

# **The Classification of Batik Besurek Fabric Motifs in Indonesia Utilizing YOLOv8 for Enhanced Cultural Preservation**

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**Abstract**—Batik Besurek is an Indonesian cultural heritage that presents a variety of motifs reflecting the richness of creativity and symbolic meanings. A significant challenge in this field is accurately and efficiently identifying and classifying batik Besurek motifs, known for their intricate designs and cultural significance. In efforts towards cultural preservation and development, a combination of modern technology and local wisdom is required. One technology that can be utilized is object detection technology using You Only Look Once (YOLO), specifically the latest version, YOLOv8, for the classification of batik Besurek motifs. The dataset collected consists of 1,656 images taken from the Roboflow public repository, containing various motifs such as Burung Kuau, Kaligrafi, Kembang Melati, Rafflesia, and Rembulan. The dataset is divided into 1,324 images (80%) for the training set, 166 images (10%) for the validation set, and 166 images (10%) for the test set. Model training is conducted with hyperparameter values: learning rate of 0.01, batch size of 16, and 100 epochs. The application of the YOLOv8 model as a training model for the batik Besurek motif dataset yields an accurate final model with an average precision value for each motif class of 96%, and an average recall value for each motif class of 93%. This study aims to assist communities in recognizing and distinguishing batik Besurek motifs, contributing to the preservation of Indonesia's cultural heritage.

**Keywords:** Batik Besurek; Classification; Motifs; Object Detection; YOLOv8

## **1. INTRODUCTION**

There is complexity and an urgent need to preserve and develop Indonesia's cultural wealth, especially in the realm of traditional textile arts [1]. Batik Besurek from Bengkulu is a traditional type of batik that holds deep meaning and historical value, contributing significantly to the richness of Indonesia's cultural identity [2]. Its unique and diverse motifs reflect the cultural diversity and creativity of the communities that produce them [3].

Batik Besurek, as part of Indonesia's cultural heritage, presents a variety of motifs reflecting the richness of creativity and symbolic meaning. Among its distinctive motifs are the Burung Kuau, Kaligrafi, Kembang Melati, Rafflesia, Rembulan, and many others. Every motif embodies stories and cultural values that are essential to the identity of Batik Besurek [4, 5].

In the midst of globalization and modernization dynamics, culture is a vulnerable aspect subject to uncontrollable changes. Therefore, efforts to preserve and develop culture are urgent and cannot be ignored [6]. In the context of batik Besurek, the combination of modern technology and local wisdom is a fundamental necessity. Image processing and artificial intelligence technologies, such as You Only Look Once (YOLO), offer great potential in enhancing the effectiveness of cultural preservation efforts [7].

However, the main problem lies in the need to accurately and efficiently identify and classify batik Besurek motifs, which are known for their intricate designs and distinctive features. These motifs, such as Burung Kuau, Kaligrafi, Kembang Melati, Rafflesia, and Rembulan, are not only visually complex but also deeply rooted in the cultural heritage of the Bengkulu community. With each motif bearing unique characteristics that reflect its cultural significance, traditional classification approaches often struggle to capture the intricate patterns and symbolic details unique to each motif [2].

This complexity presents significant challenges in terms of scaling classification efforts, as traditional manual identification methods require extensive expertise and considerable time, which slows down documentation processes. In the face of globalization and modernization, there is a real risk that these culturally valuable motifs might be forgotten or inadequately documented, which could erode their visibility and significance in Indonesian heritage [8]. Without a more efficient system for digital documentation, batik Besurek motifs risk losing their presence and cultural value as contemporary practices and influences reshape society. This underscores the need for an effective approach to document and classify batik Besurek patterns, making them accessible and better understood within Indonesia's broader cultural narrative.

