Crack Detection of Buildings and Towers

Team Code : B22PJ03

UNDER THE MENTORSHIP AND GUIDANCE OF

DR. PIYUSH JOSHI

Motivation

Manual visual inspection is inefficient, both in terms of price and consistency, as required by the individual decision of the inspectors. Small cracks that look insignificant can also develop and can eventually lead to serious structural failure. It is therefore important to consider the varieties of cracks, crack patterns and hence their causes, as well as the preventive steps to be taken to manage cracks. This project will be helpful to detect cracks in many buildings, structures, bridges and etc and provide a scope for the engineers to repair the cracks.

CLAHE (Contrast related adaptive histogram equalisation)

CLAHE is a variant of **Adaptive histogram equalization** *(AHE)* which takes care of over-amplification of the contrast.

ORIGINAL IMAGE

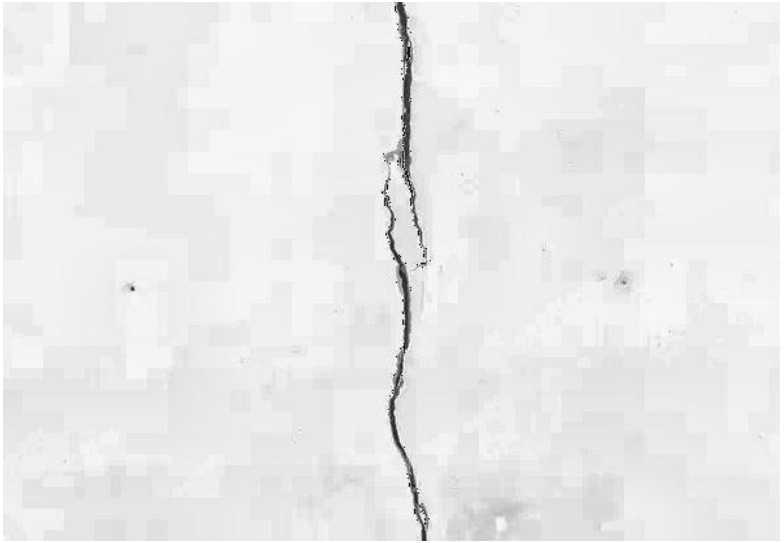
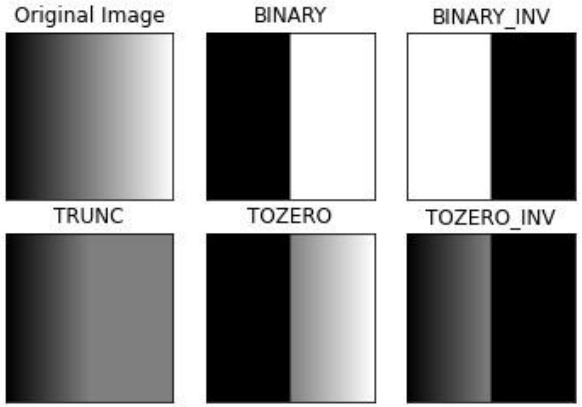


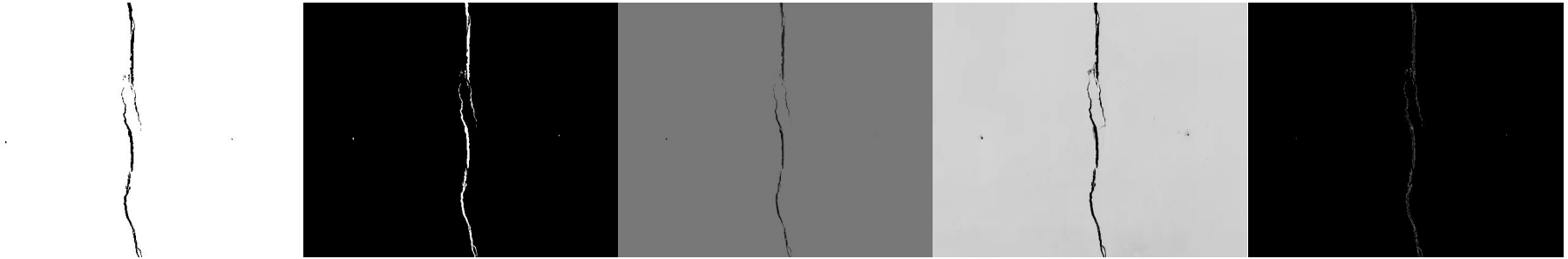
IMAGE AFTER APPLYING CLAHE

THRESHOLDING

Original Image



THRESH_BINARY	THRESH_BINARY_INV	THRESH_TRUNC	THRESH_TOZERO	THRESH_TOZERO_INV



OTSU THRESHOLDING METHOD

Otsu returns a single intensity threshold that separate pixels into two classes, foreground and background

