Project Report: Chess Piece Image Classification

1. Introduction

Chess, one of the oldest and most intellectually demanding board games, continues to captivate players and researchers alike. Chess piece classification, the task of automatically recognizing and distinguishing different chess pieces on a chessboard, is a fundamental problem in computer vision with applications in chess analysis, game recording, and chess engine development. In recent years, Convolutional Neural Networks (CNNs) have emerged as a powerful tool for image classification tasks, achieving remarkable performance in various domains. The proposed research study highlights the importance of chess piece classification via Convolutional Neural Networks (CNNs) and explores its potential benefits. By leveraging the ability of CNNs to extract complex features from images, chess piece classification can be significantly improved. CNNs can capture local spatial patterns and hierarchical representations, allowing for the accurate identification of chess pieces with high precision and recall. The advantages of CNN-based chess piece classification extend beyond accurate piece recognition. These models can provide valuable insights into game analysis, facilitating move prediction, board evaluation, and player behavior analysis. Furthermore, CNN-based classification can enhance chess recording and broadcasting, enabling real-time annotation of chess games and enhancing the viewing experience for spectators. Overall, this research study underscores the significance of chess piece classification via Convolutional Neural Networks, showcasing its potential to revolutionize various aspects of chess analysis, game recording, and chess engine development, ultimately advancing the understanding and enjoyment of this timeless game.

2. Related Work

1.Brandon Sean Kong, Irwandi Hipiny and Hamimah Ujir, "Classification of Digital Chess Pieces and Board Position using SIFT", *2021 IEEE International Conference on Signal and Image Processing Applications (ICSIPA)*, pp. 66-71, 2021.

2.G. Larregay, L. Avila and O. Moran, "A comparison of classification algorithms for chess pieces detection", *2017 XVII Workshop on Information Processing and Control (RPIC)*, pp. 1-5, 2017.

3.Maciej Czyzewski, Artur Laskowski and Szymon Wasik, *Chessboard and chess piece recognition with the support of neural networks*, 2018.

4.Y.-A. Wei, T.-W. Huang, H.-T. Chen and J. Liu, "Chess recognition from a single depth image", *Proceedings of the IEEE International Conference on Multimedia and Expo*, pp. 931-936, 10–14 July 2017.