Hence, the need arises for advanced technology that can manage the detailed, often subtle distinctions within batik Besurek motifs, enabling a more scalable and accurate classification process. The use of YOLO, especially the latest version YOLOv8, in the classification of batik Besurek motifs in Indonesia reflects an evolution in cultural studies and technology approaches. This algorithm allows for the automatic identification of batik motifs with high accuracy [9, 10], which in turn can enhance efficiency in the documentation and preservation of cultural heritage. This enables more efficient use of human resources and time, thus allowing for reaching a broader range of scattered batik Besurek collections across various regions in Indonesia.

In a previous study by Purwandari, the application of Color Histogram, Gray Level Cooccurrence Matrix, and Moment Invariant feature extraction methods was investigated to retrieve images in batik Besurek. The

dataset comprised images of various motifs such as Kaligrafi, Bunga Raflesia, Bunga Kuau, Relung Paku, and Rembulan motifs. The research resulted in an image retrieval application for batik Besurek, with successive tests conducted for cases without attacks, rotated 90°, blurred with Gaussian radius of 1.0 and 2.0, added noise, and color-changed, yielding recall values of 34.90%, 35.17%, 33.24%, 29.51%, and 29.86%, respectively, and precision values of 75%, 77%, 67%, 67%, and 74% [11]. The focus of this study was primarily on developing an application capable of detecting altered batik Besurek motifs while still recognizing their true types. However, the results were limited to the number of objects/classes that could be detected at one time. Hence, this research employs the YOLOv8 algorithm, known for its pattern recognition capabilities with relatively high accuracy. Additionally, YOLOv8 can detect more than one object/class simultaneously.

Another study by Meranggi focused on batik classification using Convolutional Neural Network (CNN) methods. The research was motivated by the increasing diversity and development of batik motifs, making it increasingly difficult for people to recognize the different types of batik motifs. The dataset comprised 621 data points with five types of motifs obtained from a public repository. The study successfully detected and classified various batik motifs, achieving a high accuracy rate of 88.88% [12]. This research supports the background of the current study, where the application of object detection facilitates laypeople in recognizing the different types of batik motifs, particularly batik Besurek.

This research aims to combine deep local cultural knowledge with the capabilities of modern technology to achieve better preservation and development goals. By applying YOLOv8 in the analysis of batik Besurek motifs, this research will not only make a significant contribution to our understanding of Indonesia's cultural wealth but also provide practical guidance for stakeholders in the preservation and promotion of batik Besurek.

Furthermore, by employing advanced scientific approaches, this research can produce a comprehensive database of batik Besurek motifs, which can be used as a reference for textile designers, historians, and cultural researchers to study and appreciate Indonesia's artistic and cultural heritage. Thus, this research is expected not only to provide new insights into batik Besurek but also to foster a deeper understanding of the importance of preserving and developing local culture in an increasingly complex globalization context.

## 2. RESEARCH METHODOLOGY

The research stages for classifying batik Besurek fabric motifs are illustrated in Figure 1. The process begins with a literature study to gain an understanding of foundational concepts and developments in motif classification research. Following this, data collection is carried out, gathering images of batik Besurek fabrics as the primary dataset for the study. Once collected, the data undergoes preprocessing, which includes data augmentation to enhance data variability and splitting the data into training, validation, and test sets. In the model training stage, the YOLOv8 model is employed to train on the data, enabling it to recognize and classify batik motifs. After training, model evaluation is conducted to assess model performance on the test set. The evaluation results then form the basis for drawing conclusions related to the research objectives in classifying batik Besurek fabric motifs.

