Parshvanath Charitable Trust's
A. P. SHAH INSTITUTE OF TECHNOLOGY
(Approved by AICTE New Delhi & Govt. of Maharashtra, Affiliated to University of Mumbai)
(Religious Jain Minority)

A MINI PROJECT REPORT

On

CHESS PIECE DETECTION

Submitted in partial fulfillment of the requirement
of University of Mumbai for the Course

In

Computer Engineering (VII SEM)

Submitted By

Jayesh Jain (24)
Zenil Gosher (16)
Parth Gujar (17)

Subject Incharge
Subject Incharge Name
(Prof. Merlin Priya Jacob)

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CERTIFICATE

This is to certify that the requirements for the project report entitled '**Chess Piece Detection**' have been successfully completed by the following students:

Name	**Moodle Id**
Jayesh Jain	19102021
Zenil Gosher	19102045
Parth Gujar	19102056

In partial fulfillment of the course **Machine Vision (CSDC 7011)** in Sem: VII of Mumbai University in the Department of Computer Engineering during academic year 2022-2023.

Prof. Marlin Priya Jacob
Sub-in-Charge

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PROJECT APPROVAL

The project entitled '**Chess Piece Detection**' by **Jayesh Jain, Zenil Gosher** and **Parth Gujar** is approved for the course of Machine Vision (CSDC 7011) in Sem: VII of Mumbai University in the Department of Computer Engineering.

Subject-in-Charge

Prof. Marlin Priya Jacob

Date:

Place: Thane

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Abstract

The game of Chess was discovered over 2000 years ago. An ancient game of strategy which captivates the world even today. We intend to detect and recognise the chess pieces on the chessboard and assign a confidence score to each prediction.We have used a kaggle dataset.We use a pre-trained model using YOLOV3 (You Only Look Once) which is used with the ImageAI library and implemented using transfer learning methodology for custom object detection and recognition.

Problem Definition

Identification of chess pieces from image as an input. Recognition of images with given images and xml files with plotting area provided from dataset. Labeling the chess pieces with high probability values from matrices.Finding out the probability matrix with pairing of input with each piece and finding out the highly coinciding output. showing the output as an image file. And saving output as image file in .png format.

Introduction

Chess is played between two players, one is White and the other is Black.The two players alternate turns (White always moves first), moving one piece at a time with the ultimate goal of capturing the enemy king. There are six pieces in chess, each moves in a unique way. All pieces do share some common traits.

For instance, no piece is allowed to land on a square occupied by a friendly piece.If a piece lands on a square occupied by an enemy piece, that enemy is captured and removed from the board.
Also, with the exception of the knight, pieces are not permitted to jump over other pieces.

Chess Pieces:-

King, Queen, Bishop,

Knight, Rook and Pawn.

Proposed System

YOLOv3 (You Only Look Once, Version 3) is a real-time object detection algorithm that identifies specific objects in videos, live feeds, or images. The YOLO machine learning algorithm uses features learned by a deep convolutional neural network to detect an object

The input is a batch of images of shape (m, 416, 416, 3).

YOLO v3 passes this image to a convolutional neural network (CNN). Finally, we do the IoU (Intersection over Union) and Non-Max Suppression to avoid selecting overlapping boxes.

