OPTIMIZATION OF TEXT MINING DETECTION OF TAJWEED READING LAWS USING THE YOLOV8 METHOD ON THE QUR'AN

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Abstract: The science of tajweed is a science that studies how to read the letters or readings in the Qur'an beautifully or well by the legal rules regulated therein. However, many people still do not pay attention to the legal rules of tajweed when reading the Qur'an, so it is not uncommon for them to make mistakes in pronunciation. From the legal rules of Tajweed reading, the slightest difference will change the meaning and intended meaning of the reading. So, paying attention to every rule of the law of reading Tajweed is very important. Therefore, considering the current technological advances, we plan a tajweed detection design using the YOLO algorithm optimized for the Qur'an. This study aims to determine and analyze the detection of text mining on tajweed reading. The method used in this study is the YOLO Algorithm method. This research uses 210 images of the Mushaf Al-Qur'an dataset, tested twice using Augmentation and Non-Augmentation to get optimal research results. The dataset underwent a training process of 138 images, or about 66%, and a validation process of 48 images, about 28%, and 24 images, or 11% of the total sample. Of the two tests using augmentation with no augmentation, augmentation testing produces the highest precision value with a value of 0.985 or 98.5% and the highest mAP50 with a value of 0995 or 99.5% for the Lafdzul Jalalah class group, with a total accuracy value of 92.94%. For testing without augmentation, the results show that the highest mAP50 value is the Lafdzul Jalalah class, with a value of 0.974 or 97.40% and an accuracy value of 91.37%. Based on optimization and comparison carried out for the accuracy value of research with augmentation of 92.94% and research conducted without augmentation is 91.37%. So, the study's results obtained an increased value of 1.57% by performing greyscale augmentation.

Keywords: Tajweed, Detection, Algorithm, Yolov8, Al-Qur'an

INTRODUCTION

According to Arifin (2021), in his journal entitled "Solutions to IT Problems in Islamic Education," the problematic development of technology in Islamic education is caused by the fact that most Muslims tend to pay less attention to the progress of modern science. Technically, the backwardness of Islamic education in the IT field is due to the weakness of human resources in mastering IT and infrastructure or IT devices that have not been well supported.

In this research, the author wants to optimize the detection of Tajweed reading laws in the Qur'an using the YOLOv8 method. The background is the rapid development of digital technology today, where speed and accuracy in carrying out activities are very important. Object detection with the YOLO (You Only Look Once) method is very suitable for real-time applications, such as object detection in videos. The author wants to apply the YOLOv8 method to detect Tajweed reading laws in the Qur'an.

Tajweed is a science in Islam that explains the rules of reading the Qur'an properly and correctly (Rahma & Zahroh, 2019). There are various reading laws in Tajweed, such as Idzhar, Idgham, Ikhfa, Iqlab, Qalqalah, and others (Hasibuan, 2014). Previous research used the YOLOv3 method for object detection, such as detecting helmets and motorcycle license plates or for accident analysis in dashcam videos. This YOLOv8 method will detect Tajweed reading laws in the Qur'an.

According to (Wang et al., 2020), in their research entitled "XYOLO: A deep learning-based toolset with multiple optimization strategies for contraband detection," to overcome the problem that Intersection over Union (IoU) cannot handle two non-overlapping objects, we apply Generalized Intersection over Union (GIoU) as a loss-limiting box. The experimental results show that X-YOLO achieves mAP up to 96.02% and recall up to 98.55%, surpassing Faster RCNN, SSD, YOLOv1, YOLOv2, Tiny-YOLO, YOLOv3, YOLOv3-tiny, YOLOv3-spp, and YOLOv3 with multiple optimization strategies. This optimization will involve using YOLO (You Only Look Once) and appropriate datasets. The author hopes that the results of this optimization can provide a high level of accuracy in Tajweed reading law detection.

Object detection is useful for recognizing and detecting objects in an image based on color, shape, and from the collected dataset (Fan et al., 2021; Lusiana et al., 2023). There are several kinds of object detection applications, one of which uses the Convolutional Neural Network (CNN) method and the You Only Look Once (YOLO) method (Abuzairi et al., 2021; Sarosa & Muna, 2021). The YOLO method detection system is proven to be faster and more accurate for detecting objects in images or images, so it is most suitable if applied to real-time object detection in videos (Mulyana & Rofik, 2022; Setyawan et al., 2021).

In real-time object detection, speed is very important because it is different in an image. A video can process more than 24 frames per second (FPS) or 24 frames per second. The resulting video is not good if the object detection process is too long. Each frame will be delayed, breaking the video (Ding et al., 2019). Using object detectors is very helpful in daily work, not infrequently. Many cases can be applied using object detection, such as electronic tickets counting the number of visitors present at an exhibition or event. In this case, the author tries to develop the detection of an object to be applied to the tajweed detector in the Qur'an.

This research has a function, namely, to change the stigma in the general public that technological science is quite difficult if implemented in the field of education, especially religion, to get the optimization value of the optimal tajweed reading text detection process, to find out the results of the accuracy value and the mapped value of the tajweed reading law detection process. In this study, the authors will optimize the text mining detection of tajweed reading laws using the YOLO (You Only Look Once) method version 8.

