A PROJECT REPORT

on

"DAMAGE DETECTION IN OLD HERITAGE BUILDINGS USING YOLO v4"

Submitted to

KIIT Deemed to be University

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
COMPUTER SCIENCE &ENGINEERING

BY

PRATIK BEHERA 1805812

UNDER THE GUIDANCE OF
Dr. RAJDEEP CHATTERJEE
Affiliation

SCHOOL OF COMPUTER ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR, ODISHA - 751024
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CERTIFICATE

This is certify that the project entitled

"DAMAGE DETECTION IN OLD HERITAGE BUILDINGS USING YOLO v4"

submitted by

PRATIK BEHERA 1805812

is a record of bonafide work carried out by me, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Science & Engineering) at KIIT Deemed to be university, Bhubaneswar. This work is done during year 2022-2023, under my guidance.

Date:27/04/2022

(Dr. Rajdeep Chatterjee)
Project Mentor

Acknowledgements

I am profoundly grateful to **Dr. Rajdeep Chatterjee** of **Affiliation** for his expert guidance and continuous encouragement throughout to see that this project rights its target since its commencement to its completion. I am highly obliged and thankful to KIIT Deemed to be University, for giving us such fruitful opportunities which helped us to build a good base of knowledge

PRATIK BEHERA

ABSTRACT

Old and ancient buildings have a high cultural value which should be maintained. This project offers a structural approach to detect the damaged parts of old heritage buildings all over India by using a state of art object detection model YOLOv4(You Only Look Once) on custom designed dataset. The dataset collection is done using web scraping- A process to scrap useful elements from websites such as images, particular data etc. A total of 1017 images were collected using web scraping which is then annotated accordingly using LabelImg- A annotating tool which supports YOLO as well as other formats. In this case the type of damages which are being focused on are mainly cracks, spalling, trees grown in cracks. These are annotated using labels which are categorized accordingly into 4 categories which are Category_One_-Brokens Bricks, Category_Two-Moss and Fern, Category_Three-Trees grown out of cracks and the last one Category_Four-Cracks in the walls. The model is trained using the darknet architecture which gives a satisfactory result upon model training

Keywords: Write at least five keywords closely relate to your project work.

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Chapter 1

Introduction

India is a place with rich culture and traditions. The ancient heritage and monumental sites hold a significant importance in Indian culture. Maintaining the monuments and the old buildings is a tedious job which has to be performed efficiently for preservation of these monuments. Maintenance at regular intervals helps to ease out the job. But, India with a huge number of monuments and heritage buildings it becomes difficult for the respective authorities to maintain every building on a regular basis. The project intends to work out a solution which would give the authorities useful information regarding the revival work of monuments which need immediate attention. Taking this into consideration this project intends to provide a medium through which the maintenance of those old buildings and monuments can be done efficiently. The damages of the buildings are divided into many categories such as hairline cracks, major cracks on the wall, separation of wall, collapsing of the roof, multiple fractures in the wall, etc. The overlapping of trees, plants, and algae on the wall also comes under a category where the building needs maintenance. Following these categories an overall division of the types of damages are done which includes category one broken bricks, category two moss on the walls, category three plants grown out of cracks and the last category cracks on the building which includes all sorts of cracks.

Chapter 2

Basic Concepts

The primary part of the project contains collection of the images for training purposes. As given a small amount of information above the image collection is done with the help of web scarping tools using libraries such as selenium and other packages as per requirement. The driver used to access the system for automation purpose is chromewebdriver which is used to access the web browser and accordingly do the needful as described in the code. The automated script works to collect images from a given a URL which is manually entered. The script has a scroll function which scrolls till the last available image and download every single image from its specified URL. There are cases built for exceptions such as if the image takes longer than the input time the it downloads the image with a lesser resolution. If that's not possible it skips to the next image. The images are then stored in the specified folder location.

