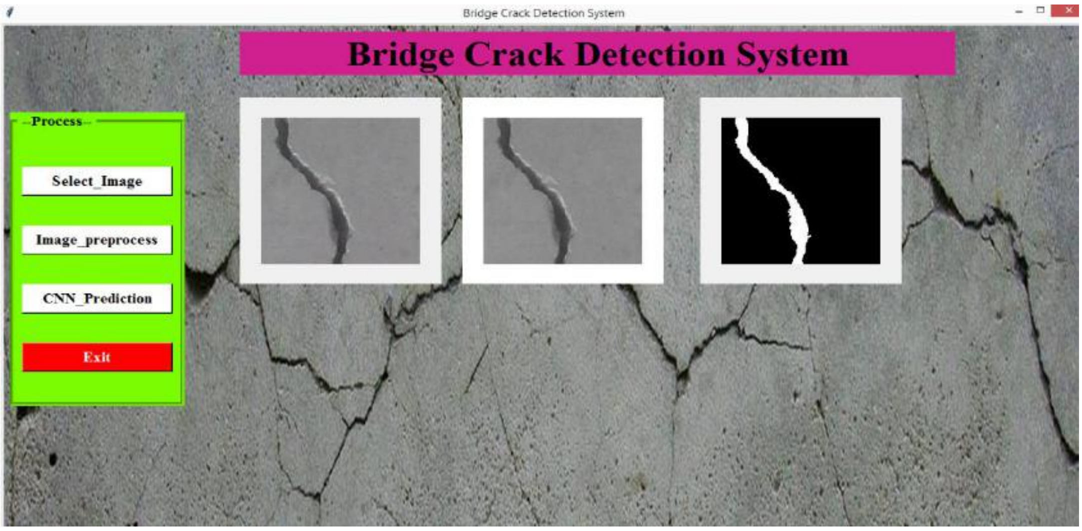
IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

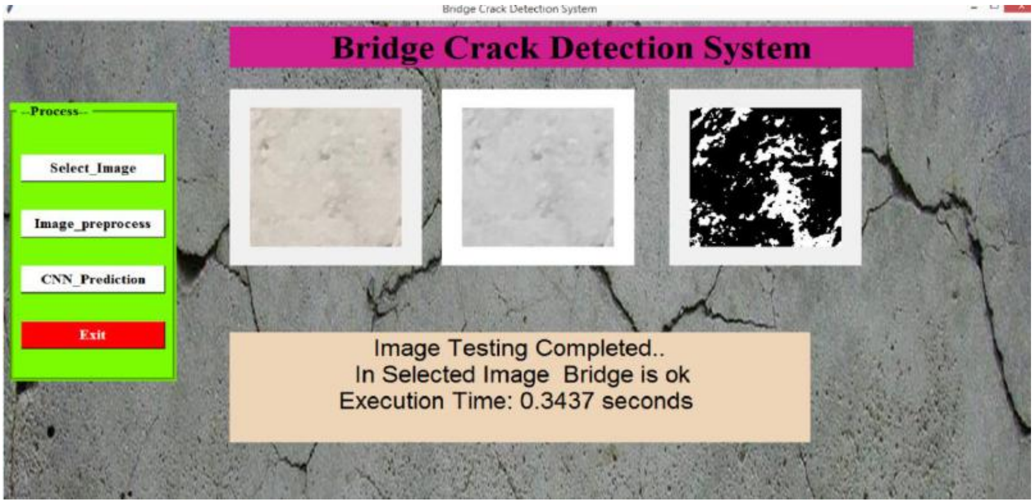
Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