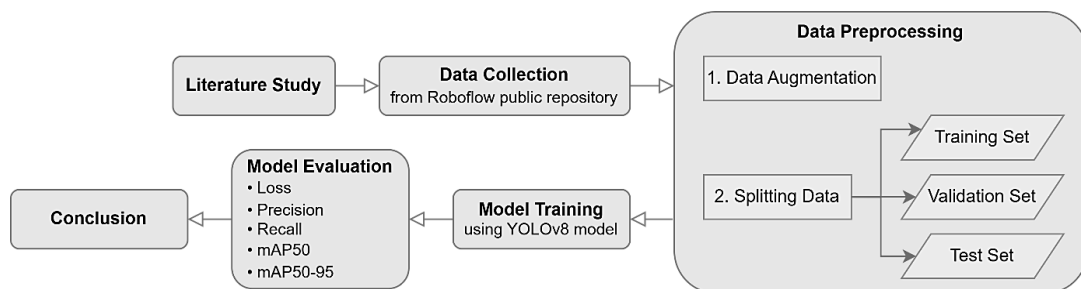


Figure 1. Research Stages

### 2.1 Literature Study

The research stages for this literature study begin with the collection and analysis of various relevant literary sources. The primary focus of this review is to comprehend the fundamental concepts of batik Besurek, including its history, philosophy, and distinctive motifs. Additionally, this study examines previous research that employed classification techniques in pattern recognition and image processing, particularly utilizing deep learning methods like the YOLOv8 model. Once the context and background are established, the research evaluates the methodologies used in prior studies to pinpoint their strengths and weaknesses. This evaluation is crucial for designing a more effective approach to classifying batik Besurek motifs using YOLOv8. By considering the findings from the literature review, the researchers can develop a robust framework for subsequent investigations and outline the appropriate steps for data collection, preprocessing, model training, and result evaluation, thereby ensuring that the primary objectives of the study are met successfully.

Here are several explanations related to various motifs of batik Besurek. The Burung Kuau (Kuu Bird) motif in Figure 2 is one of the motifs commonly found in batik Besurek. The Kuau Bird symbolizes freedom and grace. In local belief, this bird is often considered a guardian and messenger from the supernatural world. This motif is frequently used in batik as a symbol of hope for freedom and peace.



**Figure 2.** Burung Kuau Motif [3]

The Kaligrafi (Calligraphy) motif in Figure 3 highlights the elegance of Arabic script, often featuring Quranic verses or wise sayings. Batik with calligraphy motifs frequently serves as an expression of spirituality and devotion for its wearers. Furthermore, this motif is commonly used to honor local wisdom and religious values [13].



**Figure 3.** Kaligrafi Motif [3]

The Kembang Melati (Jasmine Flower) motif in Figure 4 symbolizes beauty and purity. Jasmine is a flower often associated with beauty and fertility in Indonesian culture. In batik Besurek, this motif is frequently used to adorn fabrics with an aura of elegance and gentleness [14].



**Figure 4.** Kembang Melati Motif [15]

The Rafflesia motif in Figure 5 portrays the image of the Rafflesia flower, which is the largest and most beautiful flower in the world. Rafflesia is often regarded as a symbol of natural grandeur and the uniqueness of Indonesian flora. The use of this motif in batik Besurek adds an exotic natural touch and showcases the richness of Indonesia's flora [16].



**Figure 5.** Rafflesia Motif [3]

The Rembulan (Crescent Moon) motif in Figure 6 depicts the full moon shining brightly in the night sky. The Crescent Moon is often seen as a symbol of beauty and romance. In batik Besurek, this motif is frequently used to create a romantic atmosphere and strengthen the connection between humans and nature [14].



**Figure 6.** Rembulan Motif [3]

Each motif in Batik Besurek holds profound meanings and stories, showcasing local wisdom and the natural beauty of Indonesia. These motifs are not just elements of textile art but also serve as a means to reinforce cultural identity, linking generations to the heritage of their ancestors [3].

## 2.2 Data Collection

The data used in this research was obtained from the Roboflow public repository, which is freely accessible. The data was uploaded by an account named MOTIF BATIK BESUREK in 2024 [17]. A total of 1,656 batik images were obtained, featuring various motifs such as the Kuau Bird, Calligraphy, Jasmine Flower, Rafflesia, and Crescent Moon. The next step involved labeling, which was done by manually drawing bounding boxes for each motif class using specific applications. Each image could have more than one motif class. Labeling is essential as it provides information on object identity for classification, training, evaluation, and analysis in object detection [18]. Fortunately, the dataset obtained from the Roboflow public repository already had labels, facilitating the research process, especially in data collection and labeling.