METHODS

This research belongs to quantitative research. The research method to be used in the optimization of Tajweed reading law detection using the YOLOv8 method on the Qur'an can involve the following steps:

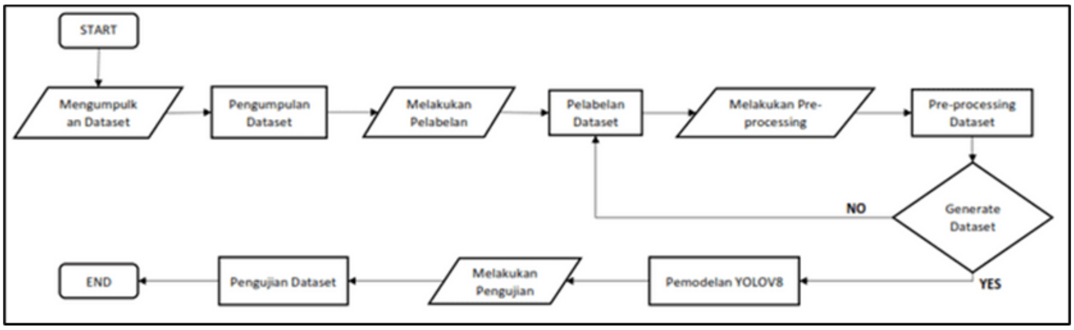

Figure 1. Process Design Diagram

Dataset Collection

The data collection technique in this research uses a literature study. This research requires a dataset that includes images of the Qur'an containing the writings of the Tajweed reading laws. This dataset should include a wide variety of Tajweed reading laws to be detected. The data can be collected from various sources, such as the Al-Qur'an Online application or relevant digital sources. The author uses sample data from as many as 210 Al-Qur'an mushaf images in this research.

Figure 2. Dataset of Al-Qur'an Mushaf

Dataset Labeling

The collected dataset needs to be prepared before proceeding with the pre-processing stage. At this stage, the dataset that has been owned is then subjected to a dataset labeling process. Labeling or annotation is the stage of tagging or detecting sample data. In this stage, data labeling involves a web platform, Roboflow. The dataset that is owned is then uploaded to Roboflow. After it is successful, labeling or annotation can be done on each dataset image, such as normalizing the image size, cutting the image into relevant parts, and annotating the data to mark the Tajweed reading law area on each image.

Figure 3. Labeling of Al-Qur'an Image Dataset

Pre-processing

Dataset pre-processing is a technique applied to remove noise, missing values, and inconsistent data (Nugraha et al., 2022). Some widely used pre-processing steps are grayscale, resize, and augmentation.

Grayscale

Grayscale is an image technique that displays the gray color resulting from averaging RGB images (Fadjeri et al., 2022).

Resize

Resize is a technique to reduce an image's size to speed up the process (Ilyas, 2020).

Augmentation

Augmentation is a data processing technique that enhances image variety by manipulating the dimensional transformation of images (Sanjaya & Ayub, 2020). In addition to these techniques, in the Roboflow platform, several techniques can be used to maximize the accuracy of image detection.

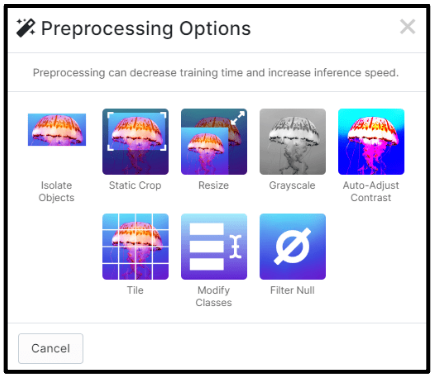

Figure 4. Pre-Processing menu in Roboflow

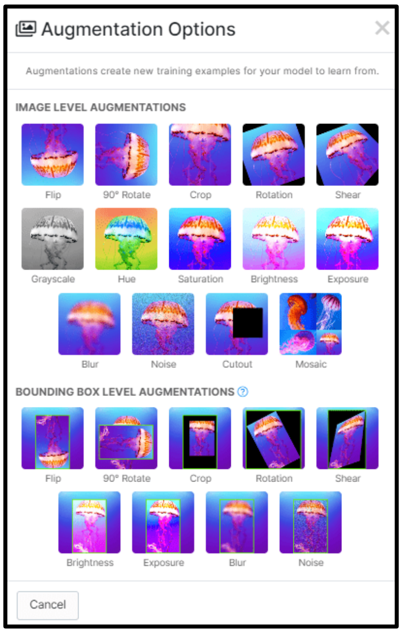

Figure 5. Augmentation menu in Roboflow

Generate Dataset

Generate Dataset is a process where the dataset has completed the labeling and pre-processing process, then the process of generating the dataset, which will continue the modeling process (Rizki et al., 2021). The resulting model needs to be evaluated to ensure the quality of detection. This involves using the Google Colab application to perform the modeling.

Figure 6. Generate Tools

YOLOV8 Modeling

YOLO (You Only Look Once) is one of the one-stage object detection algorithms (Thoriq et al., 2023). According to Armalivia (2021), Yolo has a high computational speed and can process images in real time. In YOLO, separate object detection components are united in one artificial neural network. Thus, YOLO allows end-to-end training and obtains high speed while maintaining a fairly high precision value. In general, the model and architecture of the YOLO network can be seen in Figure 7. YOLO divides the image into S x S grids.