3. Materials and Experimental Evaluation

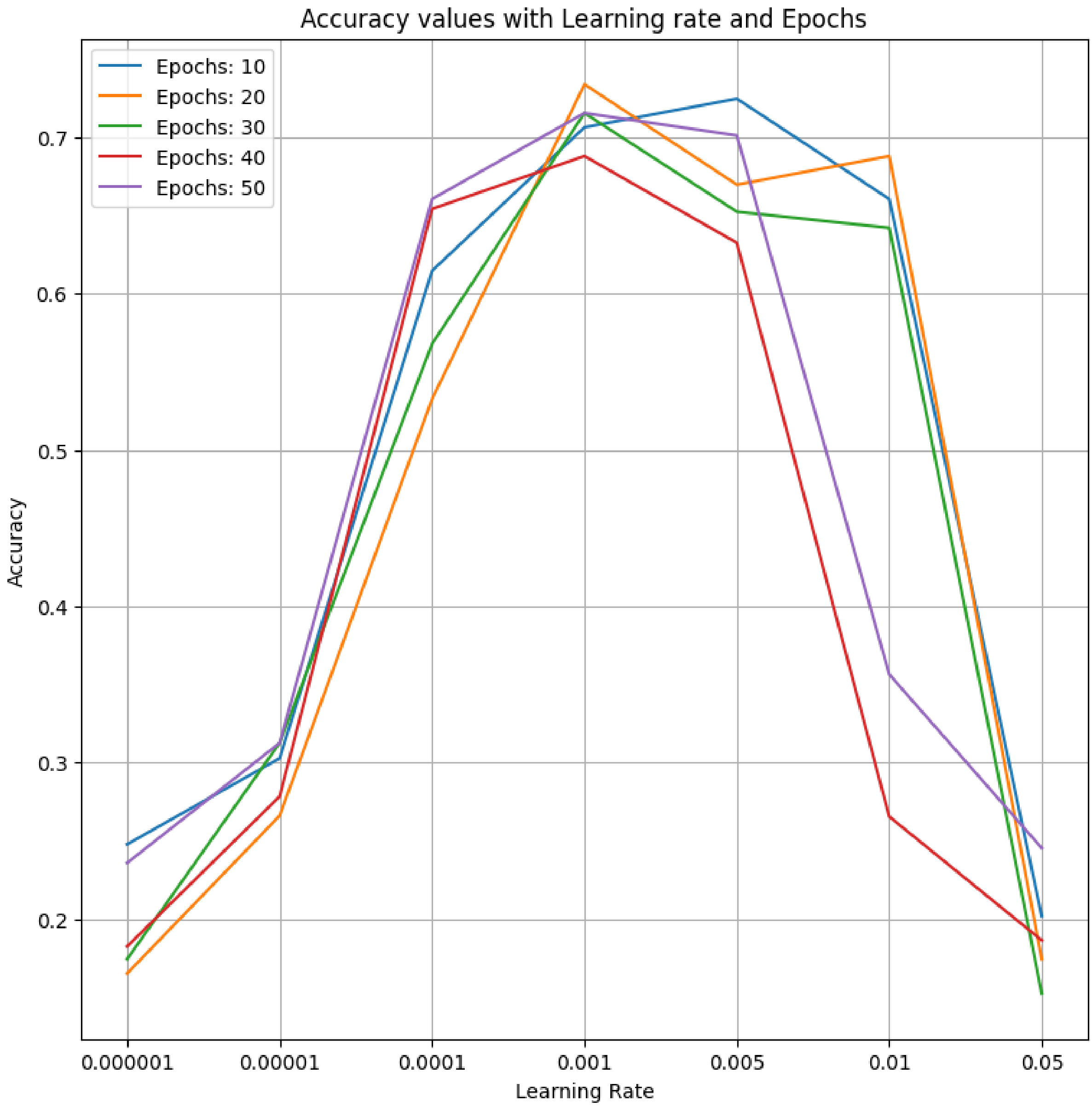
3.1 Dataset

1. Dataset source is https://www.kaggle.com/datasets/imtkaggleteam/chess-pieces-detection-image-dataset
2. Image dataset :The dataset used in this project contains images of chess pieces, categorised into six classes: Bishop, King, Knight, Pawn, Queen and Rook. These images may vary in size, quality, and orientation, presenting real-world challenges for classification.
3. Preprocessing: used original dataset
4. Number of Classes: There are 06 different classes in the data.
5. Class Distribution: Bishop=16%, King=14%,Knight=19%,Pawn=19%,Queen=19% and Rook=18%
6. Training and validation: used 80% of the data for training and 20% for Validation

3.2 Methodology

In this MobilenetV2 model is used.MobileNetV2 can be used **for transfer learning**. Its lightweight architecture and pre-trained models make it an excellent choice for fine-tuning on specific tasks or datasets.

Initially a basic model is created with the number of classes (in this case : 6 classes) with the help of pretrained models.The activation is **relu** in case of layers in the pretrained models and the activation is **softmax** in the final layer.After this an optimizer is selected to minimise the loss function during the training process.To create the image classification model the hyper parameters selected are: Epochs,Learning-rate.Based on the validation accuracy of various combinations of the hyper parameters (the table is given CSV file) for the 06 classes.