## 2.3 Data Preprocessing

To enhance the diversity of the training data, data augmentation was performed. Data augmentation is a technique used in machine learning to create additional variations in the training dataset by modifying original data into slightly different but still relevant forms [19]. Data augmentation aims to enhance the diversity of training data, allowing machine learning models to generalize patterns more effectively and make improved predictions on new data [20]. Techniques commonly used in data augmentation include rotation, shifting, scaling, mirroring, adjusting lighting, blurring, cropping, adding noise, and applying mosaic transformations. Additional methods such as color jittering, random erasing, flipping, and contrast adjustment can further enhance the diversity of the dataset [21]. Several augmentation techniques were applied to the dataset, such as rotation between  $-15^\circ$  to  $+15^\circ$ , horizontal or vertical shifting by  $\pm 10^\circ$ , lighting adjustment between  $-15\%$  to  $+15\%$ , noise addition up to 0.1% of pixels, and the application of mosaic.

Another crucial step in data preprocessing is splitting the dataset into three parts: the training set, validation set, and test set. The training set is used to train the model, where the model learns patterns and relationships between features and labels from the training data [22]. The validation set is used to assess the model's performance throughout training, allowing for periodic checks to monitor progress and optimize training parameters like the learning rate or the number of epochs [23]. The test set is used to assess the model's final performance after training is completed, allowing for measuring how well the model can make predictions on new, unseen data [24]. According to previous research, the proportion of dataset division significantly affects accuracy, error rate, and required time. A higher proportion allocated to the training set results in higher accuracy and lower error rates but requires more time [25, 26]. However, this is not definitive as it also depends on the dataset used. Therefore, in this research, the dataset was divided into a training set of 1,324 images (80%), a validation set of 166 images (10%), and a test set of 166 images (10%).

## 2.4 Model Training

Model training was carried out meticulously and systematically to ensure the optimal performance of the YOLOv8 model in classifying batik Besurek motifs. The entire training process was assisted using the Ultralytics module, which provides various YOLO models. To use the Ultralytics model, installation is straightforward using pip commands in the terminal. The first step was to set the pre-trained YOLOv8 model in the Ultralytics module as the starting point to leverage feature representations generated from large previous datasets. Then, fine-tuning of the model was performed using the previously collected dataset, consisting of various batik Besurek images with different motifs. During training, hyperparameters such as learning rate, batch size, and the number of epochs were adjusted to achieve optimal convergence and prevent overfitting [27, 28]. The hyperparameter values used in the research were a learning rate of 0.01, a batch size of 16, and 100 epochs. Additionally, an additional parameter was applied, namely an image size of 640 pixels, where all image sizes for training were standardized, resulting in more stable training outcomes.

### 2.5 Model Evaluation

A comprehensive approach was used to ensure reliable and accurate performance of the YOLOv8 model in classifying batik Besurek motifs. Firstly, the prepared validation dataset was used to objectively test the model. Inference was then performed on the validation dataset, and the model's performance was measured using various evaluation metrics, including loss, precision, recall, mAP50, and mAP50-95. The loss value indicates how well or poorly the model is performing on the training data at any given point in the training process. Consequently, a lower loss value suggests that the model is performing better in making predictions [29]. Precision value is used to measure how many of the positive results predicted by the model are truly positive. Precision provides information about the accuracy of positive predictions made by the model, hence higher precision values are expected in a model [30]. Meanwhile, recall value is used to measure how many of all positive samples are correctly identified by the model. Recall provides information about how well the model can classify all true positive samples as positive, therefore higher recall values are expected in a model [31].