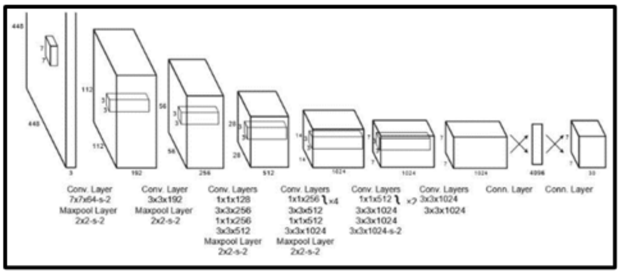

Figure 7. YOLO Architecture

If the center of an object is in a particular grid cell, then that grid cell has the task of detecting the object. Each grid cell predicts several bounding boxes. YOLO will predict the class of the detected object and its bounding box. Each bounding box predicts five variables: x, y, w, h, and the confidence value. The x and y coordinates represent the center point of an object, while width (w) and height (h) are the width and height of the bounding box of the entire object. If an object is detected, the confidence value represents the IOU between the predicted and ground truth boxes (Khairunnas et al., 2021). Some of the main reasons why you should consider using YOLOv8 for a project to design a detection program:

1. YOLOv8 has a high level of accuracy measured with COCO and Roboflow 100 (Hidayatulloh, 2021)
2. YOLOv8 has many developer-friendly features, from an easy-to-use CLI to well-structured Python packages.

3. Having a large community or forum means that many people in the computer vision circle may be able to help if they have difficulties or need guidance.

4. YOLOv8 achieved strong accuracy at COCO (V et al., 2022). For example, when measured on COCO, the YOLOv8m medium model achieved 50.2% mAP. When evaluated against Roboflow 100, a dataset that specifically evaluates model performance on various task-specific domains, YOLOv8 scores much better than YOLOv5.

5. In addition, the developer convenience features in YOLOv8 are significant. Unlike other models, where tasks are divided into many different Python files that can be run, YOLOv8 has a CLI that makes model training more intuitive. This is in addition to the Python package, which provides greater ease of coding than previous models.

YOLOv8 has a command-line interface that trains, validates, or infers models for various tasks and versions. The CLI requires no customization or code. It can run all tasks from the terminal.

RESULTS AND DISCUSSIONS

Result

In this study, the expected results are the optimization of the real-time Tajweed reading law detection system using the YOLOv8 method on the Al-Qur'an. Based on the research process, the author divides this research into three stages, namely:

First Stage

The first stage of this research is processing the dataset, from collecting the Al-Qur'an image dataset, labeling according to the Tajweed detection label, and pre-processing the image to generating the dataset. Here is the flowchart for the dataset process.

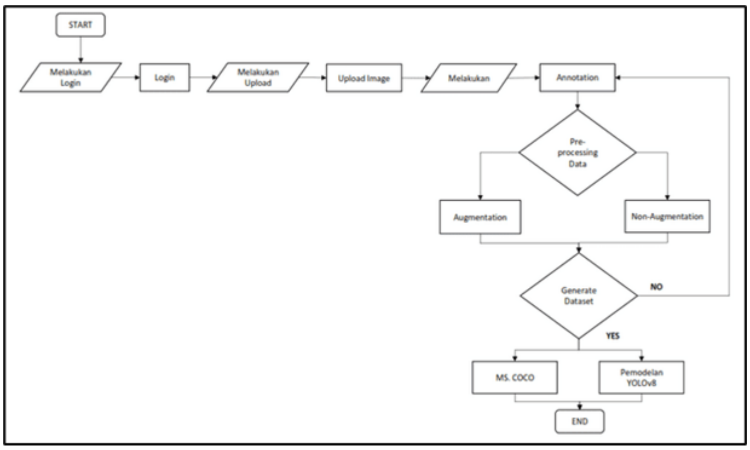

Figure 8. Dataset Processing Flow

In this study, the author used a sample of 210 Al-Qur'an mushaf images. Furthermore, this image sample is uploaded to the Roboflow website, and then the dataset labeling and pre-processing process is carried out. The dataset will be classified into each class according to the type of Tajweed reading law. The author makes the classification of Tajweed law classes as follows:

Table 1. Classification of Tajweed Classes

Number	Rulings of Tajweed
1	Idgham Bighunah
2	Idgham Bilaghunah
3	Iqlab
4	Lafdzul Jalalah
5	Mad Arid Lisukun
6	Mad Iwad
7	Mad Jaiz Munfashil
8	Mad Lin
9	Mad Wajib Munttashil
10	Qalqalah

The author makes ten classes of tajweed types from the sample data of 210 Al-Qur'an images. The next process is to determine the labeling or annotation of each verse contained in the Al-Qur'an mushaf according to the class that has been created. This labeling is done in the Roboflow application. In roboflow annotation, several tools can facilitate the annotation or labeling process. These tools are the drag tool, the bounding box tool, the polygon tool, and the smart polygon. In this research, the author utilizes the bounding box tool for labeling.