3.3 Results

Classification report:

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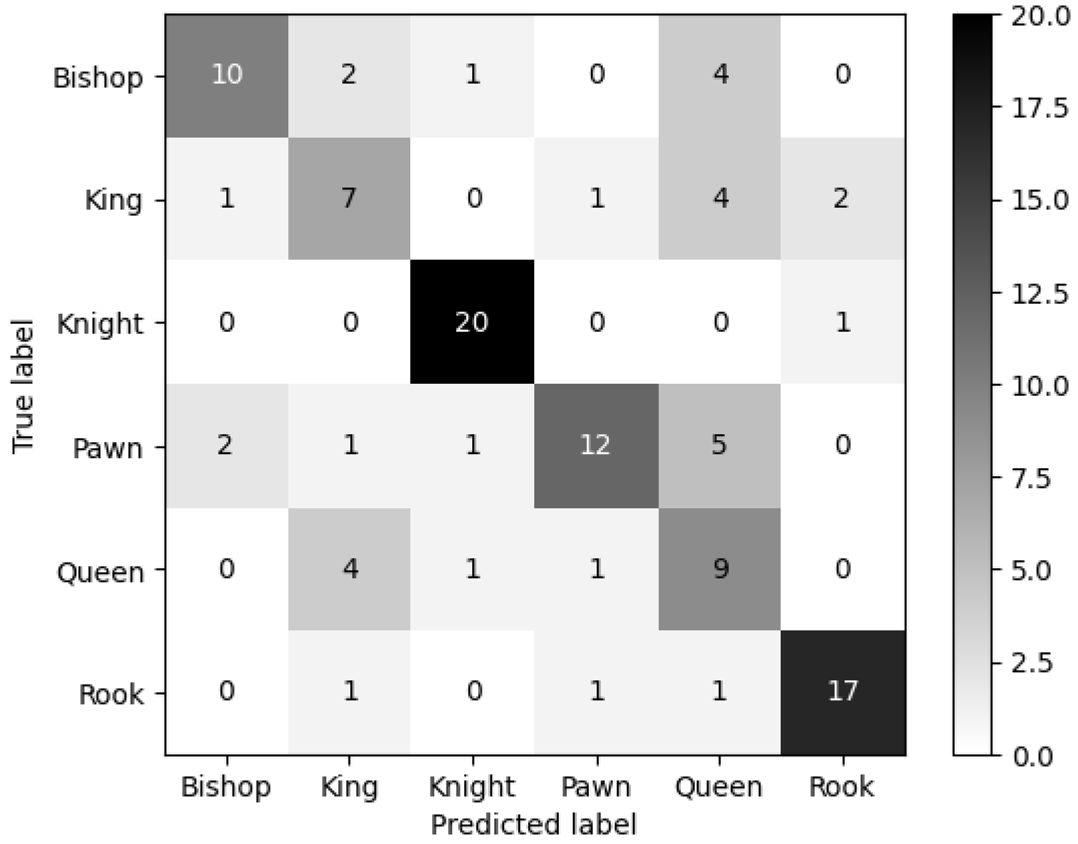
Classification Report :
              precision    recall  f1-score   support

           0       0.73      0.65      0.69        17
           1       0.53      0.60      0.56        15
           2       0.77      0.95      0.85        21
           3       0.76      0.62      0.68        21
           4       0.64      0.47      0.54        15
           5       0.83      0.95      0.88        20

    accuracy                           0.72       109
   macro avg       0.71      0.71      0.70       109
weighted avg       0.72      0.72      0.72       109
```

Confusion Matrix:



3.4 Discussion

The results are acceptable but not that much accurate, if the image alignment is changed, features are changed as the dataset is used as it is without preprocessing.

4. Future Work

The results imply that to improve the accuracy to some extent, the model has to be trained with the dataset (by increasing the number of images), by augmenting the images during the preprocessing. so that the model can mitigate the weakness and improve the prediction accuracy.

5. Conclusion

With the application/ implementation of MobilenetV2 which is a light weight convolutional layered network, using an optimiser, by tuning the hyper parameters to the optimal combination, the model gave better results with average prediction accuracy of 72%.

6.Reference

1.Brandon Sean Kong, Irwandi Hipiny and Hamimah Ujir, "Classification of Digital Chess Pieces and Board Position using SIFT", *2021 IEEE International Conference on Signal and Image Processing Applications (ICSIPA)*, pp. 66-71, 2021.

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