

CHAPTER I

INTRODUCTION

1.1 Background

Khat naskhi and riqah are types of khat (handwritten in Arabic) which are generally used in the art of calligraphy and writing important documents in the Islamic world. The classification of naskhi and riqah khat can be done manually by calligraphers or handwriting experts ¹, but it takes quite a long time and experience and is expensive.

In recent years, deep learning technology has become popular for solving image classification problems, including the classification of khat naskhi and riqah. One of the techniques that has been developed is the use of artificial neural networks (neural networks), especially with the convolutional neural network (CNN) architecture to carry out the classification of naskhi and riqah khat automatically.

However, the existing CNN architecture is still quite complex and requires considerable computational resources ², especially when implemented on resource-constraining devices such as mobile devices or embedded systems. Therefore, it is necessary to conduct research and development of a lighter and more efficient CNN architecture for naskhi and riqah khat classification so that it can be implemented on these devices.

In addition, the classification of naskhi and riqah khat also has several challenges such as variations in writing style, variations in size and rotation, and the presence of noise or disturbance in the image. Therefore,

¹ Siti Lathifatus, "KHAT IN SUPPORTING ARABIC BIBLE PROFICIENCY," *The Synergy of the Roles of Teachers and Parents in Learning During the Covid Pandemic* 2, no. November (2019): 1–16.

² Jiaqi Shao et al., "A Lightweight Convolutional Neural Network Based on Visual Attention for SAR Image Target Classification," *Sensors (Switzerland)* 18, no. 9 (2018), <https://doi.org/10.3390/s18093039>.

it is also necessary to develop appropriate pre-processing techniques to overcome these problems so that the classification results are more accurate. In conclusion, the problem of classifying khat naskhi and riqah using deep learning technology, especially the CNN architecture, has several challenges and needs to be developed further to create a more efficient and accurate model to be implemented on devices that have limited resources and in areas that have wide internet connection coverage. minimal.

Lightweight CNN or lightweight CNN can be the right choice in overcoming these technical challenges. CNN's Lightweight architecture allows models to run on simpler devices such as smartphones or tablets, without sacrificing performance or accuracy. In addition, Lightweight CNN can process data quickly and efficiently, making it possible to process data in real-time. Another advantage of using lightweight CNN is the ability to adapt to different variations of writing styles of naskhi and riqah, as well as variations in size and rotation of written images. With the data augmentation technique, the Lightweight CNN model can be trained with a variety of image data, thereby increasing the accuracy and generalization of the model to different data variations. In addition, by fine-tuning the Lightweight CNN model, the model can be adjusted to study the special features of different writing styles, naskhi and riqah. By using CNN lightweight technology, the development of the naskhi and riqah khat classification models becomes more efficient and effective, and can improve the accuracy and performance of the model in recognizing different variations of writing styles.³

In addition, the selection of datasets used to train the model also needs attention. Datasets that are not representative or large enough can result in inaccurate models. Therefore, researchers need to look for a dataset that includes a wide variety of writing styles of khat naskhi and riqah, and has a large enough size to train an accurate model. In addition to technical challenges and other factors, the use of deep learning technology for naskhi and riqah khat classification also raises several ethical questions. For

³ Edo Prasetyo N. A Wijaya, "Classification of the Javanese script with Cnn," *Teknika Journal* 12, no. 2 (2020): 61, <https://doi.org/10.30736/jt.v13i2.479>.

example, should the developed model take into account the differences in writing styles from different countries or only take into account only one type of writing style? Will the use of this technology threaten the profession of calligraphers and handwriting specialists, or can it help them expand their market and create new innovations?

In the hadith narrated by Muslims, the importance of developing knowledge in various sectors has also been conveyed.

رِيَّةٍ أَوْ عِلْمٍ يُنْتَفَعُ بِهِ أَوْ وَلَدٍ صَالِحٍ يَدْعُو لَهُ

Meaning: “When a human being dies, all his deeds are cut off from him except for three things; from charity or knowledge that benefits or a pious child who prays for him.” (HR Muslim no. 1631).

In making the Lightweight CNN model, care needs to be applied so that the model does not pose a danger to the human profession. Lightweight CNNs designed must take into account factors such as accuracy, security and stability. In addition, the use of data used to train the model must be considered carefully so that there are no unwanted biases in decision making. Moreover, when creating a Lightweight CNN model that will be used to make critical decisions such as in the arts or in human professions, it becomes increasingly important to take care to ensure the safety and usability of the model. Therefore, as a Lightweight CNN model designer, it is necessary to pay attention to every detail and evaluate the model regularly to minimize risks and maintain human safety, this is in line with QS. Al-Isra: 7 which explains the importance of being careful in doing and creating new knowledge.

