

# **CHESS**

*A Project*

*Submitted in partial fulfillment of the  
requirements for the award of the Degree of*

## **BACHELOR IN COMPUTER APPLICATIONS**

**BY**

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**Noida Campus**

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This is to certify that the work presented in the thesis/project entitled "**Chess**" in partial fulfilment of the requirement for the award of Degree of **Bachelor of Computer Applications** of Birla Institute of Technology Mesra, Ranchi is an authentic work carried out under my supervision and guidance. To the best of knowledge , the content of this thesis does not form a basis for award of any previous Degree to anyone else..

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The forgoing project entitled "**Chess**", is hereby approves as a creditable study of research topic and has been presented in satisfactory manner to warrant its acceptance as prerequisite to the degree for which it has been submitted.

It is understood that by this approval, the undersigned do not necessarily endorse any conclusion drawn or opinion expressed therein, but approve the thesis for the purpose for which it is submitted.

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**(Director)**

## **ACKNOWLEDGEMENT**

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## **ABSTRACT**

This is the oldest and most popular two player strategic board game in which we have two opponents black and white. We play on chess board of 64 squares . White have the first chance to make a move and then the black, similiarly we have alternating turns. Each player moves the piece with the specified rules and tries to force the opponent's king to a checkmate, which he cannot avoid.

In this project we tried to make a chess game, that has all the basic rules and functionalities of a chess game but also much more time efficient and overall low cost. This version is available for only two player chess game that are at the same remote location

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## INTRODUCTION

As discussed previously, we calculate the valid moves for the given selected piece based on the current position, this minimize the cost by not calculating all the moves and separating the legal ones. Each piece has an algorithm that calculates its valid moves and indicates them on the board. The game starts with the white's turn then black and so on.

A side window of captured pieces is also created for both the player and with that we have status window instructing whose turn's it is to move the piece.

Also a flashing warning box on the KING is outlined whenever it is in check by the other player. This is "red" for WHITE and "blue" for BLACK.

A forfeit button is also added when either of the player wants to quit the game. We have different scenarios to end the game :

1. Checkmate
2. Forfeit
3. Draw

DRAW – This is either due to the following reasons

- a. Stalemate : No legal moves are available for the player whose chance it is to make the move
- b. Threefold – Repetition of position : When no one is able to avoid repeating moves without getting a disadvantage
- c. The fifty-move rule – When no pawn has moved or no piece is captured in the last 50 moves.

After the game has been over either by forfeit or any of the king is captured, the system declares the winner and restarts the game on hitting the "ENTER" button. If the players mutually decides for the draw then no one wins and game is restarted on pressing "Enter". This is done with the PYGAME library of python

## OBJECTIVE

Main objective of this project is to build a **efficient low-cost** chess game. This is achieved through by predefining all the available moves for the selected piece. There are six types of pieces namely King , Queen , Rook, Bishop,Knight and pawn. Each side have 16 pieces to start with containing a king , a queen, two rooks,two knights and two bishops. Each side have eight pawns. The most powerful piece is the “**queen**”which can perform the moves of both rook and bishop.

Both player have the option to forfeit the game on their repective turns and all the captured pieces will be shown on a side window of the board.

We will be using pygame library of Python to make the project. This is an opensource library for the development of 2-d games and providing graphical user interface(GUI)

## **SYSTEM REQUIREMENT ANALYSIS**

- Hardware requirements:
  - Processor: Minimum 1.5 GHz, Recommended 2Ghz of 32bit,64bit
  - Hard Disk: Minimum 32 GB
  - Memory: Minimum 4 GB or more
- Software requirements:
  - Operating System : Windows 7 or higher
  - Language : Python with PIP and Pygame Library
  - Integrated Development Environment(IDE) : IDLE(python) and VSCode
  - Memory: Minimum 4 GB; Recommended 8GB or more

# TOOLS FOR DEVELOPMENT

## 1. PROGRAMMING LANGUAGE

**Python** : One of the most easy to use, user friendly , versaltile programming language. It implements the prototype results instantly, which make game development very convinient.

## 2. SOURCE-CODE EDITOR

**VS Code(Visual Studio Code)** is one most popular sorce code editor proovided with many useful extensions, developed by Microsoft. It supports mostly all the programming language and frameworks , very versatile and customizable.It provide many debugging tools and make iteasy to manage all the lines of code.

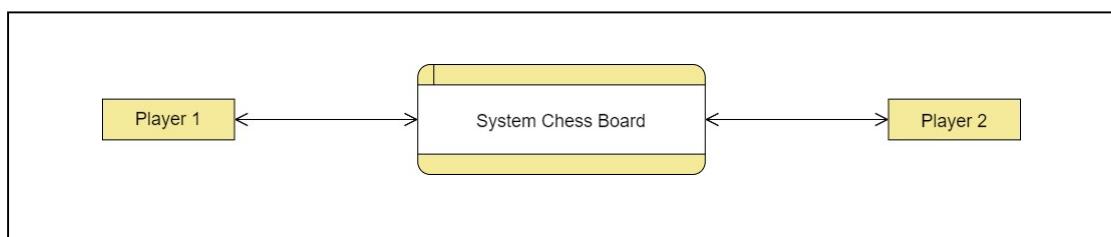
## 3. LIBRARY USED

**Pygame** is one of most popular library in python for game development,it is free and open source and makes game development very simple due to it's predefined fun

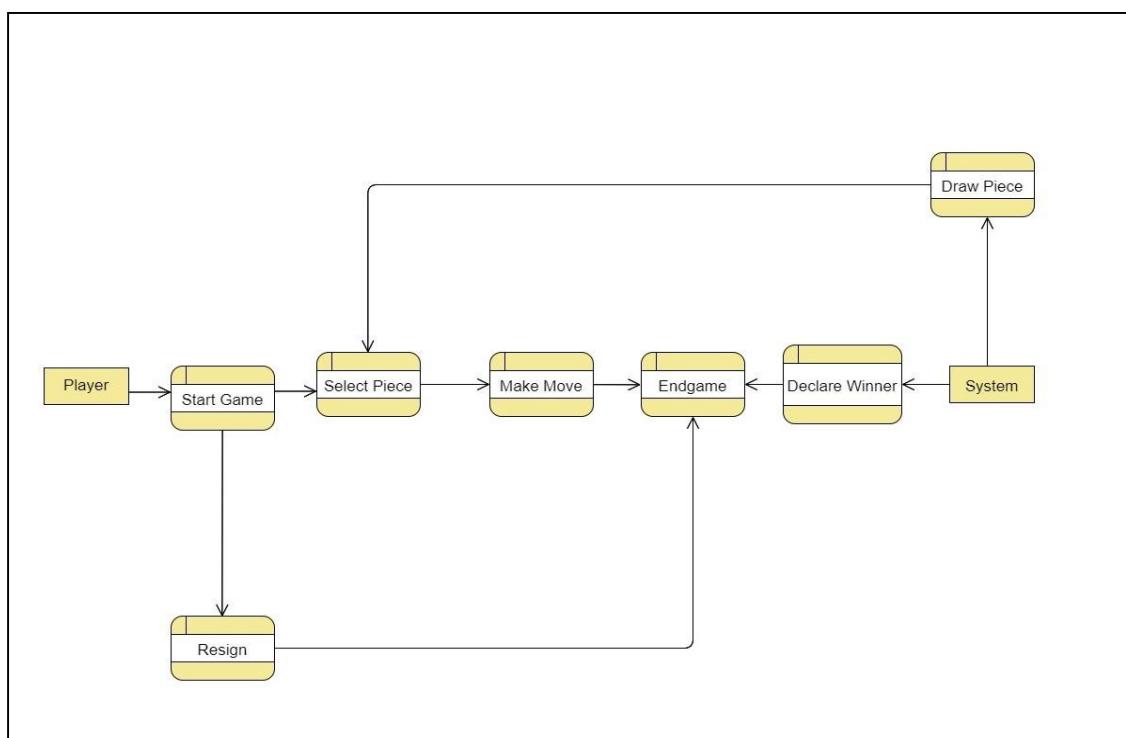
# DESIGN

**1. Data Flow Diagram:** It tells us how the information flows through the system from the data input to the output. This helps in the logical implementation of the system and map out a system design. They are categorized by level, from most simple and basic to more detailed and complex as the level increases.