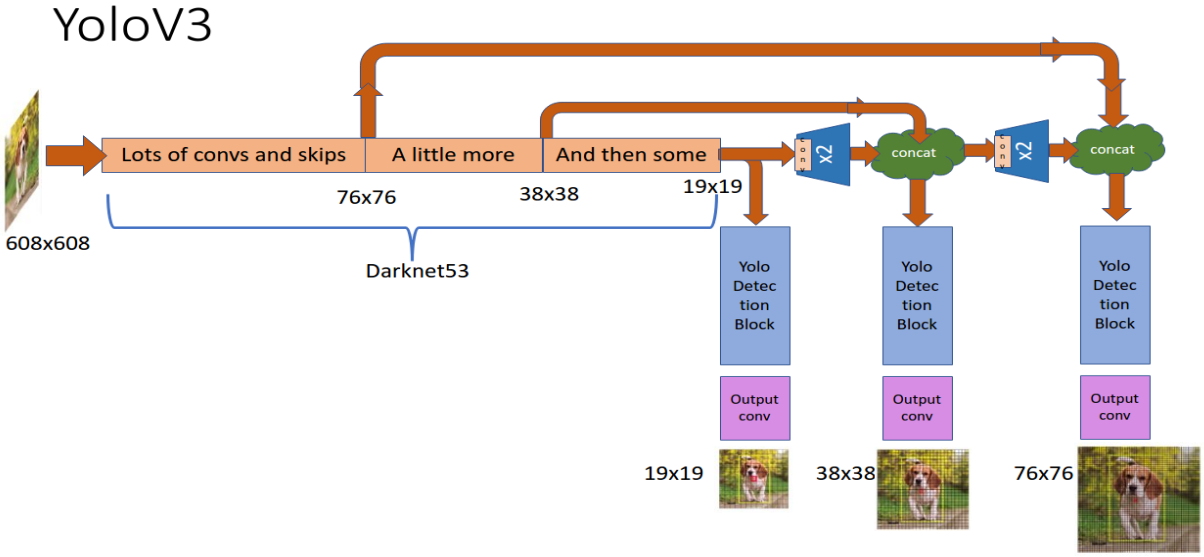


Fig. 1. Architecture of chess piece detection system.

System Specification and Requirements

Software Requirement

Following are the software requirement necessary of the project:

a) Python as programming language.

b) NumPy:

A library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.

c) PIL Python Imaging Library:

A free and open-source additional library for the Python programming language that adds support for opening, manipulating, and saving many different image file formats.

d) ImageAI:

A python library built to empower developers, researchers and students to build applications and systems with self-contained Deep Learning and Computer Vision capabilities.

e) Kaggle

f) YOLOv3

System Implementation

Prediction features:

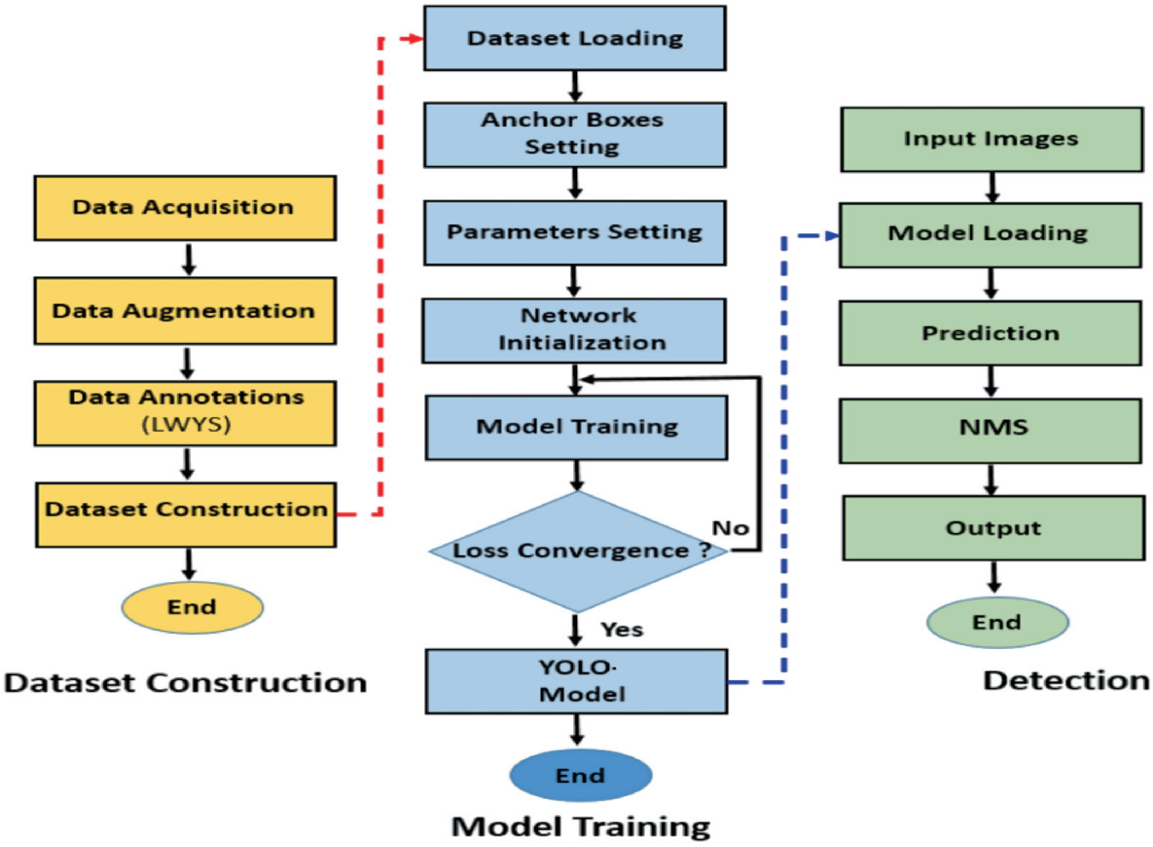
Anchor Boxes -

Although anchor boxes, or bounding boxes,. Object detectors using YOLOv3 usually predict log-space transforms, which are offsets to predefined "default" bounding boxes. Those specific bounding boxes are called anchors. The transforms are later applied to the anchor boxes to receive a prediction. YOLOv3 in particular has three anchors. This results in the prediction of three bounding boxes per cell.

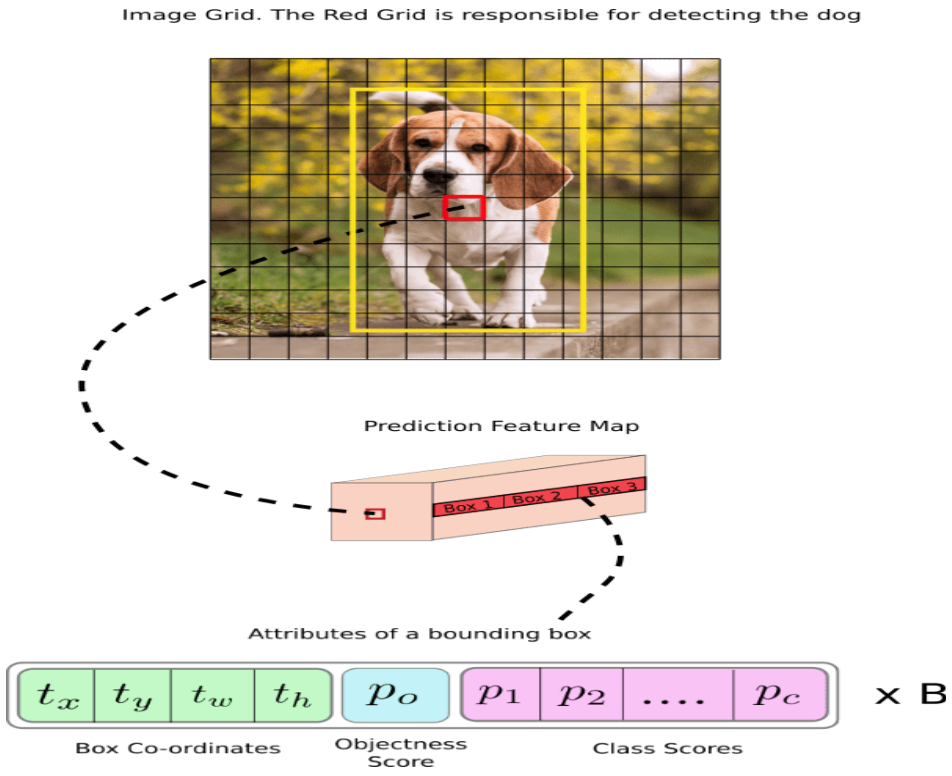
Non-Maximum Suppression -

Objects can sometimes be detected multiple times when more than one bounding box detects the object as a positive class detection. Non-maximum suppression helps avoid this situation and only passes detections if they haven't already been detected. Using the NMS threshold value and confidence threshold value, NMS is implemented to prevent double detections. It is an imperative part of utilizing YOLOv3 effectively.