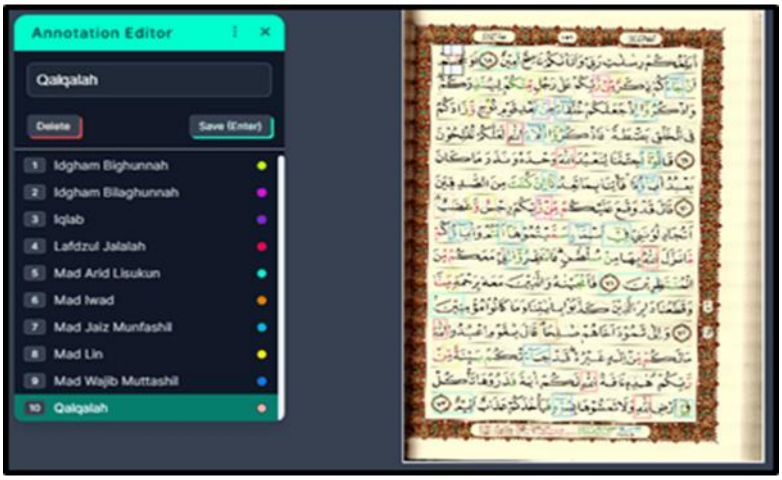

Figure 9. Labeling Results in Roboflow

A dataset that includes images of Al-Qur'an manuscripts with Tajwid reading laws has been collected. The dataset has also been annotated by marking the legal area of Tajwid reading on each image. This allows the model training process to use relevant datasets. After labeling or annotating each data set image based on the Tajweed classification, In Roboflow, some tools can be used for pre-processing, such as grayscale and augmentation. Roboflow provides several types of conventional augmentation, such as flip, rotate, brightness, exposure, shear, and others. After several annotation corrections, the dataset becomes 138 training images, 48 validation images, and 24 testing images.

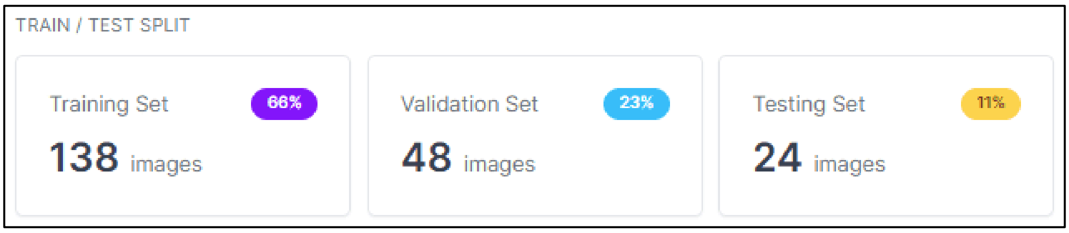

Figure 10. Results of Training, Validation, and Testing dataset

The dataset will be generated, and the results can be downloaded for later modeling in the YOLOv8 framework to get the best.pt file as a dataset will be used as training data during detection tests. In terms of downloading the dataset, the source code will appear in the following image:

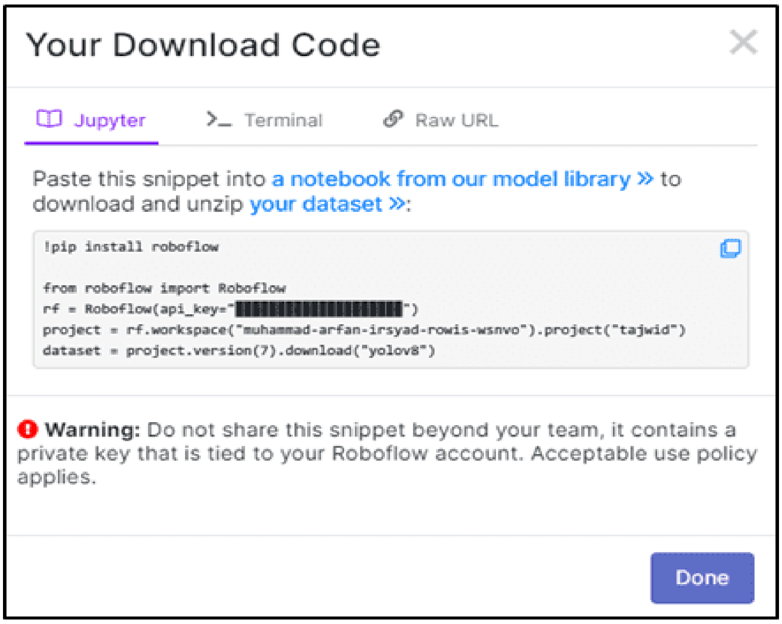

Figure 11. Source Code Download Dataset

Second Stage

When doing YOLOv8 modeling, when the dataset has been generated, copy the dataset download code into Google Colab. I started by opening the Yolov8 custom data set file using Google Colab. Then, perform validation sequentially according to the following diagram:

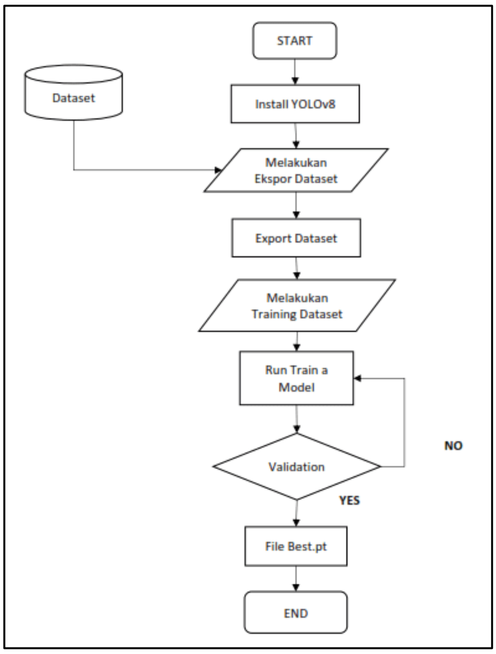

Figure 12. Validation flow diagram

In this stage, the author uses a previously available dataset and the Google Collaboration application (Google Colab). This stage begins by opening the Google Colab application and installing YOLOv8 on the Google Colab command line. Then, exporting the dataset previously created in Roboflow is followed by the train model process in YOLOv8.