mAP50 value is used to measure the average precision of object detection at IoU (Intersection over Union) of 0.5. IoU measures how well the predicted bounding box by the model overlaps with the actual bounding box of the existing object [32]. Meanwhile, mAP50-95 value is used to measure the average precision of object detection in the IoU range from 0.5 to 0.95. This value provides a more complete picture of the model's performance in producing good detections at various levels of overlap between the predicted bounding boxes and the actual bounding boxes [33]. These metrics provide a comprehensive understanding of the model's ability to correctly recognize batik motifs. Additionally, visual analysis of the classification results was conducted to understand possible error patterns and assess the extent to which the model can recognize motifs with consistent accuracy [34]. This evaluation process provides valuable insights into the quality and generalization of the YOLOv8 model, as well as helping to identify areas that require further improvement or adjustment.

### 2.6 Conclusion

The conclusion stage in this study summarizes key findings from the entire research process, assesses goal achievement, and provides an interpretation of the results obtained. At this stage, a review of the model evaluation results is conducted to determine how well the method used such as the YOLOv8 model in classifying batik Besurek motifs has fulfilled the research objectives. The conclusion serves as a closing section, outlining the research's contribution to pattern recognition, especially in the automatic preservation and classification of batik Besurek motifs.

## 3. RESULT AND DISCUSSION

The process of training the model using the Ultralytics module with the YOLOv8 model took approximately 0.672 hours. This efficient training duration highlights the capabilities of the YOLOv8 framework in processing the given dataset. After training, a confusion matrix was generated, which is a critical tool for assessing the model's classification performance across different batik motif classes, as shown in Figure 7. The confusion matrix helps visualize both successful classifications and the model's challenges.

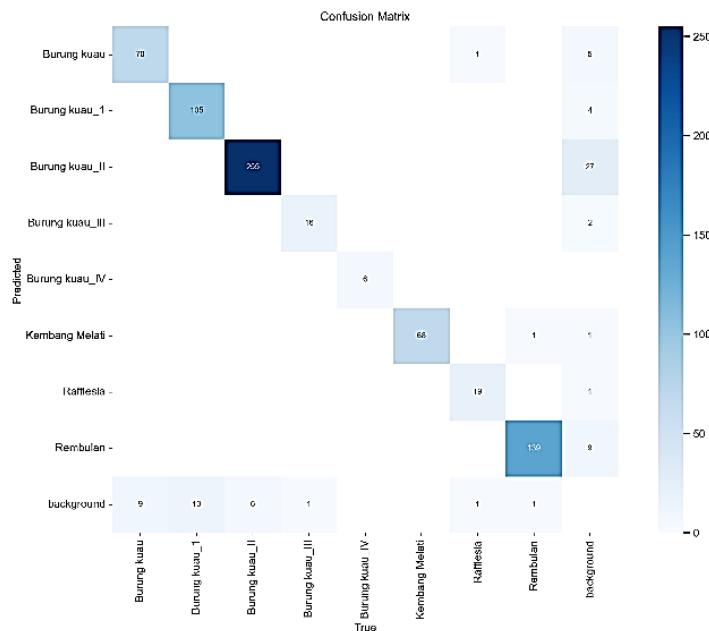


Figure 7. Confusion Matrix

Confusion matrix was obtained by validating using the provided validation set consisting of 166 images. The results of the confusion matrix show that the most classified label is for the Burung Kuau II motif with 255 instances, while the least classified label is for the Burung Kuau IV motif with 6 instances. The imbalance in motif classification is not a problem, as it could occur due to errors in the distribution of datasets in the train, valid, or test sets.

To address this imbalance, normalization was performed, resulting in a normalized confusion matrix, which can be seen in Figure 8. This normalization process allows for a fairer assessment of the model's performance across different classes, effectively minimizing bias caused by varying instance counts. The normalized confusion matrix results show that each motif achieved values of 0.89 and above, indicating that the model predicts each motif with an accuracy of around 89% or higher, which points to a successful validation process with high overall accuracy.