2.1 PYTHON

The above code is written in python which makes the work easier for the purpose of automation. The written code has two parts- Collection of images for dataset and Renaming of the folders for easier annotation purposes

2.2 LABELIMG-Annotation Tool

The images collected have to be carefully analysed for proper training. Annotation of the images are done using the software LabelImg.py which allows annotation of files in YOLO format. The labels on the basis of which the images are specified are edited in the predefined classes.txt files cause the tool has predefined classes of 14 categories by default. The labels used for annotation are Category_One-Broken_Bricks, Category_Two-Moss_and_Fern, Category_Three-Trees_grown_out_of_cracks and Category_Four-Cracks_in_the_walls.

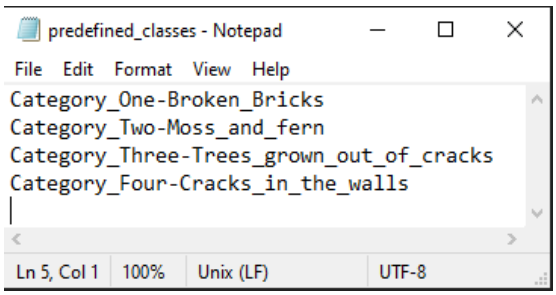

Fig1: The predefined classes used for annotation(predefined_classes.txt)

An average of 2 annotation boxes per image is tried to be maintained. The examples of some labelled annotations boxes are mentioned shown below.

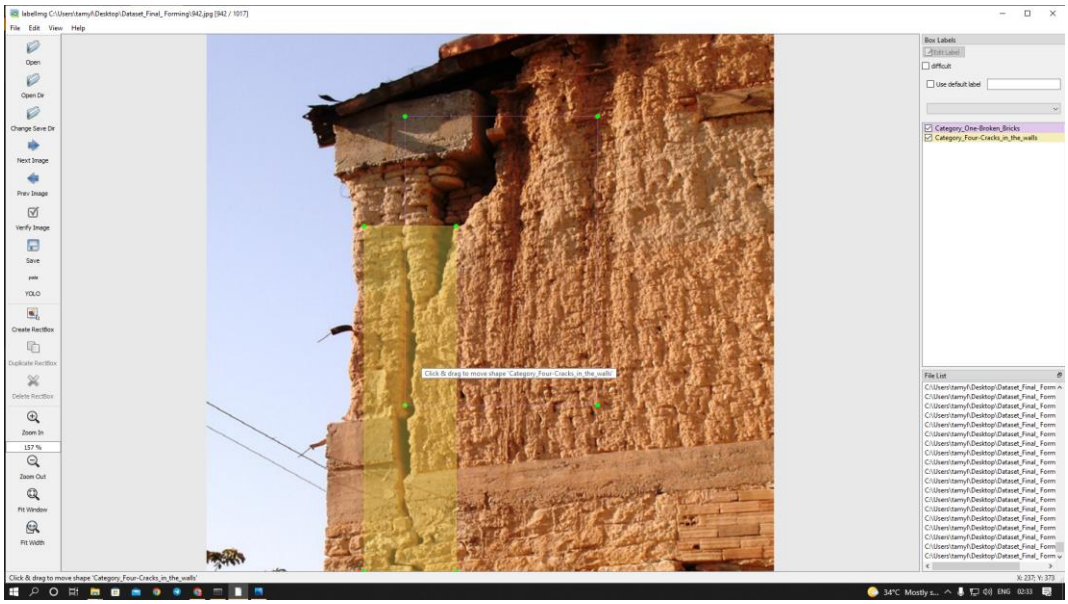

Fig2: Annotations labels of cracks in the wall and broken bricks

Fig3: Annotations labels of Trees in the cracks and broken bricks

2.3 YOLO v4:-Darknet Implementation

The main motive of the project implementation lies in the detection of damages in old heritage buildings which can be restored. In this project the algorithm used for detection is YOLO v4 which a state-of-the-art object detection algorithm [1]. The algorithm basically works by breaking the object detection task into two pieces which uses regression for identification of object detection and classification to determine the class of the object. The damage detection on this dataset is done on namely four classes which almost summarizes the types of the damages a building can encounter over a long period of time