In this process, validation will be carried out to determine whether the modeling can run well. If there is a failure in the process, you must check again. What is the problem with the failure? Is the source code inappropriate? Or is the dataset failing? The identification process can refer to the error output, from which conclusions can be drawn regarding where the error lies so that the process of repairing or changing the error or failure can be carried out. If the validation process goes well, in other words, the modeling process runs without any failure output. Then, the modeling process will produce an output file called the "best. pt" file.

The file "best. pt" in a Python program refers to the file with the best weights produced during training or modeling a neural network. In the context of the YOLO algorithm mentioned previously, the "best. pt" file is the file that contains the best weights of the Tajwid detection model that has been trained using the YOLO method. After going through the training process, the model will produce several detections that record the model weights at certain points during the training process. Ultimately, the model will select the detection areas with the best performance, namely the points that provide the most accurate detection results. The Python program can use the trained model to detect Tajweed in the Al-Qur'an in real time or other applications by loading the best weights from this file.

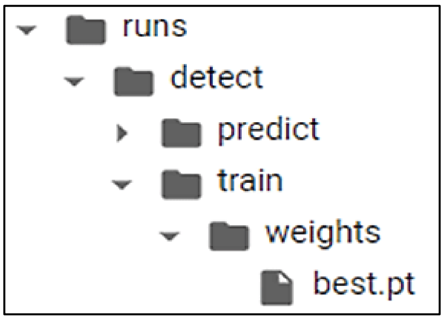

Figure 13. Location of the best.pt file

Then, after the validation process is complete, the "best. pt" file can be downloaded in the directory, as shown in Figure 13 above.

Third Stage

The third stage is the merging process of a series of previous stages. At this stage, what is prepared is the dataset (COCO and Best. pt files), Thonny (python application), and IP Webcam (android application).

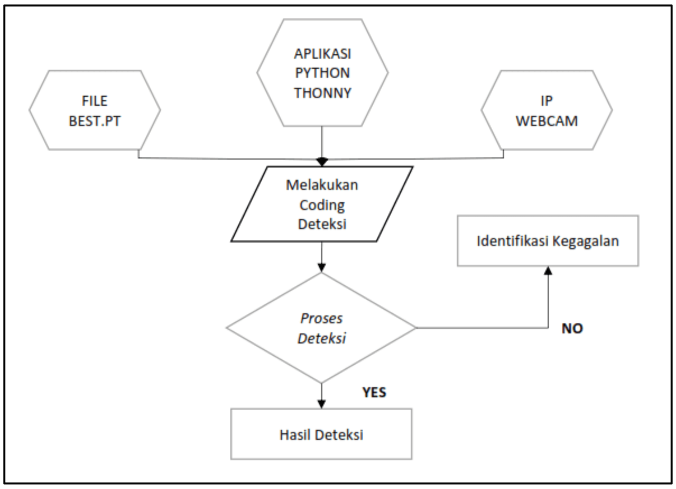

Figure 14. Detection process diagram

The first step of this process is to open the Thonny Python application and then start compiling a Python script framework to connect the COCO, Best. PT and IP Webcam files to perform real-time detection. The author utilizes the HP Android IP Webcam application to support the detection process and make it run better. Connecting the laptop camera to the HP camera simplifies and optimizes the detection process, considering that the laptop camera has shortcomings in the detection process. To connect, it uses the IP address of the IP Webcam application, which is then entered into the Python script for the running process.

After the script-running process runs well, the cellphone camera will be connected to the laptop camera. To detect tajweed by entering the IP Webcam application, the cellphone camera is directed to the tajweed object, which will detect the type of tajweed. Then, Python will start detecting and reading the object based on the classification of its type.

Figure 15. Detection Object

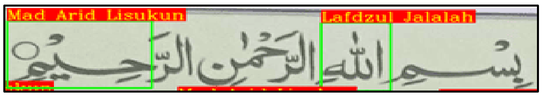

Figure 16. Detection Results

In Figure 15, there is an image of the tajweed detection object, and in Figure 16, there is an image of the results of the tajweed detection object. Figure 16 shows that the results of the detection object from the sentence or reading "BISMILLAHIRRAHMAANIRRAHIIM" in the reading detected the tajweed laws "Lafdzul Jalalah" and "Mad Arid Lissukun."

The author conducted experiments with three sheets of paper that had been printed out, which contained Surat Al-Fatihah with various display conditions, namely, (1) Figure 17, which is an example of Surat Al-Fatihah using a green background, (2) Figure 18, which is an example of Surat Al-Fatihah in the form of a screen display (screenshot), and (3) Figure 19, which is an example of Surat Al-Fatihah using a white background.