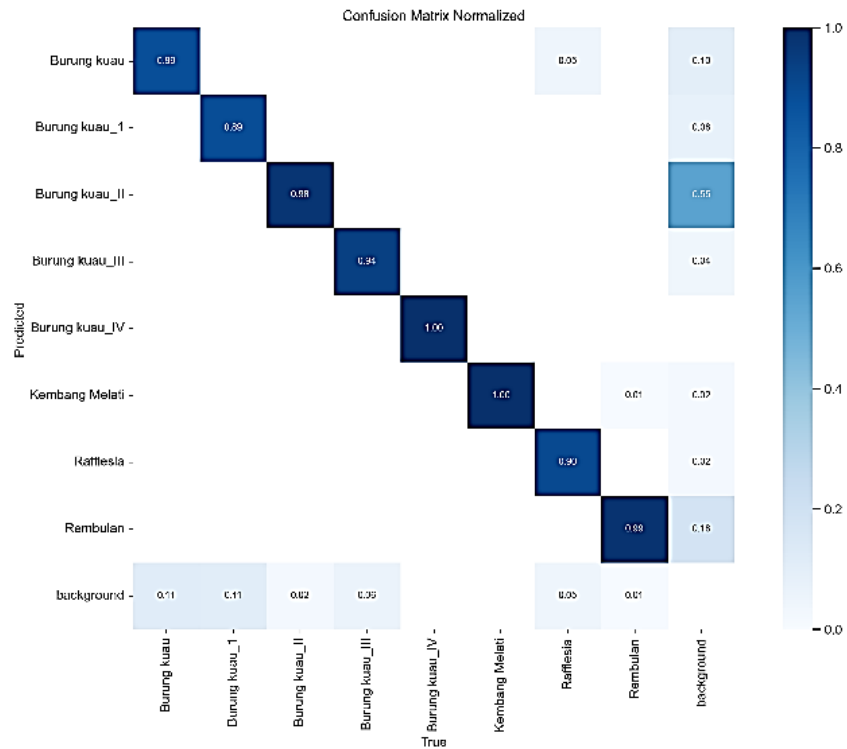


Figure 8. Confusion Matrix Normalized

Following the confusion matrix analysis, attention shifted to additional evaluation metrics, focusing on essential values such as loss, precision, recall, mAP50, and mAP50-95. High values in mAP50 and mAP50-95 are particularly favorable, suggesting that the model performs well. Figure 9 presents the training results curve, which illustrates the model's performance throughout the training process across 100 iterations.