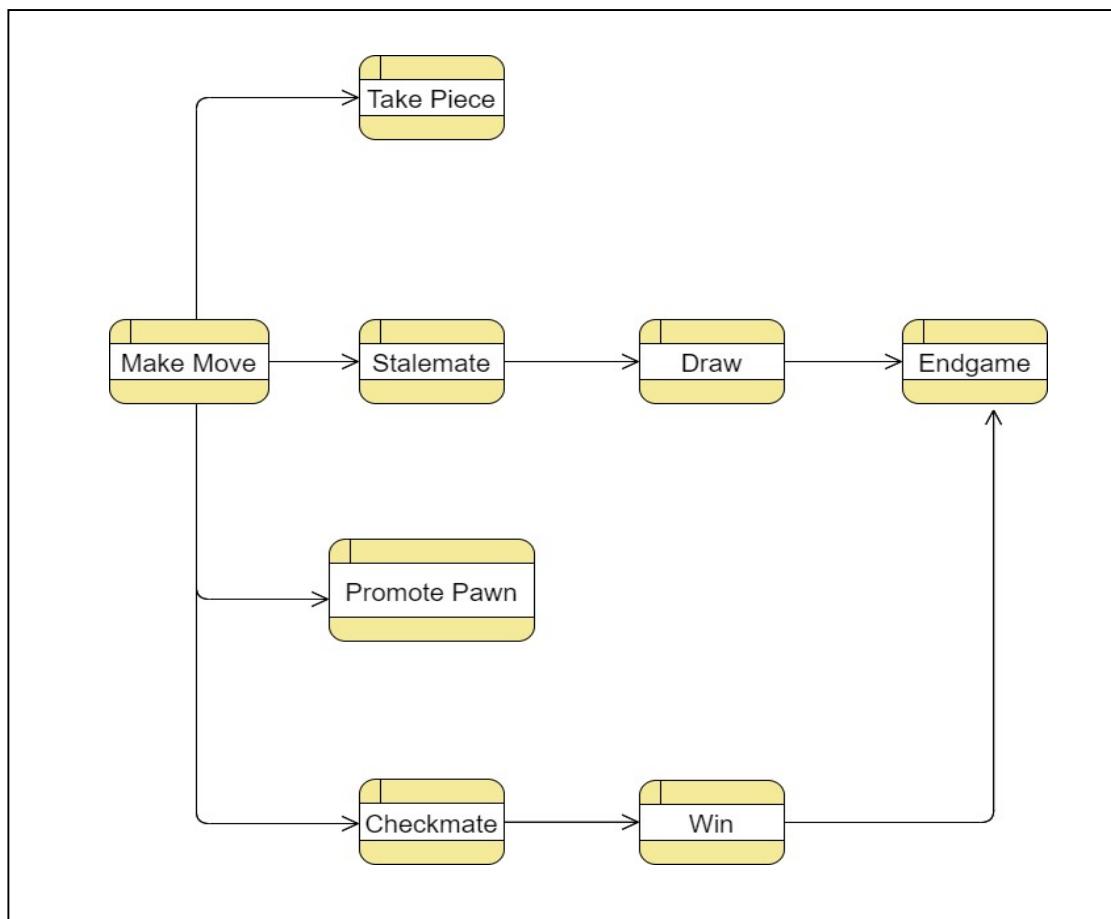
- a. **0 –Level DFD:** The most basic and simple level DFD , also known as the context diagram.Below diagram shows 0-level DFD consisting of two players in which the data is flowing both ways.



- b. **1-Level DFD:** More detailed than previous DFD. The single node is broken into subprocesses which shows additional flow of data. In this example it is shown how the data flows through between the player and the system.



- c. **2-Level DFD-** Nodes are further broken into subprocesses for a more detailed view and better understanding of whole design. In this below diagram the data flow after the “Make\_Move” node is broken depicting the further options.



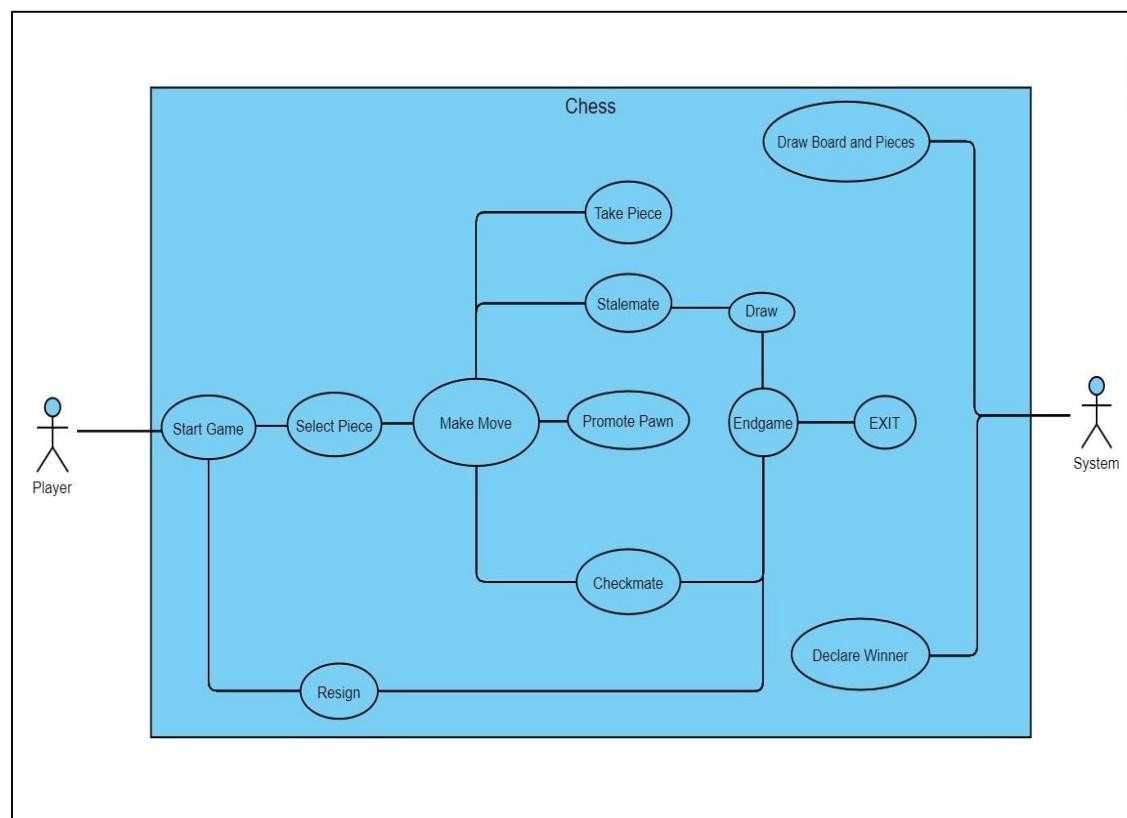
## 2. Use-Case Diagram

a. Use Cases:

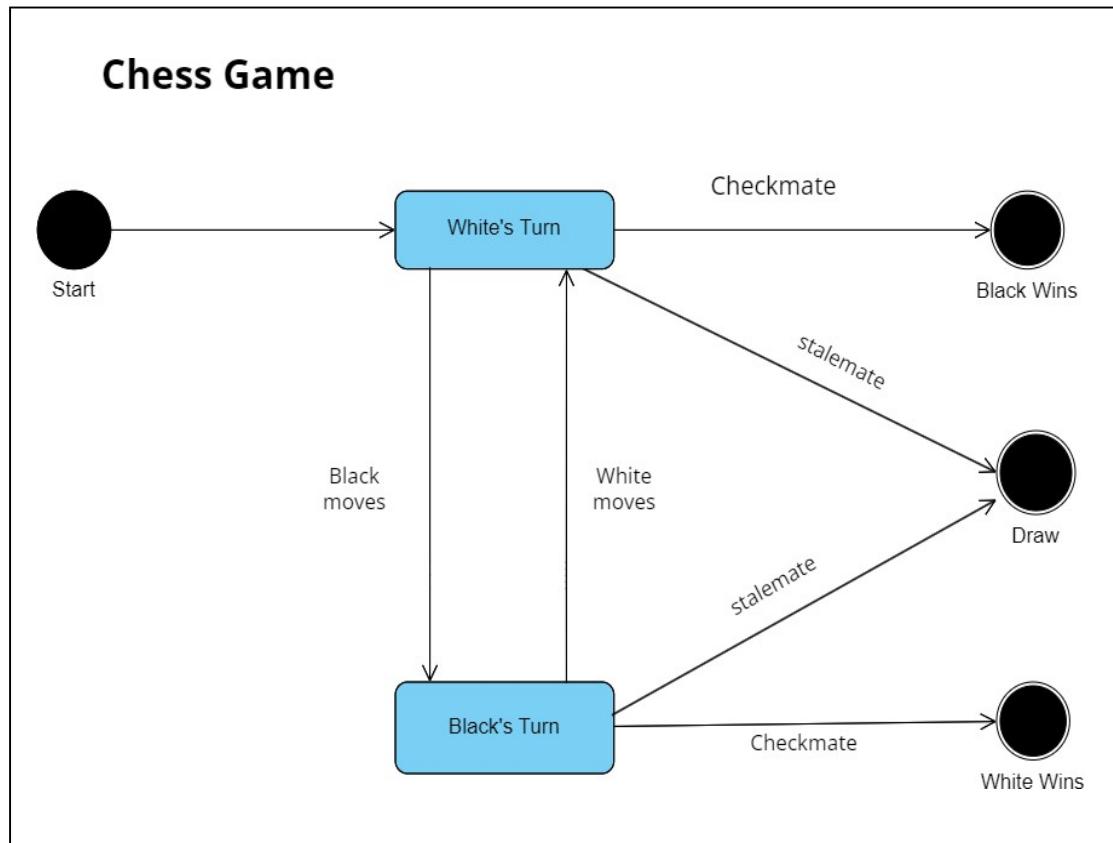
- i. Start Game
- ii. Resign
- iii. Select Piece
- iv. Make Move
- v. Draw
- vi. Endgame
- vii. EXIT
- viii. Declare Winner
- ix. Draw board and pieces

b. Actors :

- i. System
- ii. Player

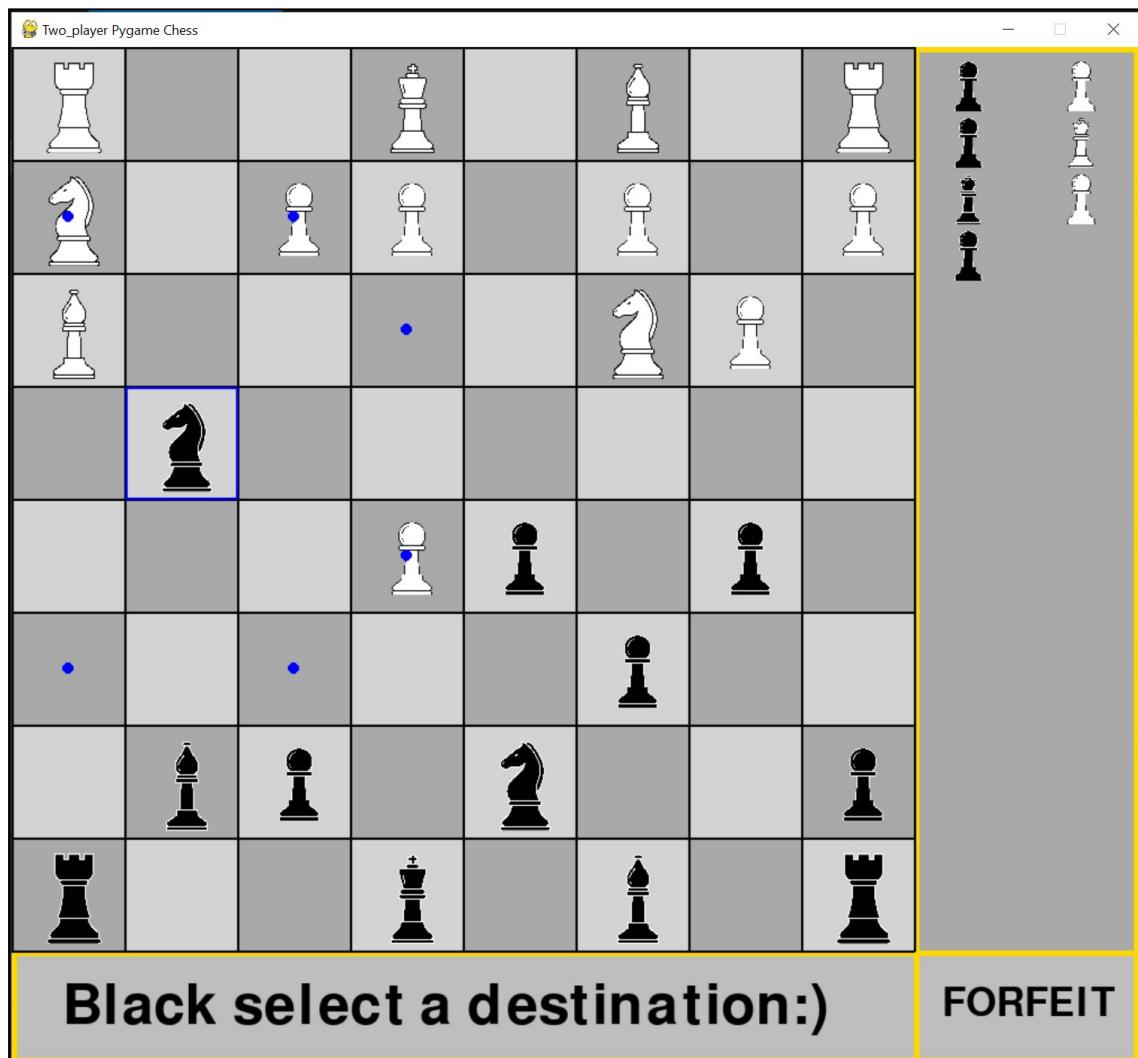


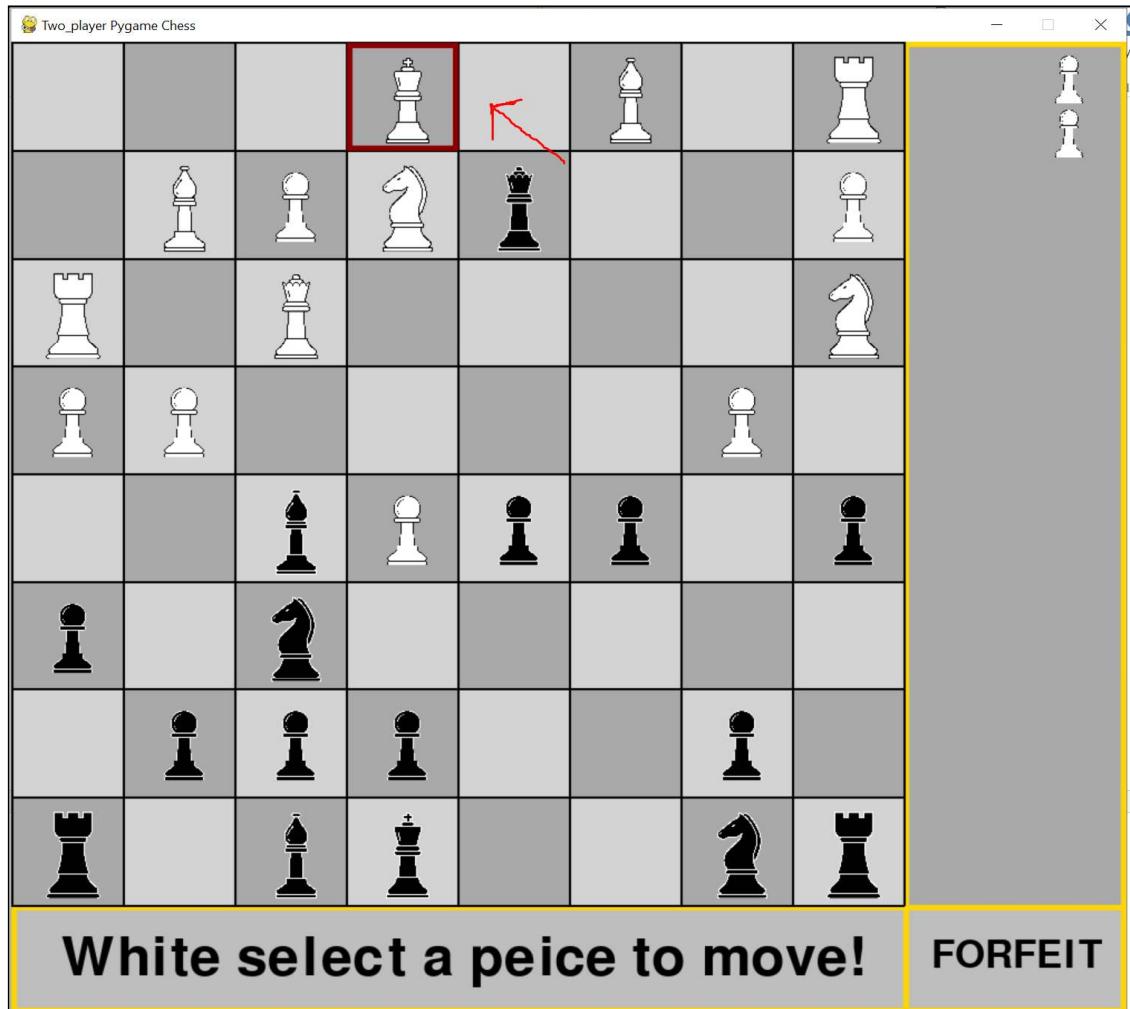
**3. State Diagram :** It depicts the status of an object at a given time and can change status or cause other actions according to the given output. A state is a combination of different data information that an object can hold, not how it behaves. Dark circle is the initial state and bordered circle is the final state.