ORIGINAL IMAGE

IMAGE AFTER APPLYING OTSU THRESHOLDING

MEDIAN THRESHOLDING METHOD

This block performs image thresholding by taking the output median as a global threshold. If the intensity value in the input image is greater than the median value, it is set to '1'. Otherwise, the intensity value is set to '0'. The output of the model is the thresholded image.

CANNY EDGE DETECTION

The **Canny** edge detector is an **edge detection** operator that uses a multi-stage **algorithm** to detect a wide range of edges in images.

ORIGINAL IMAGE

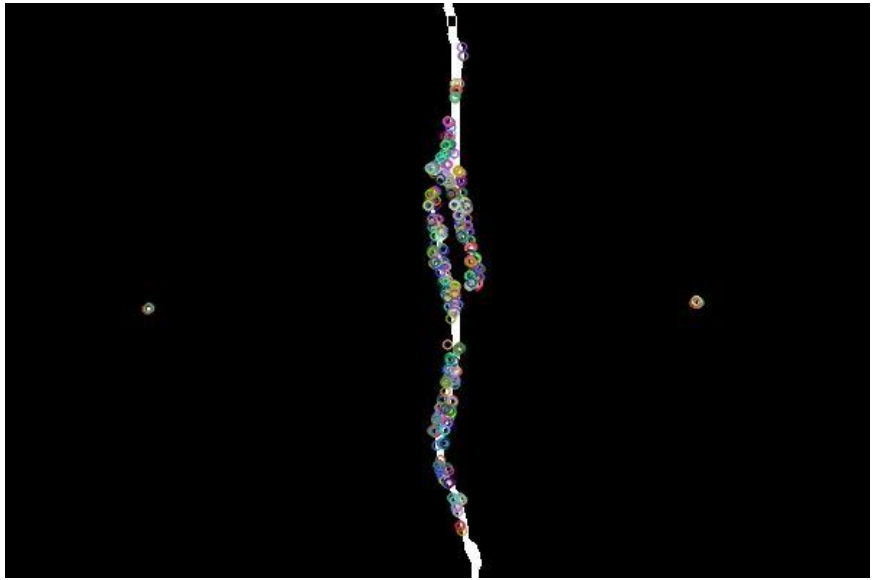


IMAGE AFTER APPLYING
CANNY EDGE DETECTION

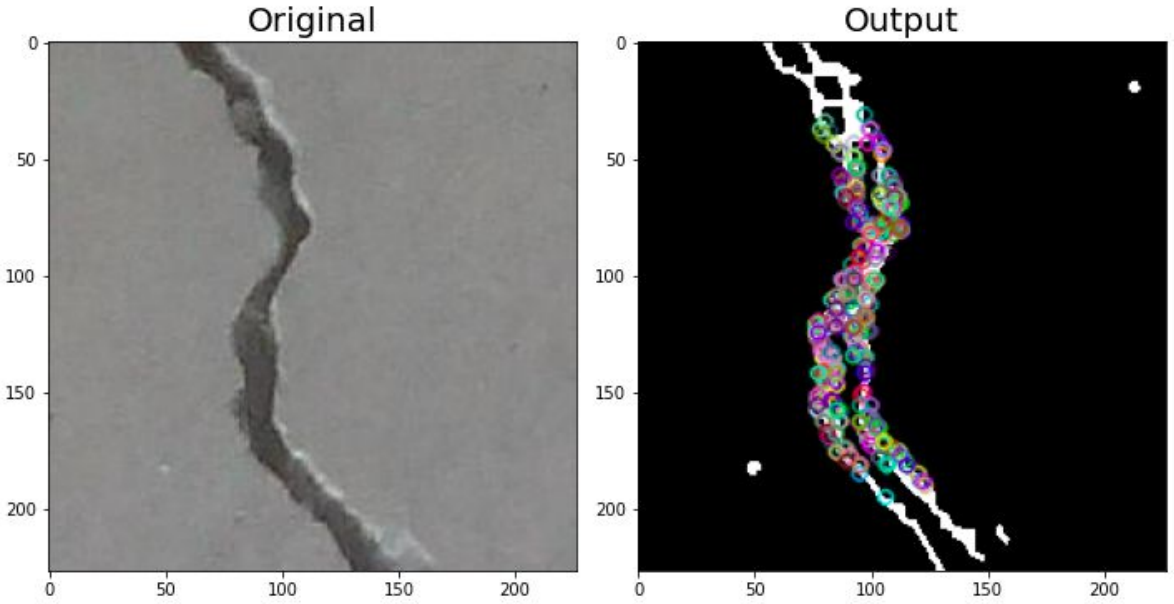
RESULTS

METHOD	CRACKED	NON CRACKED
THRESH_BINARY and CLAHE and Canny	63.67%	73.33%