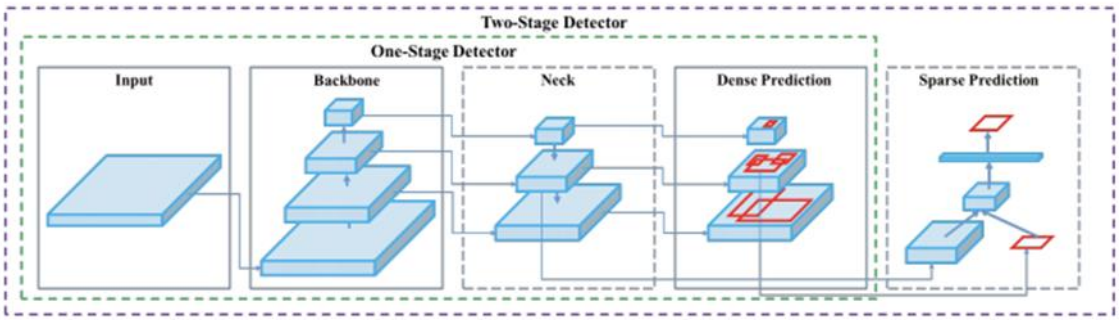

Fig4: Basic Architecture of architecture of YOLO v4

The algorithm is implemented using the darknet architecture which allows seamless object detection thus enabling for efficient damage detection.

The number of classes, final layers, max batches, filters and other required data for training are calculated with formulas which are mentioned below.

Filters= (Number of classes+5) *B

YOLO v4 predicts three bounding boxes for every cell of the features maps hence the value of B is 3.

Max Batches= (No. of classes * 2000)

Steps= (80 percent and 90 percent of max batches)

For this case the values used are 27,8000,6400,7200 respectively. (The number of classes used for this case is 4).The dataset here has been divided into a ratio of 80:20 for training and testing purposes.The dimensions used were 416 by 416 as the algorithm usually understands better with multiples of 32. The darknet architecture has been used for this model training which was trained for 10000 iterations where after every 1000 iterations the weights were saved in the backup folder and the last weight was saved in the file name of yolov4_train_last.weights.

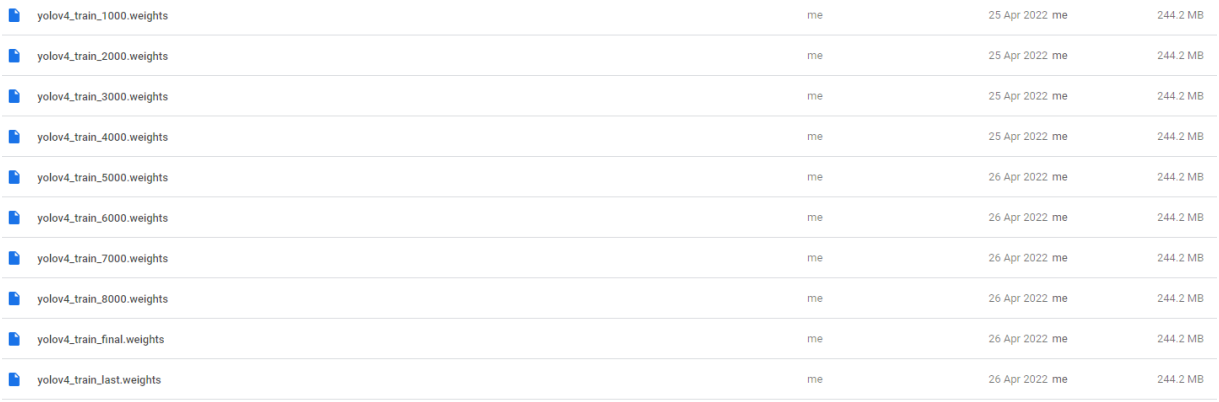

Fig5:yolov4_train_last.weights file

Chapter 3

Problem Statement / Requirement Specifications

The project is based on the problem of maintenance of Old heritage buildings all over places which cannot be monitored properly. The basic objective is to create an efficient enough model to detect the degree of damage which would improve their knowledge regarding the same and they can direct their active effort in the restoration of the buildings demanding instant care.

3.1 Project Planning

Collection of images for training the model
Sorting out the images efficient for the model to learn
Annotating the images
Train model with decided algorithm efficient and fast to produce results

3.2 Project Analysis

The dataset needs to be carefully created with accurate annotations should that the model learns appropriately to differentiate between degrees of damage.