Figure 17. Surah Al-Fatihah with a green background

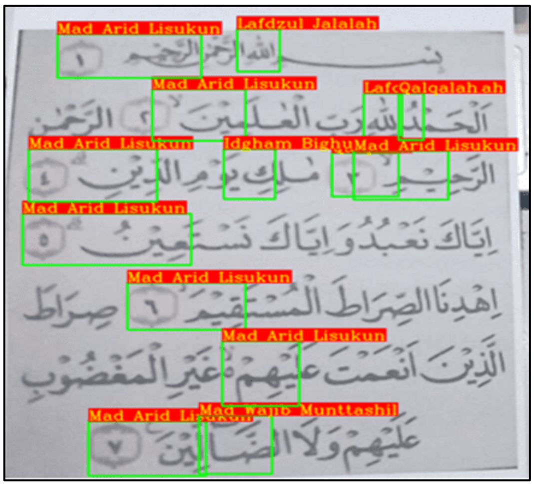

Figure 18. Surah Al-Fatihah in screenshot view (screenshot)

Figure 19. Surah Al-Fatihah with a white background

These three experiments can be classified as follows:

Table 2. Detection of Tajweed in Surah Al-Fatihah

No	Figure	Tajweed Law	Detected (Number)
1	Figure 17	Idgham Bighunah	0
		Idgham Bilaghunah	0
		Iqlab	0
		Lafdzul Jalalah	2
		Mad Arid Lisukun	7
		Mad Iwad	0
		Mad Jaiz Munfashil	1
		Mad Lin	0
		Mad Wajib Munttashil	0
		Qalqalah	0
2	Figure 18	Idgham Bighunah	1
		Idgham Bilaghunah	0
		Iqlab	0
		Lafdzul Jalalah	2

No	Figure	Tajweed Law	Detected (Number)
		Mad Arid Lisukun	8
		Mad Iwad	0
		Mad Jaiz Munfashil	0
		Mad Lin	0
		Mad Wajib Munttashil	1
		Qalqalah	1
3	Figure 19	Idgham Bighunah	1
		Idgham Bilaghunah	0
		Iqlab	0
		Lafdzul Jalalah	2
		Mad Arid Lisukun	7
		Mad Iwad	0
		Mad Jaiz Munfashil	0
		Mad Lin	0
		Mad Wajib Munttashil	0
		Qalqalah	2

From the experiment results, two classes are consistent in detection, namely, Lafdzul Jalalah and Mad Arid Lissukun, which have a fairly high and consistent detected value. From the three experiments, Lafdzul Jalalah is very consistent with two detections. While Mad Arid Lissukun in Figure (17) was detected seven times, Figure (18) was detected eight times, and Figure (19) was detected seven times.

Final Test Results

MAP Value

The Tajweed detection testing process produces mAP (mean average precision) values from each experiment for each detection class. The comparison between two experiments using augmentation and non-augmentation is as follows:

```
Validating runs/detect/train/weights/best.pt...
Ultralytics YOLOv8.0.20 🚀 Python-3.10.12 torch-2.0.1+cu118 CUDA:0 (Tesla T4, 15102MiB)
Model summary (fused): 168 layers, 11129454 parameters, 0 gradients, 28.5 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 2/2
                   all         48       1689       0.71      0.687      0.731      0.468
       Idgham Bighunnah         48        243      0.728      0.671      0.745       0.47
     Idgham Bilaghunnah         48         75      0.679      0.733      0.735      0.445
                 Iqlab         48         44      0.764      0.545      0.612      0.427
       Lafdzul Jalalah         48        236      0.985      0.992      0.995      0.659
      Mad Arid Lisukun         48        374      0.864      0.874      0.933      0.638
              Mad Iwad         48         87      0.748      0.851      0.877      0.617
    Mad Jaiz Munfashil         48        173      0.861      0.896      0.929      0.577
               Mad Lin         48         12          0          0     0.0603     0.0334
    Mad Wajib Muttashil         48        138      0.829      0.876       0.91      0.574
              Qalqalah         48        307      0.637      0.433      0.509      0.243
Speed: 0.3ms pre-process, 9.5ms inference, 0.0ms loss, 1.8ms post-process per image
Results saved to runs/detect/train
```

Figure 20. Class summary value with augmentation

Figure 20 shows that the highest mAP50 value is the Lafdzul Jalalah class with a value of 0.995 or 99.50%, and the lowest value is the Mad Lin class with a value of 0.0603 or 6.03%, and the mAP50 value for all classes is 0.731 or 73.10%.

```
Validating runs/detect/train/weights/best.pt...
Ultralytics YOLOv8.0.20 🚀 Python-3.10.12 torch-2.0.1+cu118 CUDA:0 (Tesla T4, 15102MiB)
Model summary (fused): 168 layers, 11129454 parameters, 0 gradients, 28.5 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 2/2
                   all         48       1689      0.819      0.649      0.699      0.446
      Idgham Bighunnah         48        243      0.683      0.593      0.703      0.445
    Idgham Bilaghunnah         48         75      0.519      0.693      0.616      0.363
                 Iqlab         48         44      0.838      0.545      0.626      0.419
       Lafdzul Jalalah         48        236      0.974      0.979      0.993      0.648
      Mad Arid Lisukun         48        374      0.867      0.817        0.9      0.623
              Mad Iwad         48         87      0.907      0.781      0.858      0.589
    Mad Jaiz Munfashil         48        173      0.864      0.879      0.911      0.572
               Mad Lin         48         12          1          0     0.0274     0.0166
   Mad Wajib Muttashil         48        138      0.872      0.836        0.9       0.56
              Qalqalah         48        307      0.663      0.365      0.458       0.22
Speed: 0.3ms pre-process, 9.8ms inference, 0.0ms loss, 1.9ms post-process per image
Results saved to runs/detect/train
```

