THE AMERICAN UNIVERSITY IN CAIRO

Arabic Language Classification

Advanced Machine Learning – CSCE4604

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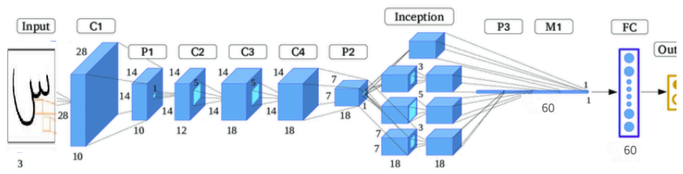
Problem Statement

Arabic handwriting recognition presents unique challenges due to its cursive nature and character variability, which have hindered the development of robust recognition models. Our project aims to address these challenges by evaluating existing models on datasets and proposing enhancements to improve accuracy and efficiency in Arabic text recognition systems.

Original Model

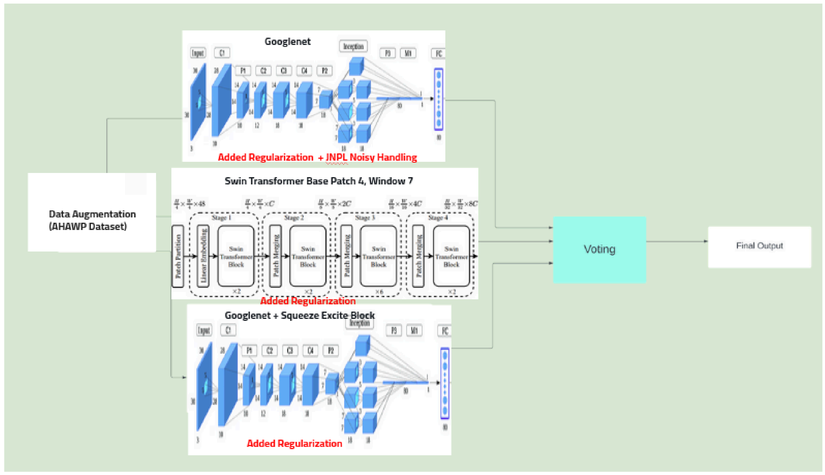
The GoogleNet model was chosen for its alignment with our research direction of incorporating an noisy label mechanisms and vision transformers mechanisms for arabic letter classification. It has straightforward architecture for easier understanding and updates, user-friendly implementation, and efficiency in training. Also, it includes minimal file count and use of recent frameworks, and It got the highest accuracy in past papers.



Updates

- Run the Model on AHAWP Dataset.
- Use Regularization Techniques, a Learning Rate Scheduler, and data augmentation techniques.
- Apply the proposed noisy labels handling mechanisms.
- Try different attention mechanisms to test its affect on the model performance
- Try different Vision Transfer Learning architecures.
- Use ensemble classifier.
- Try to use OCR Techniques to validate whole words.

Final Model Architecture



Dataset

The selected dataset was AHAWP. It comprises 65 distinct Arabic characters, capturing their variations at the beginning, middle, end, and in isolation, alongside 10 unique Arabic words that collectively include all the characters, and 3 distinct paragraphs. The size of these datasets is not large. As a result, training will not take a huge time and we will not face memory issues. Also, because of its good size, we can run the model on some online platforms such as google collab for training and testing. The number of images in these dataset is very good and we will be able to build a good model based on it. The existing Arabic alphabet identication datasets (Hijja, AHCD datasets) do not provide any user information. The existing writer identication of Arabic text datasets (IFN/ENI, KHAT, QUWI datasets) only provide handwritten words or paragraphs and do not contain alphabets. This dataset fills in this gap.

Ain Regular

Saad Begin

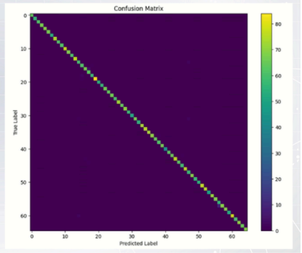
Results

After finishing all of our updates, we found that the ensemble classifier of the original model + regularization + JNPL, Swin Transformer and excitation blocks has the highest accuracy with a good balance between precision, recall, and accuracy. So, we selected it as our final model.

Results:

- Testing Accuracy= 0.9931
- Weighted Precision= 0.9933
- Unweighted Precision = 0.9932
- Weighted Recall = 0.9931
- Unweighted Recall=0.9932
- F-1 Score=0.9931

- Confusion Matrix:



Conclusion

- Deep Learning is mainly about trial and error.
- Detecting a whole “Arabic” word or paragraph is very challenging as Arabic is RTL.

Future Work

- Trying the same problem approach but on Arabic Paragraphs.
- Try to use RNNs.

Lessons Learned

- Attention mechanisms, Noisy Label Handling mechanisms.
- Transfer Learning, Vision Transformers, and YOLO.
- Always make checkpoints.

References

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