3.3 System Design

Google Colab Pro was used for training the model. The website provides a suitable environment for model training and improved collection of GPUs and RAM as well as disk usage for longer training times.

3.3.1 System Architecture **OR** Block Diagram

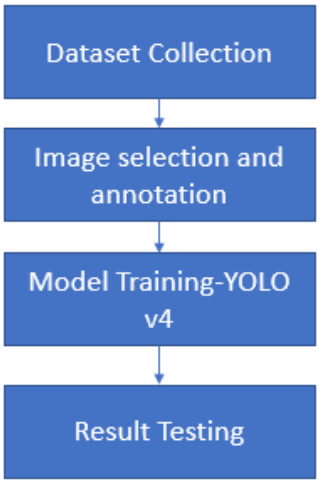

Fig6:Process Flowchart

Chapter 4

Implementation

4.1 Methodology OR Proposal

The algorithm used is YOLOv4(You look only once) for model training which has been explained above.

4.2 Testing OR Verification Plan

The dataset was divided into 80:20 ratio where the 20 percent was the training data.

4.3 Result Analysis OR Screenshots

The threshold used for the object detection testing for the image was 0.05 and the weights used where the yolov4_train_last.weights. The result was accurate to detect the damage in the image.

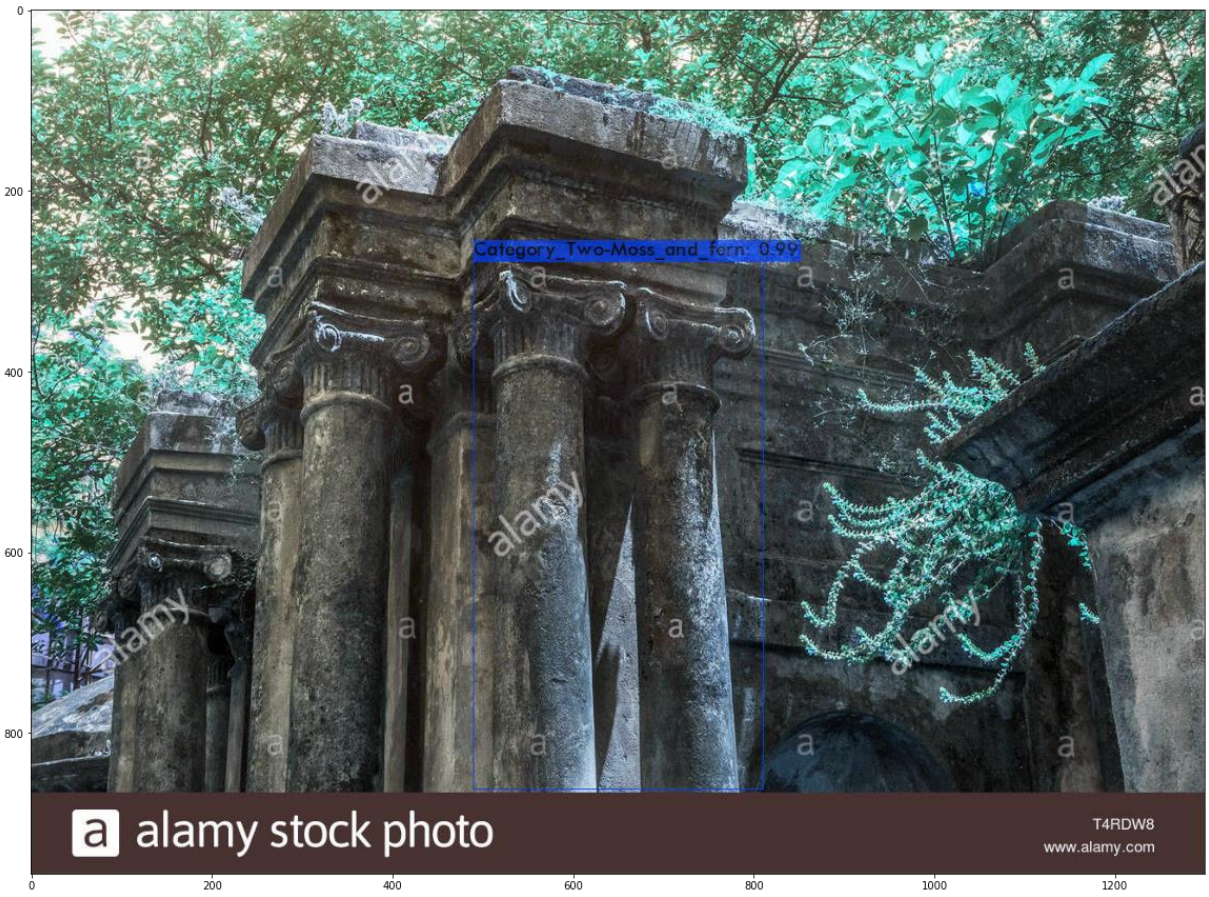

Fig7:Ouput image of the model tested on a random image.

Chapter 5

Standards Adopted

5.1 Design Standards

The design of the algorithm was to keep as simple as possible which gives us result accurate and fast enough to work upon

5.2 Coding Standards

```
!./darknet detector test /please/YOLO_V4/darknet/data/FINALDATASET/image
_data.data /please/YOLO_V4/darknet/cfg/yolov4_train.cfg  /please/YOLO_V4
/darknet/backup/yolov4_train_last.weights  /please/YOLO_V4/darknet/774.j
pg -thresh 0.05
```

The code line to run the custom detection on random image stored in the drive.

```
Loading weights from
/please/YOLO_V4/darknet/backup/yolov4_train_last.weights...
 seen 64, trained: 256 K-images (4 Kilo-batches_64)
Done! Loaded 162 layers from weights-file
 Detection layer: 139 - type = 28
 Detection layer: 150 - type = 28
 Detection layer: 161 - type = 28
/please/YOLO_V4/darknet/774.jpg: Predicted in 32.080000 milli-seconds.
Category_Two-Moss_and_fern: 99%
```

The output of the above code.

Chapter 6

Conclusion & Future Scope

6.1 Conclusion

This project tends to gives range of information on damage detection using YOLO V4 which successfully detects images which an accuracy ranging from 89 percent to 95 percent. A little more tweaking with the criteria such as trying out augmentation with different angles would in return increase the per image training with multiple copies of the same image different enabled parameters might enable the achievement of a accuracy more than the one achieved. This would ensure that the input aerial data would be efficiently detected.