Figure 21. Summary value of non-augmentation class

From Figure 21, it is found that the highest mAP50 value is the Lafdzul Jalalah class with a value of 0.974 or 97.40%, and the lowest value is the Mad Lin class with a value of 0.0274 or 2.74%, and the mAP50 value for the entire class is 0.699 or 69.90%.

Accuracy Value

These tests with optimization using augmentation and non-augmentation produce the following matrix:

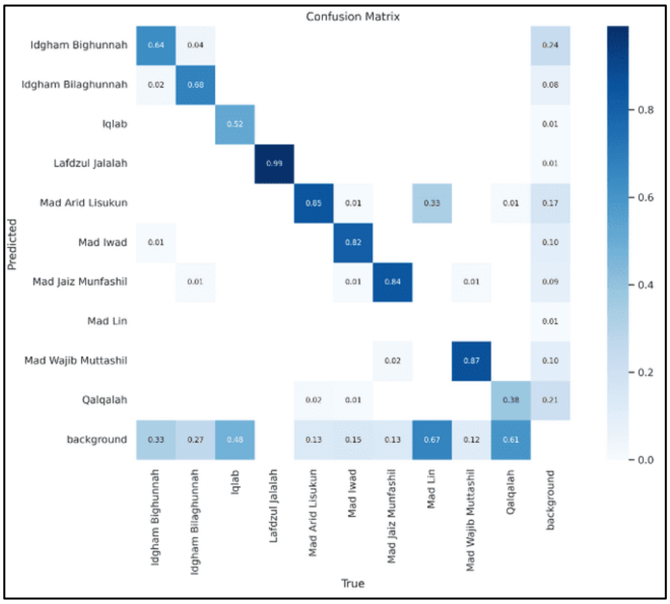

Figure 22. Confusion Matrix with Augmentation

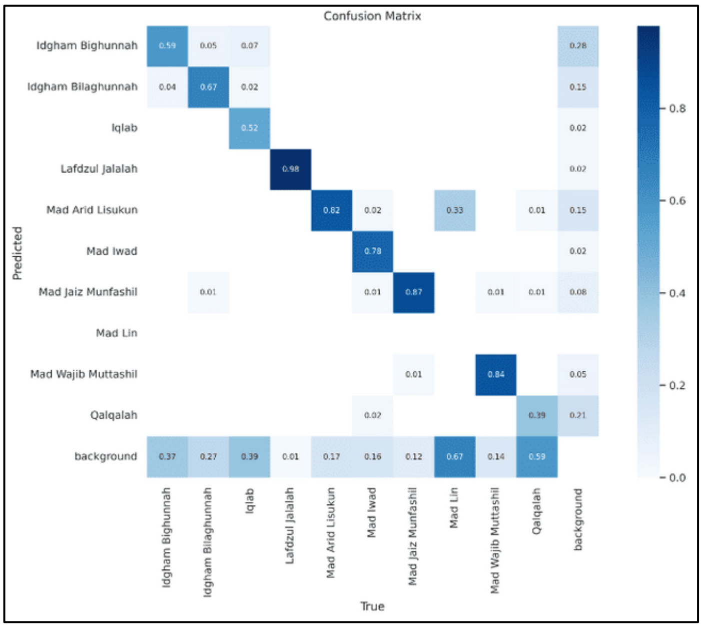

Figure 23. Confusion Matrix with Non-augmentation

To get the accuracy value of each test dataset using the YOLOv8 method. After getting the confusion matrix from the two experiments, the accuracy value can be calculated; the formula for determining the accuracy value is:

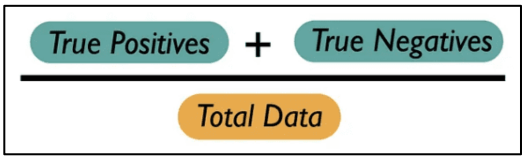

Figure 24. The formula for Calculating Accuracy

Then, it can be generated as follows:

Testing with Augmentation

TP + TN = 0.64 + 0.68 + 0.52 + 0.99 + 0.85 + 0.82 + 0.84 + 0.38 + 0.87 = 6.59

Total Data = 0.64 + 0.68 + 0.52 + 0.99 + 0.85 + 0.82 + 0.84 + 0.33 + 0.87 + 0.38 + 0.04 + 0.02 + 0.01 + 0.01 + 0.01 + 0.01 + 0.01 + 0.02 + 0.01 = 7.09

Accuracy = (6.59 / 7.09) x 100% = 92.94%

So, the accuracy value obtained if the augmentation process is 92.94%.