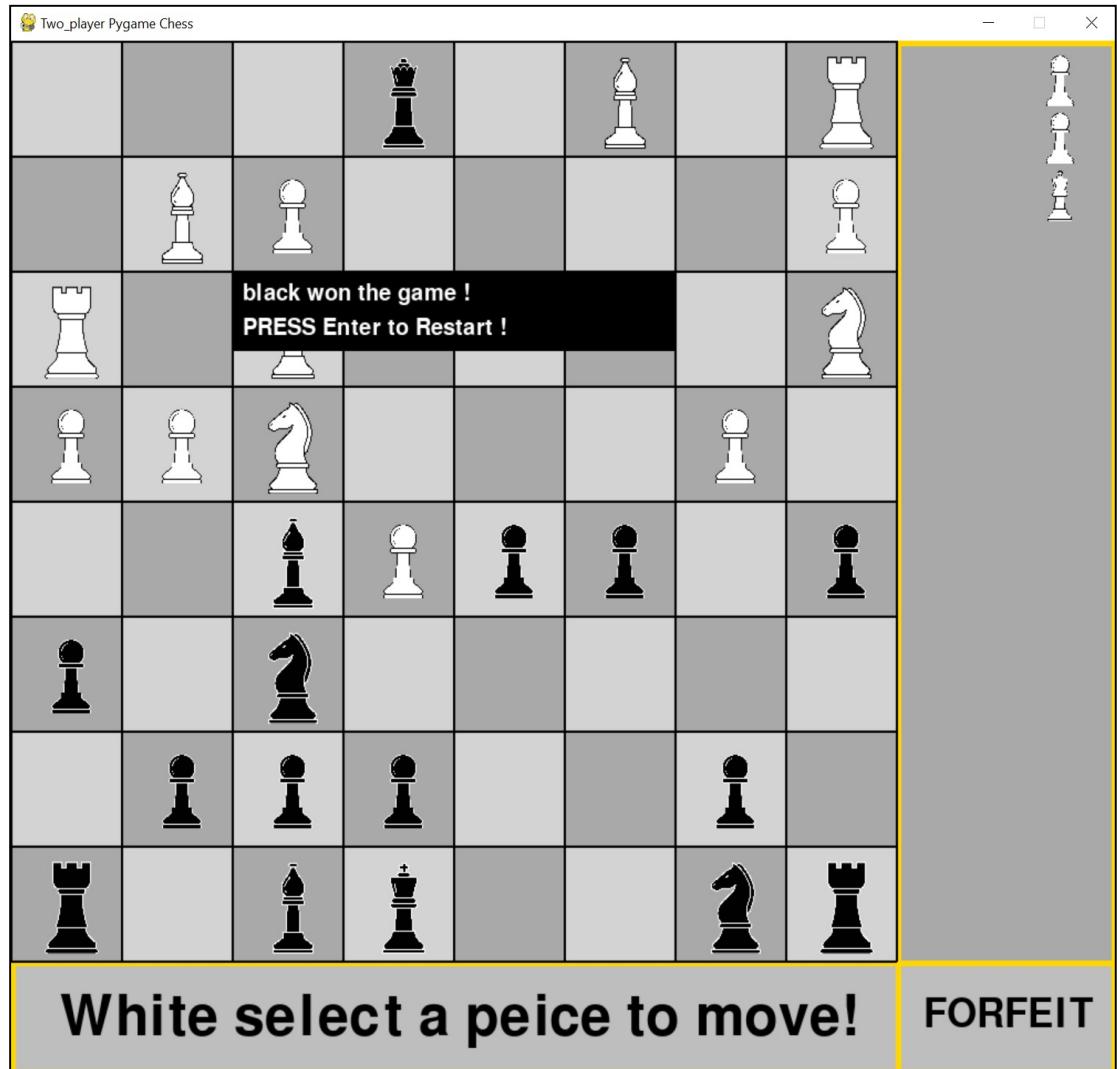
## FEATURES

1. **Valid moves:** Valid moves for black are shown with blue and for white they are shown by red. Above is an illustration depicting the black knight which have currently 6 positions that he can acquire three of them resulting in taking the piece of white. For all of the pieces we have calculated the valid moves already, which appears on selecting them.
2. **Captured Pieces Window:** All the captured pieces of both sides are shown in the right-side window.
3. **Forfeit:** Below the captured window we have the forfeit button for the player to quit the game.
4. **Status Window :** Below the board we have status window indicating whose turn it is to move the piece. In the newer version we have different windows for both the player