A convolutional neural network (CNN) is a subset of machine learning. It is one of the various types of artificial neural networks which are used for different applications and data types. A CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data. There are other types of neural networks in deep learning, but for identifying and recognizing objects, CNNs are the network architecture of choice. Thus, for recognizing various chess pieces, we make use of CNN.



Bounding boxes and Non-maximum Suppression (NMS)



Class Confidence and Box Confidence Scores

Each bounding box has an x, y, w, h, and box confidence score value. The confidence score is the value of how probable a class is contained by that box, as well as how accurate that bounding box is.

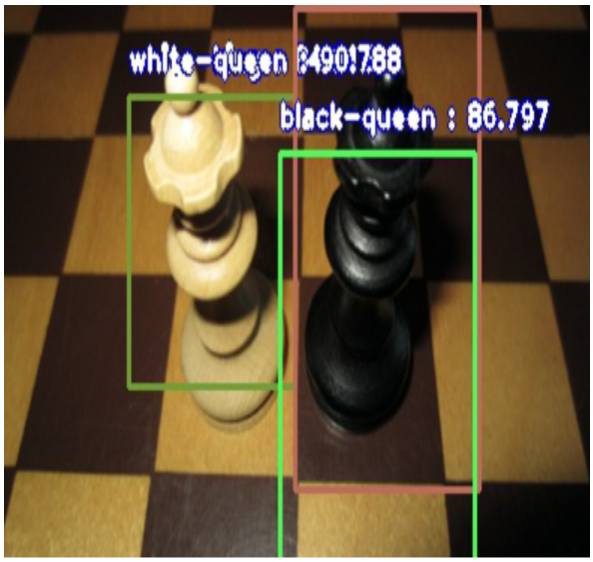
Output:

Chess Pieces **Chess Pieces being detected**

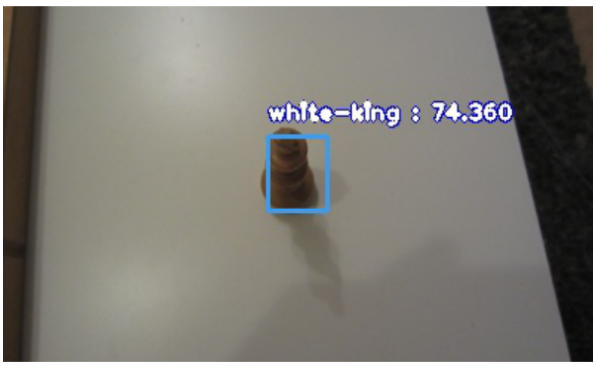
Probability Matrix

```
black-bishop  :  86.06919050216675  :  [111, 72, 147, 112]
black-queen  :  81.38693571090698  :  [111, 72, 147, 112]
white-king  :  81.79835677146912  :  [153, 69, 189, 112]
black-bishop  :  82.90383219718933  :  [205, 109, 231, 155]
black-rook  :  90.92341661453247  :  [205, 109, 231, 155]
black-queen  :  80.28221726417542  :  [201, 113, 236, 152]
white-pawn  :  84.49097275733948  :  [92, 43, 112, 73]
white-pawn  :  83.65756273269653  :  [158, 176, 190, 200]
```

Detection of Similar Pieces



Detection from Top



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We have great pleasure in presenting the mini project report on "Chess Piece Detection". We take this opportunity to express our sincere thanks towards our guide Prof.Merlin Jacob Department of Computer Engineering, APSIT Thane for providing the technical guidelines and suggestions regarding line of work. We would like to express our gratitude for his constant encouragement, support and guidance through the development of the project.
We thank ma'am for her encouragement during the progress meeting and for providing guidelines to write this report.
We wish to express our deep gratitude towards all our colleagues of APSIT for their encouragement.

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