THRESH_BINARY_INV and CLAHE and Canny	64.5%	71.83%
THRESH_TRUNC and CLAHE and Canny	98%	68.3%
THRESH_TOZERO and CLAHE and Canny	64.66%	85.33%
THRESH_TOZERO_INV and CLAHE and Canny	98.18%	73.16%
BINARIZATION AND OTSU and Canny	98%	1.33%
Median and Canny	98.5%	94%

Choosing the best combination

We chose Median Thresholding method with Canny edge detection because in rest of the cases the accuracy is comparatively low for uncracked images. For other combinations, we even saw many cases of cracks getting detected in uncracked images. The median thresholding with Canny edge detection gave us an accuracy close to 98% for cracked images and 94% percent for uncracked images.

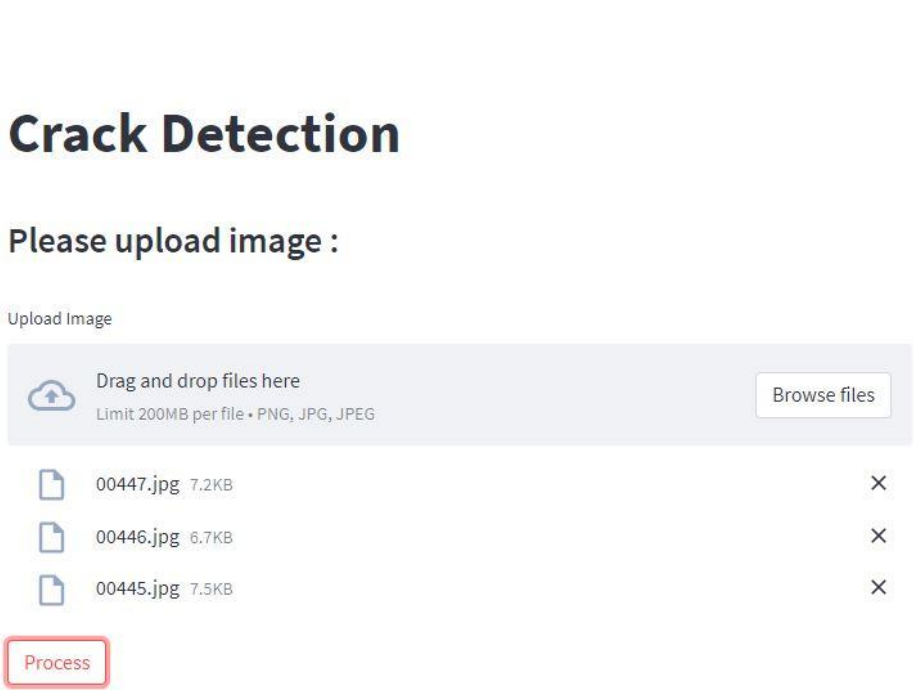
Median thresholding with canny edge detection