6.2 Future Scope

The model can be used to efficiently intimate the concerned authorities for quick and efficient restoration purpose of the ancient monuments and buildings which hold historic significance.

References

Referencing style for journals:

1. Alexey Bochkovskiy, Chien-Yao Wang, Hong-Yuan Mark Liao, "YOLO v4 optimal speed and accuracy of object detection"

2.Julia Armesto and Pedro Arias, "Damage detection on historical buildings using unsupervised learning techniques"

Referencing style for webpages (Mention the entire URL)

1. https://github.com/AlexeyAB
2. https://github.com/tzutalin/labelImg

<DAMAGE DETECTION IN OLD HERITAGE BUILDING USING YOLO v4>

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Abstract: Old and ancient buildings have a high cultural value which should be maintained. This project offers a structural approach to detect the damaged parts of old heritage buildings all over India by using a state of art object detection model YOLOv4(You Only Look Once) on custom designed dataset. The dataset collection is done using web scraping- A process to scrap useful elements from websites such as images, particular data etc. A total of 1068 images are collected using web scraping which is then annotated accordingly using LabelImg- A annotating tool which supports YOLO as well as other formats. In this case the type of damages which are being focused on are mainly cracks, spalling, trees grown in cracks. These are annotated using labels which are categorized accordingly into 4 categories. The model is trained using the darknet architecture which gives a satisfactory result upon model training.

Individual contribution and findings: Creation of dataset, training the model, project report preparation and project presentation preparation. Along with literature review.

Individual contribution to project report preparation: Collected and processed suitable material for this report and created the entire report

Individual contribution for project presentation and demonstration: Collected, edited and processed the whole presentation

Full Signature of Project Mentor: Full signature of the student:

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PLAGIARISM REPORT