مَرَّةٍ وَلِيَتَّبِعُوا مَا عَلَّمُوا تَتَّبِعُوا Allah???

Meaning: “If you do good (means) you do good for yourself. And if you do evil, then (the loss of evil) is for yourself. When the second punishment (crime) comes, (We raise up your enemies) to darken your faces then they enter the mosque (Masjidil Aqsa), as when they entered it the first time and they destroyed whatever they controlled.” (QS. al-Isra’: 7)

Therefore, developing a khat naskhi and riqah classification model using deep learning technology needs to take into account technical challenges and other factors, as well as relevant ethical considerations.

⁴Several solutions that can be taken to overcome the challenges and factors that have been mentioned in the development of the khat naskhi and riqah classification models using the CNN architecture include:

1. Development of a lighter and more efficient CNN architecture, such as using pruning or quantization techniques to reduce model size without reducing accuracy.
2. Development of appropriate pre-processing techniques to overcome variations in size and rotation, as well as eliminate noise or disturbances in images.
3. Selection of a dataset that is representative and large enough to train an accurate model capable of dealing with variations in writing styles of naskhi and riqah khat.
4. Conduct careful evaluation and validation of the developed model, including testing on different datasets and testing on different variations of writing styles.
5. Paying attention to ethical considerations in the use of deep learning technology for naskhi and riqah khat classification, taking into account the needs of calligraphy and handwriting experts, and creating new innovations that can help the development of calligraphy art.

By taking these solutions, it is hoped that the development of khat naskhi and riqah classification models using deep learning technology can produce models that are more efficient, accurate, and can be implemented on devices with limited resources, while taking into account relevant ethical considerations.

⁴ Sebastián Salazar-Colores et al., "Efficient Single Image Dehazing by Modifying the Dark Channel Prior," *Eurasip Journal on Image and Video Processing* 2019, no. 1 (2019), <https://doi.org/10.1186/s13640-019-0447-2>.

1.2 Problem Formulation

Based on the background explanation, the formulation of the problem in this study can be obtained, that the use of conventional CNN architecture to classify images takes a lot of time and resources so that it is less effective in applying limited resources.

Therefore the use of the Lightweight CNN architecture can be a good choice to be applied to the Naskhi and Riq'ah khat classification because it has a fast training time, higher inference speed, compared to previous studies and the ability to run on devices with limited resources such as hardware devices. mobile.

1.3 Problem Limitation

In preparing this thesis, the scope of writing is limited to matters concerning the following problems;

1. The object of this research is the image of Naskhi and Riq'ah khat.
2. This research is limited to the classification of Naskhi and Riq'ah khat imagery.
3. The dataset used is Naskhi and Riq'ah khat image data that have been collected by previous researchers with a total of 200 image data taken from secondary data collection in Ridho's research ⁵.
4. This research only classifies Naskhi and Riq'ah khat using the Lightweight CNN architecture, does not include implementation on products such as mobile applications.

1.4 Research Objectives

From the formulation of the problem that has been described above, the objectives of the research conducted are as follows:

1. Creating an optimal architectural model with fast processing time in this case the Naskhi and Riq'ah khat classification

⁵ Oddy Virgantara Putra et al., "Classification of Calligraphy Writing Types Using Convolutional Neural Network Method (CNN)," *Procedia of Engineering and Life Science* 2, no. 1 (2021): 2–8, <https://doi.org/10.21070/pels.v2i0.1136>.

2. Get the best results from the classification of Naskhi and Riq'ah khat with convolution layer modifications.

1.5 Purpose of Research

The expected benefits of this research are as follows:

General purpose:

Implementing the Lightweight CNN architectural model for Naskhi and Riq'ah khat classification with the addition of *depthwise convolution* to reduce the number of parameters and speed up model training so that it can be applied to devices with limited resources.

Special purpose:

1. As a requirement to fulfill the final assignment of lectures or thesis.
2. Add experience and skills so as to increase interest and talent in exploring and being creative.
3. Add insight and variety of research studies on *Machine Learning* and *Deep Learning*.
4. Understanding problems that can be solved with effective and solutive solutions.