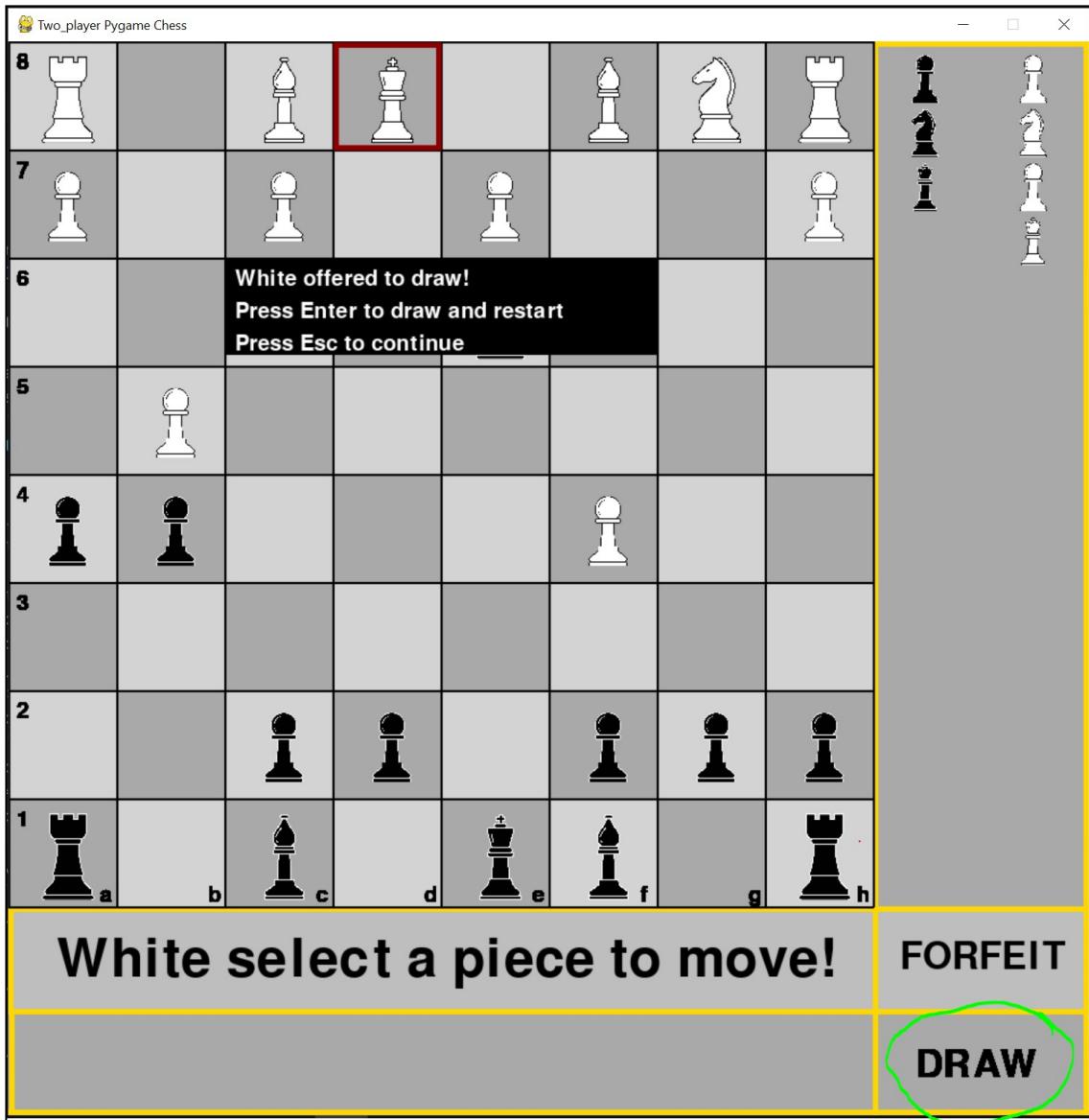




5. **Flashing Warning Box** : Whenever the king is in the check by the other player a red/ blue flashing box will appear on the king. In the above example we have the white king in check with the black queen. Hence the red box the king is appearing.



6. **Declaring the winner :** After the checkmate by either player the system prompts a window declaring the winner..
7. **Restarting on game Over:** On pressing ENTER on this prompt the new game will be restarted. Above illustration depicts that Black has won the game by capturing the white king

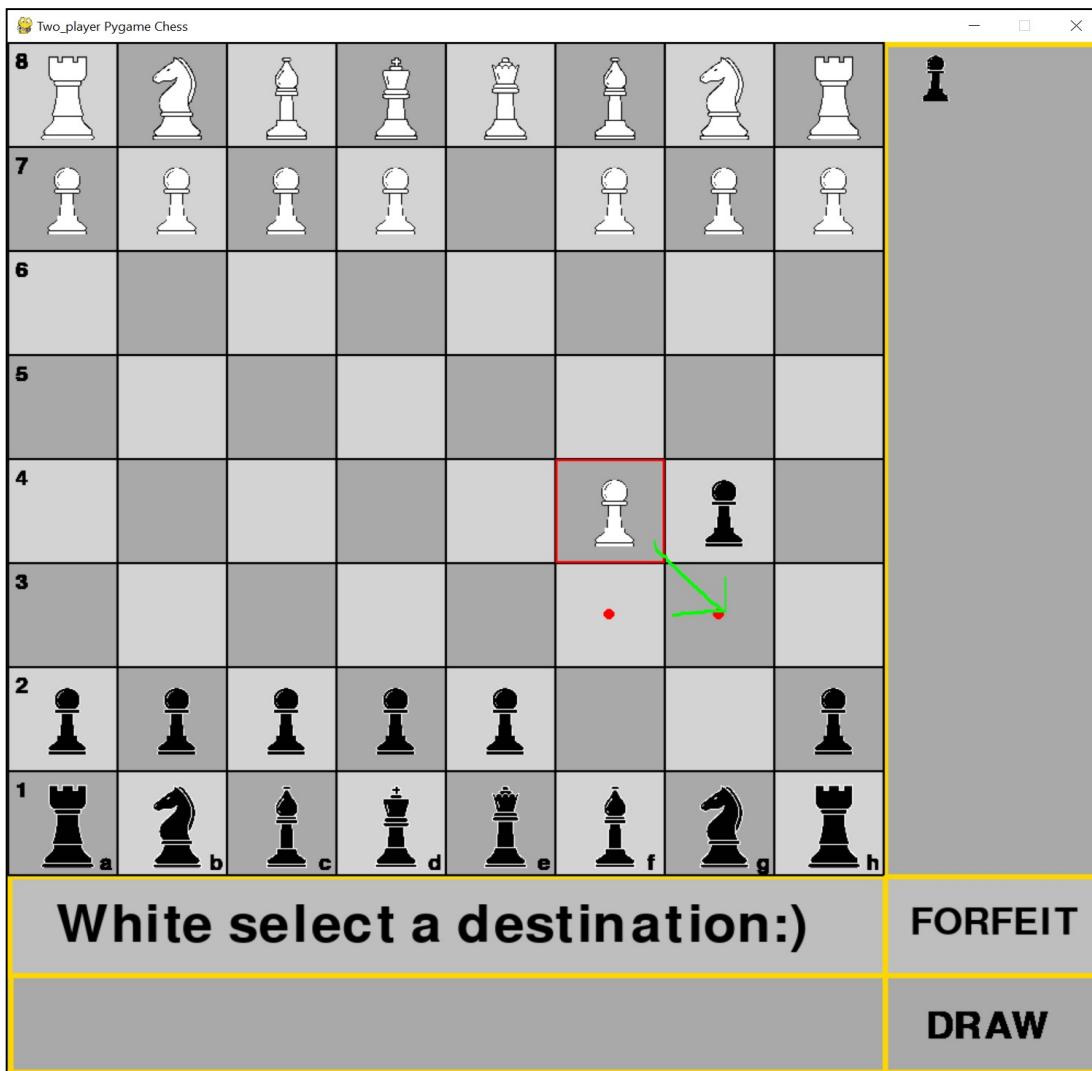


8. **Board Positions :** has been introduced by horizontal and vertical mapping of both x-y axis , just like an original chess board.

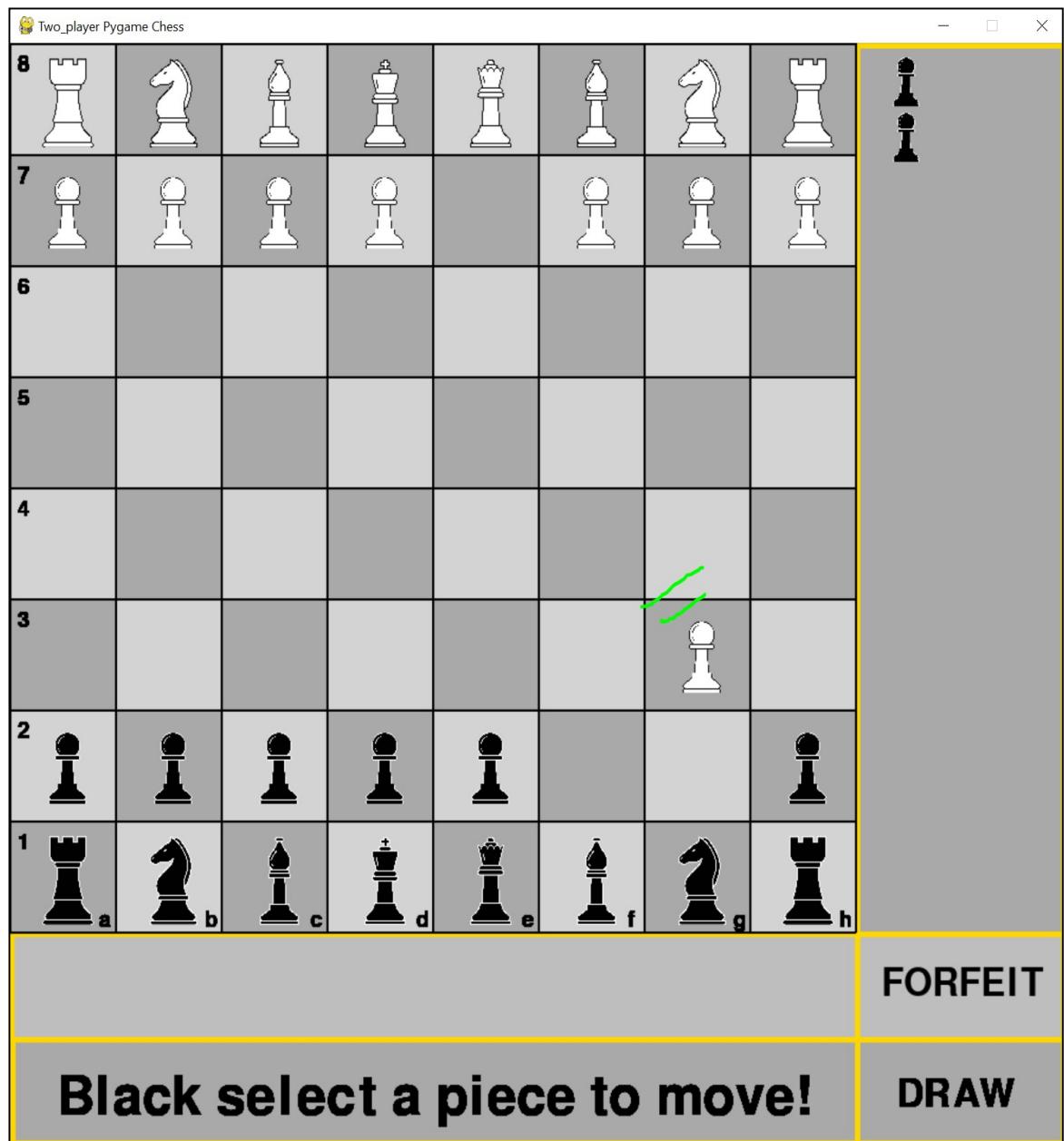
9. **Draw :** The game can also be ended by draw from the mutual understanding of both the players.In the above illustration White king is in check then White offered a draw which prompts up a menu stating the following :