Testing With Non-Augmentation

TP + TN = 0.59 + 0.67 + 0.52 + 0.98 + 0.82 + 0.78 + 0.87 + 0.84 + 0.39 = 6.46

Total Data = 0.59 + 0.67 + 0.52 + 0.98 + 0.82 + 0.78 + 0.87 + 0.84 + 0.39 + 0.33 + 0.05 + 0.07 + 0.04 + 0.02 + 0.02 + 0.01 + 0.01 + 0.01 + 0.01 + 0.01 + 0.02 = 7.07

Accuracy = (6.46 / 7.07) x 100% = 91.37%

So, the accuracy value obtained by testing without augmentation is 91.37%.

Discussion

A study conducted by (Maulana et al., n.d.) on "Fruit Pattern Recognition Using the Freeman Chain Code Algorithm" explains that the Freeman Chain Code algorithm can be applied to detect fruit patterns that serve to improve learning for young children and Down syndrome patients and in his research it produces that the process of recognizing fruits has 2 data, namely training data and test data useful for testing the level of similarity. The percentage of research results can recognize citrus fruits and bananas at 70%, pears at 60%, apples at 30%, mangoes, pineapple fruit, and salak fruit at 20%, mangosteen fruit and durian fruit at 10%, and strawberries at 0%.

Research has been conducted by Dewi & Armanto (2015) on "Analysis of Various Types of Computer Letters Using Chain Code-Based Algorithms in the Form of Run Length Encoding."Explaining that the Freeman Chain Code algorithm is useful for giving the identity of a computer letter by calculating the chain code with 8-way connectivity, the results are almost 85% of computer letters calculated using the Algortima. The results are correct.

Research conducted by Riyanda (2016) with the research title "Development of Malay Arabic Script Recognition Applications Using Freeman Chain Code Algorithm and Support Vector Machine (SVM)," in his research the Freeman Chain Code method is used to extract the characteristics of Malay Arabic letters by tracing the letter-forming pixels using 4 or 8 cardinal directions and implementing the Freeman Chain Code algorithm as feature extraction. The Support Vector Machine (SVM) method is a pattern recognition classification that aims to find the best hyperplane on the characteristics of letter formation.

Further research was conducted by Antari et al. (2015) with the title Recognition System Based on Hand Geometry Using Chain Code and Moment Invariant Methods. This study uses a combination of chain code and moment invariant methods to obtain hand geometry characteristics needed for the matching process between the hand geometry image stored in the database and the hand geometry image inputted in the identification/verification module. Testing this study's hand geometry recognition system using 70 hand geometry images belonging to 10 participants. The results of system testing with a combination of the two methods produced a success rate of 94.17% with FAR = 0%, FRR = 5.83%, and threshold value = 103.819.

In this study, the test design that can be done is as follows: Tests are carried out to determine the performance of the CNN and YOLOv8 algorithms on object detection to determine the type of tajweed from the tajweed class that has been classified and labeled. Testing is done using Google Colab. The dataset is obtained from the online Al-Qur'an application and then extracted into an image file. Then, the data will go through several processes: labeling (annotating image), pre-processing, modeling, and testing. The labeling stage uses annotation or annotation, which has various tools to label the desired image character or tajweed letter in the form of a drag tool, bounding box tool, polygon tool, smart polygon, and so on. Then, proceed with pre-processing by doing greyscale and augmentation with a type previously adjusted to the detection you want to do. Then, the dataset is generated, which can be downloaded using the download source code from Roboflow. Then, the source code can be validated with the YOLOv8 model with Google Colab by following the Yolov8 custom data set script validation steps. Until then, the best.pt file appears, which contains data sets, labels, and classes that have been tested.

After getting the best.pt file as a dataset, then detection testing can be done by entering the best.pt file into the code for tajweed detection, which, in this case, uses the Tonny application to display the code and tajweed detection results.

This test is carried out in 2 different dataset tests, namely, with datasets that have been carried out grayscale Augmentation and Non-Augmentation grayscale to know the optimization value obtained.

CONCLUSION

Based on the background mentioned regarding the lack of technology in the religious education environment. The solution to this problem is to open the mindset of Muslims about the importance of science and technology, prepare quality human resources, and prepare adequate information technology infrastructure for the educational process. Based on detection research using the YOLOv8 method with augmentation, the results showed that the highest mAP50 value was the Lafdzul Jalalah class with a value of 0.995 or 99.50%, and the lowest value was the Mad Lin class with a value of 0.0603 or 6.03%. The mAP50 value for all classes was 0.731 or 73.10%. Based on detection research using the YOLOv8 method without augmentation, the results showed that the highest mAP50 value was the Lafdzul Jalalah class with a value of 0.974 or 97.40%, and the lowest value was the Mad Lin class with a value of 0.0274, or 2.74%. The mAP50 value for the entire class was 0.699, or 69.90%. Based on the optimization and comparison, the accuracy value for research with augmentation was 92.94%, and research carried out without augmentation was 91.37%. So, from the results of this research, an additional value of 1.57% was obtained by carrying out grayscale augmentation. The annotation or labeling process is important to obtain an appropriate dataset so that the detection process can be optimized. You must be more precise in each paragraph by labeling the detection area when carrying out the labeling process. So that there are no errors or inconsistencies in the detection process.

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