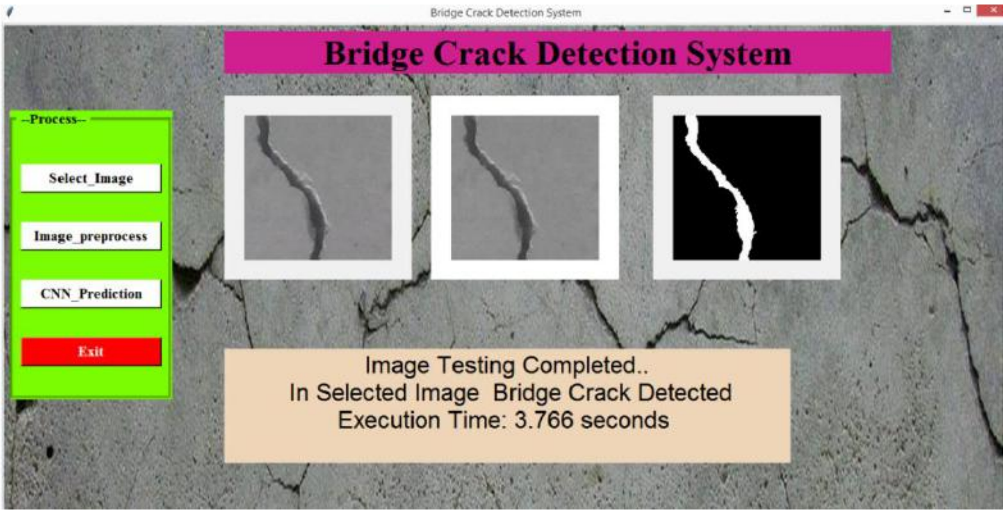


Step-5: By clicking on button named CNN Prediction. Then display the label of cnn predication. Image Testing Completed then will get output of is Bridge ok or Cracked and Display Execution time of processing image.

1) Bridge is Ok :



2) Bridge is Cracked :



VII. CONCLUSION

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 5, May 2021

DOI: 10.17148/IARJSET.2021.85103

Our system is designed to locate the crack image of the bridge with high precision in this project. Moreover, the crack length estimation is accomplished by fitting the function map obtained by the traditional layer into the ideal map. Our network classification accuracy rating is higher than 96 percent, according to the experimental findings. We infer that for detailed damage analysis, a larger number of researchers have used camera style images with better segmentation algorithms such as threshold technique and reconstructed feature extraction technique. We can assume from the above results that crack detection via bridge crack detection is a viable choice.

VIII.REFERENCE

[1] P. Prasanna, K. J. Dana, N. Gucunski, B. B. Basily, H. M. La, R. S. Lim, and H. Parvardeh, "Automated crack detection on concrete bridges," IEEE Transactions on Automation Science and Engineering, vol. 13, no. 2, Oct. 2016, pp. 591-599.

[2] Y. A. Zhou, Z. Wang, and X. H. Chen, "Automatic crack detection robot system for bottom surface of concrete bridges," Highway Engineering, vol. 42, no. 3, Jun. 2017.

[3] Z. A. Chen, Z. F. Hu, and X. P. Yang, "Edge detection of remote sensing image based on improved Soble operator and Zernike moment," Journal of Hubei University for Nationalities (Natural Science Edition), vol. 35, no. 2, Jun. 2017.

[4] A. Mohan, and S Poobal, "Crack detection using image processing: A critical review and analysis," Alexandria Engineering Journal, 2017, in press.

[5] L Zhang. Road Crack detection using deep convolutional neural network [C]. 2016 IEEE International Conference on Image Processing (ICIP), Phoenix, AZ, 2016, pp. 3708-3712.

[6] YJ Cha, O Buyukozturk. Deep Learning Based Crack Damage Detection Using Convolutional Neural Networks[J].Computer-aided Civil Infrastructure Engineering, 2017.

[7] Vinod Bharat et al. "Study of Detection of Various types of Cancers by using Deep Learning: A Survey", International Journal of Advanced Trends in Computer Science and Engineering, 2019, Volume 8 Issue 4,pp 1228-1233.

[8] Vinod Bharat et al. "A review paper on data mining techniques", International Journal of Engineering Science and Computing (IJESC), 2016, Volume 6 Issue 5, pp 6268-6271.

[9] Vinod Bharat, Sandeep Mali, Kishor Sawant and Nilesh Thombare. Article: A Survey on Public Batch Auditing Protocol for Data Security. IJCA Proceedings on National Conference on Advances in Computing NCAC 2015(7):39-42, December 2015.

[10] V Bharat, S Shubham, D Jagdish, P Amol and K Renuka, "Smart water management system in cities", 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), 2017, March.

[11]] E. Magsino, E. Young, R. Pesit, L. Magpili and J. R. Cornejo, "Visual Simul1taneous Localization and Mapping for Co-operating Unmanned Aerial Vehi1cles," in 21st M2VIP: Mechatronics and Machine Vision in Practice, Manila, Philippines, 2015.