- a. **Enter to draw and restart:** After pressing enter, it means that Black accepted the **DRAW** and game will be restarted.
- b. **Esc to continue the game :** This depicts that Black refused to draw chose to continue the game.

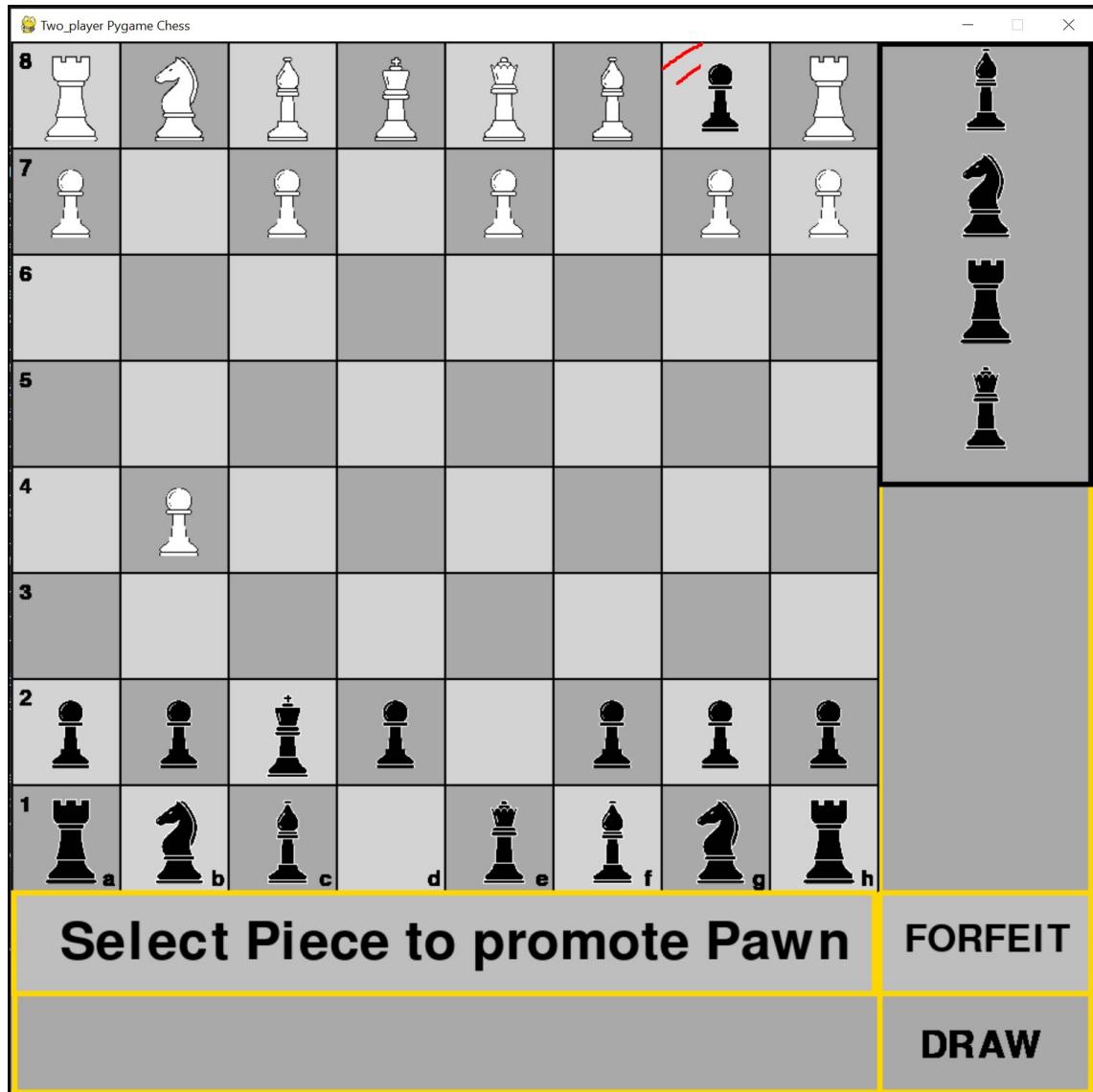
**10. En-Passant :** French word meaning “PASSING BY” . This is the only rule in which the capturing piece does not end up in the place of captured piece. Rule has also been implemented into the game.  
Illustration has been shown below :