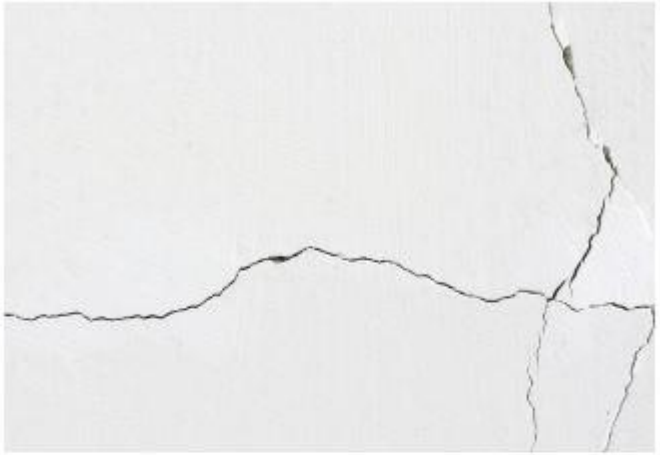
Output:

Morphological gradient Image

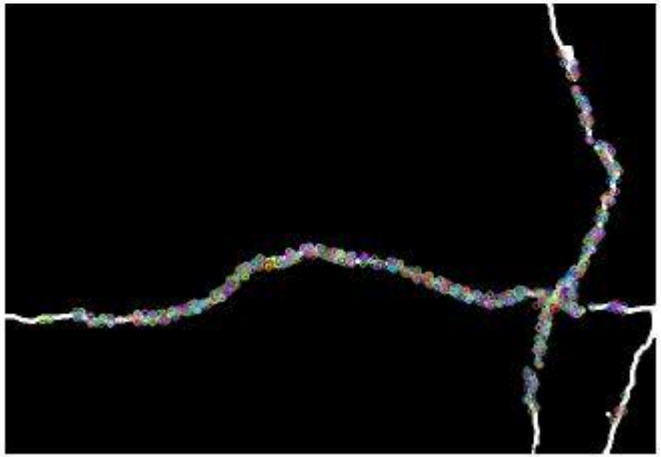
WEBSITE


Crack Detection
Please upload image :
Upload Image
Drag and drop files here
Limit 200MB per file • PNG, JPG, JPEG
Browse files
00447.jpg 7.2KB
00446.jpg 6.7KB
00445.jpg 7.5KB
Process

WEBSITE



Uploaded Image



Output

Size of image: `292500` pixels

Size of crack: `55883.33179473877` pixels

Percentage of crack on image: `19.10541257939787` %

It has a crack!

Percentage of crack on image: `19.10541257939787` %

TIMELINE

1st Review	2nd Review	3rd Review	4th Review
Description of our Research project in PPT presentation Collected some research papers Literature review	Experiment on various types of binarization, enhancement methods and used Canny edge detection for crack detection	We will try to analyse all the algorithms and choose the best algorithm. We will try to optimize the algorithm to provide the best output by verifying with classified dataset. We will also provide a analysis of the crack detected in the image	Deploy the algorithm on website where a user can use them for crack detection and provide the analysis of the crack

Dataset

https://www.kaggle.com/c/crack-identification-ce784a-2020-iitk/data

References

1. W. A. Mustafa and H. Yazid, “Illumination and Contrast Correction Strategy using Bilateral Filtering and Binarization Comparison,” J. Telecommun. Electron. Comput. Eng., vol. 8, no. 1, pp. 67–73, 2016.
2. S. Jenifer, S. Parasuraman, and A. Kadirvelu, “Contrast enhancement and brightness preserving of digital mammograms using fuzzy clipped contrast-limited adaptive histogram equalization algorithm,” Appl. Soft Comput. J., vol. 42, pp. 167–177, 2016.
3. Nhat-Duc Hoang, "Detection of Surface Crack in Building Structures Using Image Processing Technique with an Improved Otsu Method for Image Thresholding",*Advances in Civil Engineering*, vol. 2018, Article ID 3924120, 10 pages, 2018.
4. Parente, L. Falvo, E. Castagnetti, C. Grassi, F. Mancini, F. Rossi, P. Capra, A. Image-Based Monitoring of Cracks: Effectiveness Analysis of an Open-Source Machine Learning-Assisted Procedure. J.Imaging 2022
5. https://docs.opencv.org/4.x/da/d22/tutorial_py_canny.html

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Thank you