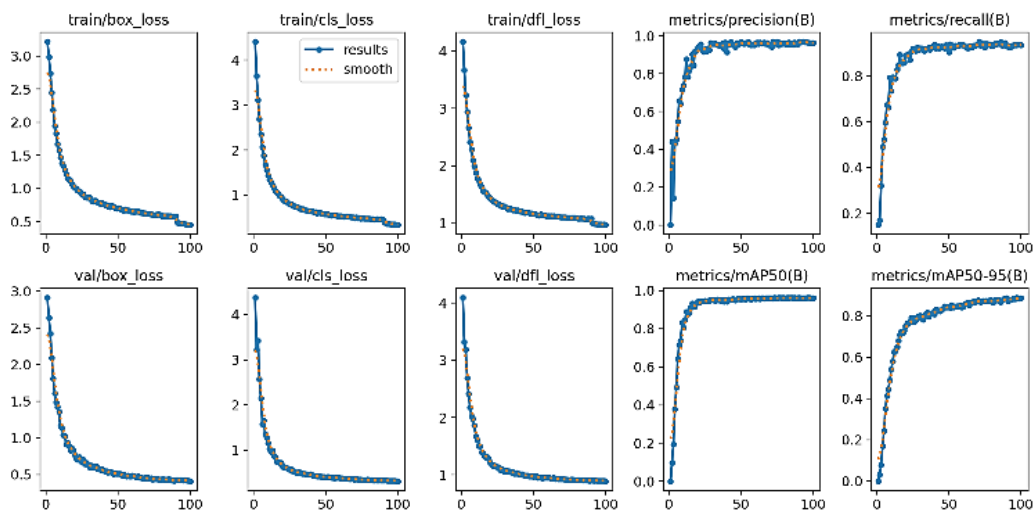


Figure 9. The Training Results Curve

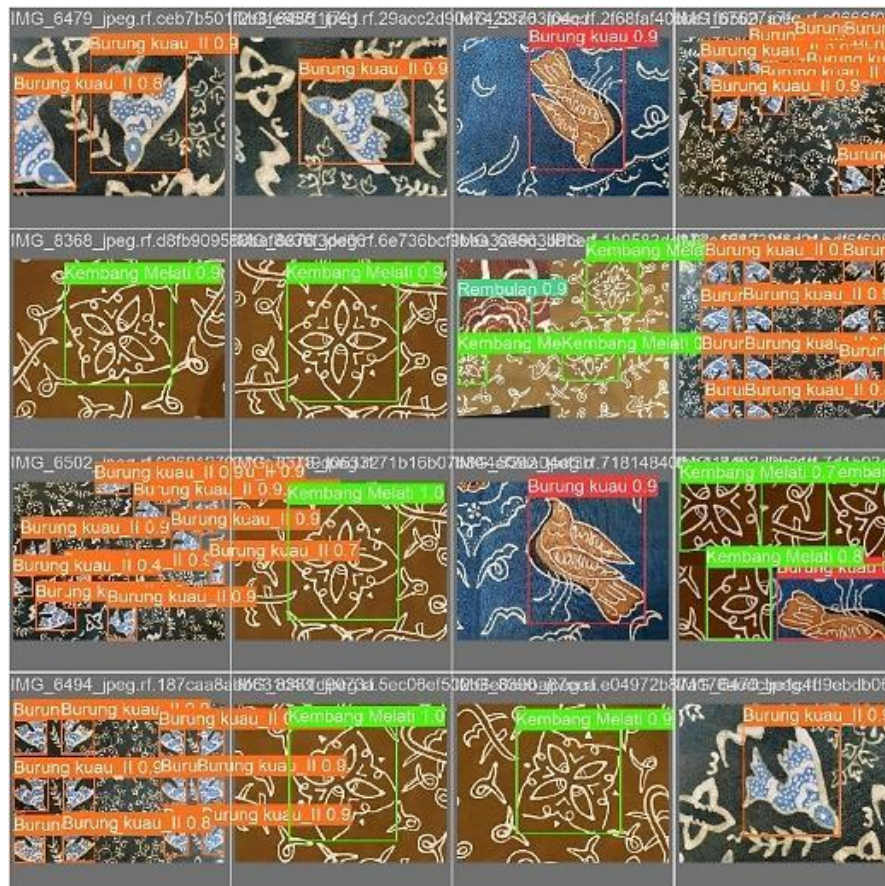
From the analysis of Figure 9, it is evident that loss values for both training and validation datasets displayed a consistent downward trend. In contrast, precision, recall, mAP50, and mAP50-95 values showed a steady upward trajectory. These trends collectively indicate that the training process was successful, leading to a well-functioning model. For a more detailed examination of each class's performance, Table 1 summarizes the training results.