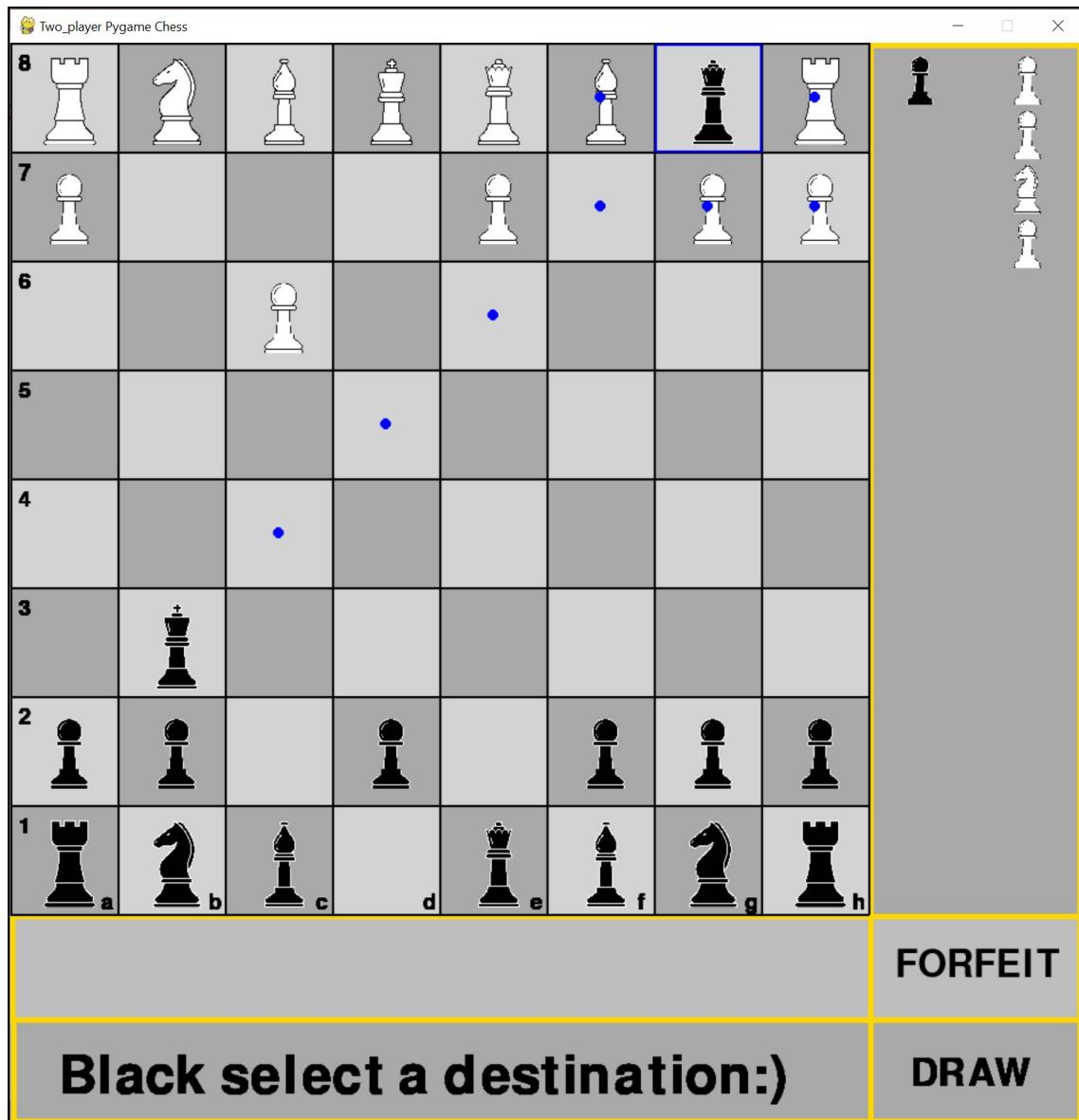
In the above example we have Black pawn who had moves 2 positions from it's initial first position and White pawn is adjacent to it . For one time and one time only White pawn will have a chance to capture the **PASSING PAWN** and taking the place onebelow the black pawn.New position of white pawn after capture is G3. If the white pawn does not capture for that one time availablemove, it will not be shown in valid moves again.



**11. Pawn Promotion :** When the pawn of respective sides reach to the last row of opposite side, it gets promoted to one of the following pieces: Rook, Bishop, Queen or knight.Example given below:



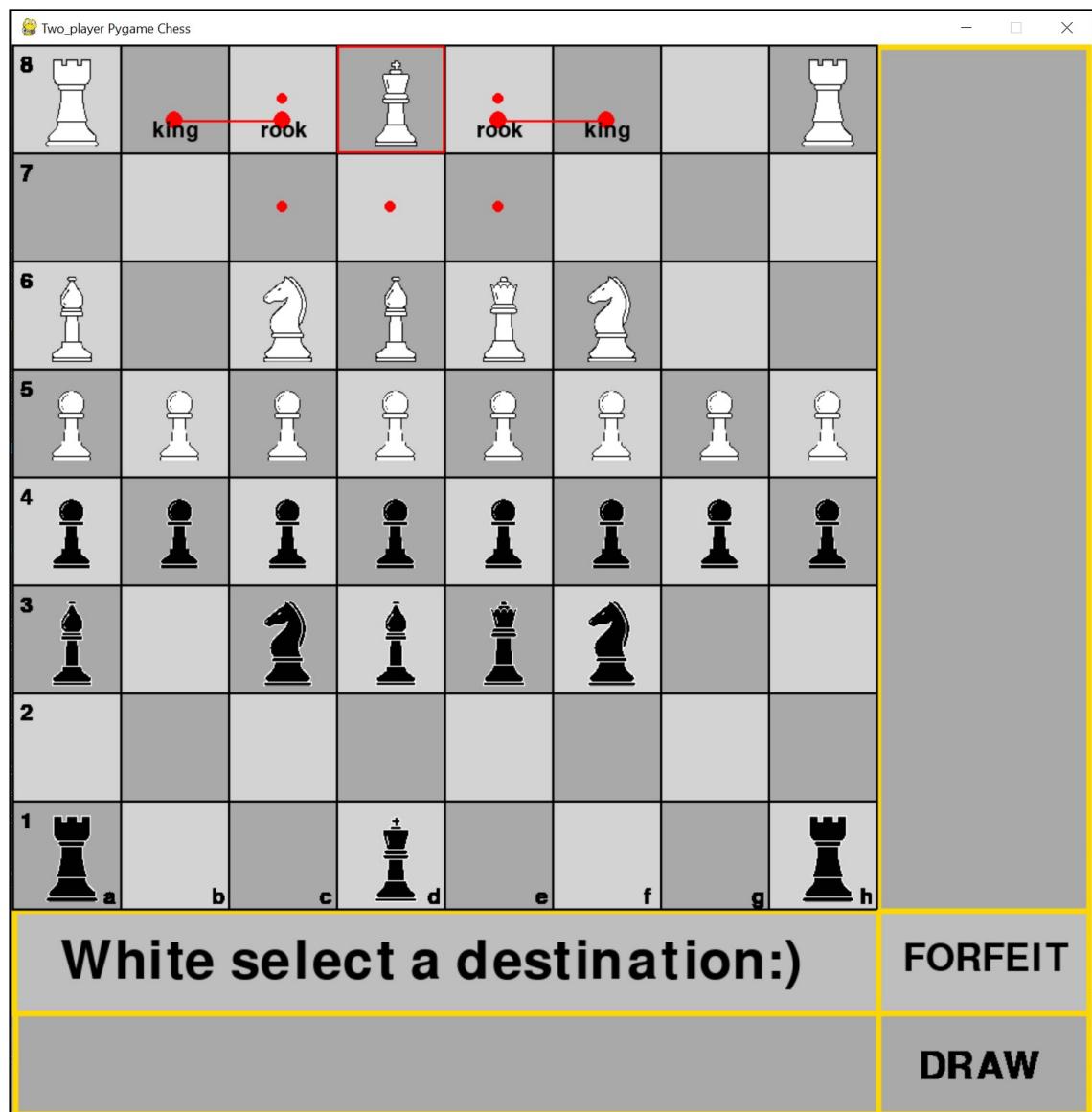
After the black pawn reaches the 8<sup>th</sup> row , we have drop-down menu onthe top right side for pawn promotion.After selecting the desired piece from the manu let's say Queen ,then the quen will take the place of pawn.After black promotion it is white's turn now .Now all the pawn'svalid moves are replaced by than that of queen.This is shown below.



12. **Castling** : Both long(queen-side) and short castling(non-queen side) has also been implemented with all the specified rules. Rules are as follows:

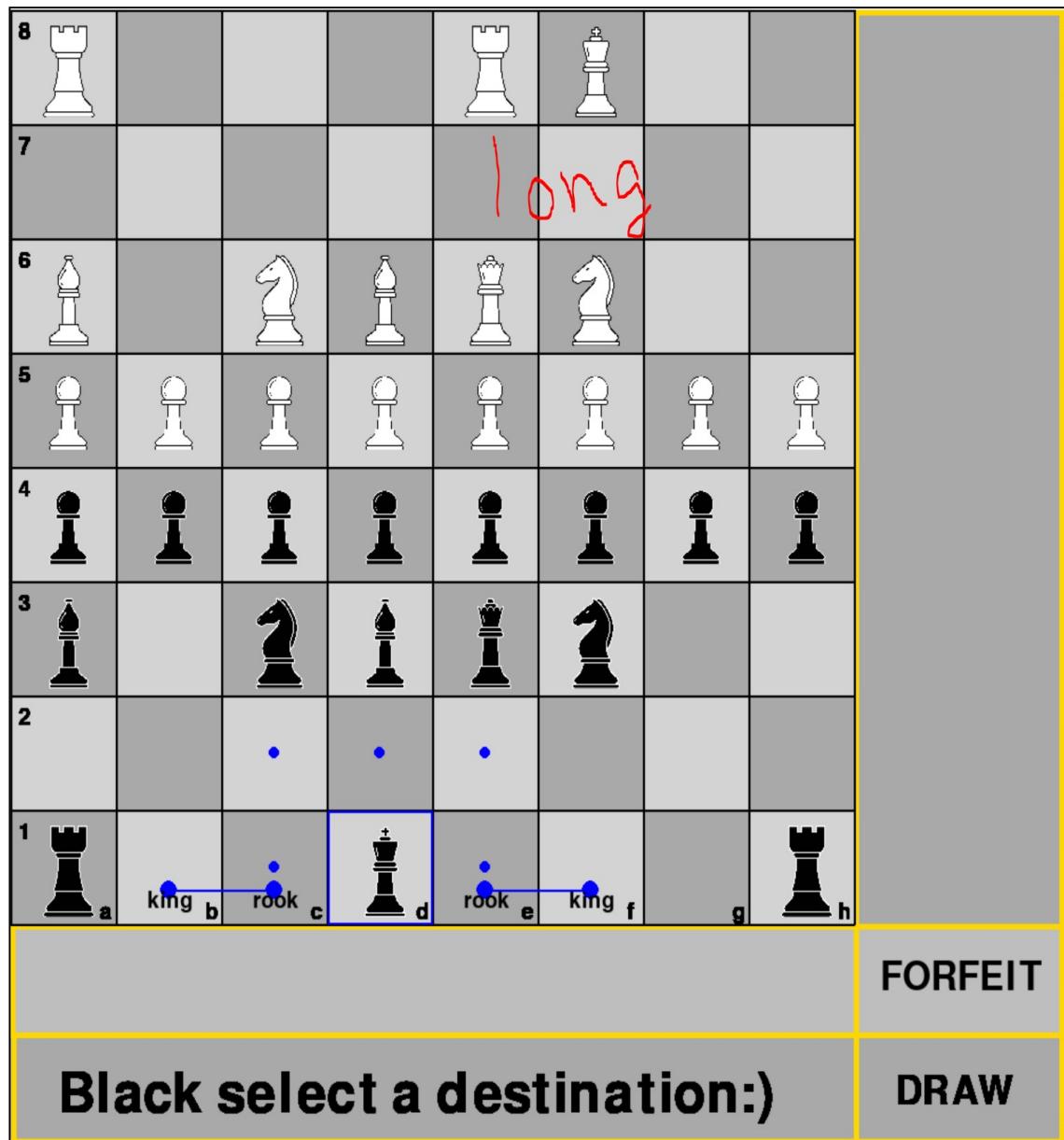
- a. No pieces between the rook and king.
- b. King and rook both have not been move from their intial positions.
- c. King should not be in check
- d. King should not pass through a check

This is only time two pieces can be moves at once. King will move two spaces from the right or left and rook moves over and front of the king allin one move. Only time a piece can go over a piece apart from knight.

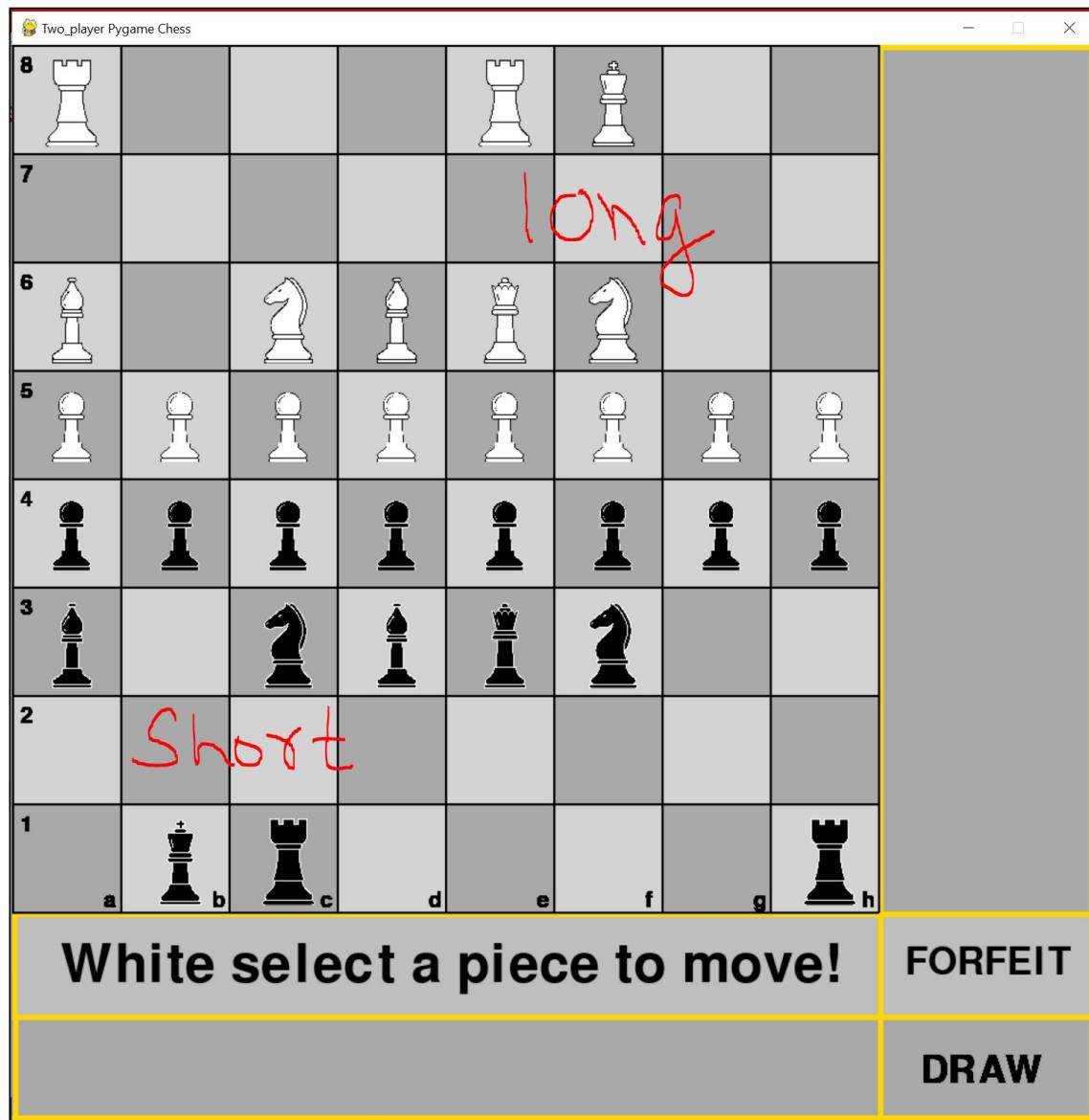


White king have both the options i.e long and short castle. We choose long castle for white king. Also note that apart from castling we have default moves also available from the king.

Below example shows white long castling and black king have both options to castle either or short we choose short this time.



Short Castling by Black and long castling by White :



## FUTURE ENHANCEMENT

The following future features can be added for to increase functionality, performance and to improve the user interface:

1. **Artificial Intelligence** : With **alpha-pruning** techniques of optimal depth we can add “Player vs Computer” feature. We can further enhance the AI by adding **Move Ordering** algorithms that focuses taking expensive pieces like Queen , rook etc taken by a low value piece like pawn.  
Varying of depths vary the difficulty level , more the depth more the difficulty.
2. **Chess Online** : Using socket APIs we can play on the same board from 2 different locations of both players.
3. **Timer**: A clock can be added for both the players to set a time limit.
4. **Moves History** : We can note down the moves made by both the players and show them on a separate list beside the board to review the blunders and mistakes and plan for future moves.
5. **Theme** : A light and dark theme can make the game look better.

## CONCLUSION

In conclusion, this chess project offers a 2 player chess game at low cost of time complexity and in a very efficient manner with all the specified rule including **En-passant , Pawn Promotion and Castling.**

It also provides a user friendly interface with status text and instructions. It also provides a captured piece menu for both the respective players and also flashes a warning box whenever the **King** is in check. It also shows the available moves for the selected piece.

A **DRAW** option is also provided to end the game with a draw or continue.

## **REFERENCES**

1. youtube@lemastertech
2. chess.com
3. google.com

## **PROGRAM EDUCATIONAL OBJECTIVE (PEO)**

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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*By Rohit  
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