**Table 1.** Summary of Training Results for Each Class

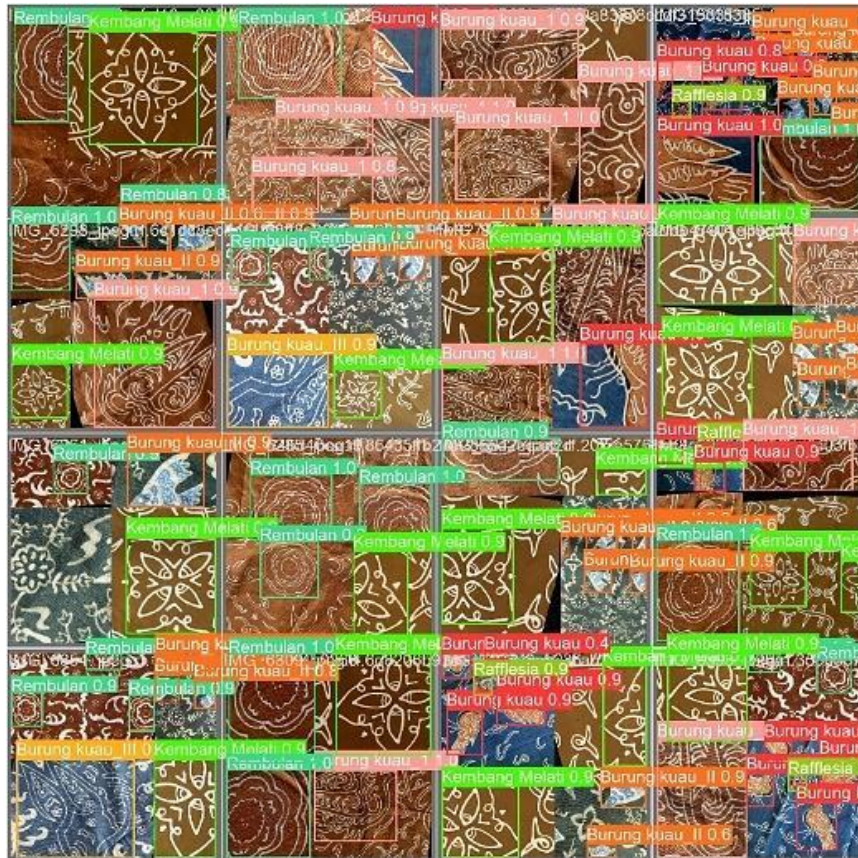
Class	Instance	Prec	Rec	mAP50	mAP95
all	711	0.96	0.94	0.96	0.89
Burung kuau	79	0.96	0.87	0.90	0.82
Burung kuau_I	118	0.96	0.86	0.91	0.88
Burung kuau_II	261	0.94	0.93	0.98	0.87
Burung kuau_III	17	0.96	0.94	0.95	0.94
Burung kuau_IV	6	0.95	1.00	1.00	0.92
Kembang Melati	68	0.99	0.99	0.99	0.94
Rafflesia	21	0.99	0.91	0.98	0.79
Rembulan	144	0.95	0.99	0.99	0.95

Table 1 provides an overview of the training performance for each batik motif class. Overall, the metrics indicate that 711 instances were classified, with an impressive precision of 0.96 and a recall of 0.94, yielding a mAP50 of 0.96 and an mAP95 of 0.89. Among the classes, both the Kembang Melati and Rafflesia motifs achieved the highest precision value of 99%. The Burung Kuau IV motif recorded the highest recall value of 100%, indicating perfect recognition of this class.

Additionally, the Burung Kuau IV class achieved a top mAP50 value of 100%, showcasing the model's accuracy for this particular motif. The Kembang Melati and Rembulan classes followed closely with mAP50 values of 99%. Regarding mAP50-95, the Rembulan class excelled with a value of 95%, reflecting robust performance. These results highlight the model's effectiveness in classifying motifs accurately across a diverse range of categories. To further assess the model's capabilities, predictions were conducted using various images from the test dataset. The results from these tests demonstrated encouraging prediction outcomes, as illustrated in Figure 10. The predictions from two test scenarios showed the model's ability to generalize well to new data.



(a)



(b)

Figure 10. Results of Model Testing on the Test Set (a) Test 1 (b) Test 2

The test results showed that almost every existing batik motif could be predicted with prediction values mostly around 0.9 or ±90%. Furthermore, the model could also predict various motifs quite accurately within one image.

### 4. CONCLUSION

Object detection conducted using the Ultralytics module with the YOLOv8 model can classify several batik Besurek motifs with an average precision value of each motif class around 96%, and an average recall value of each motif class around 93%. The selection of the YOLOv8 model as the training model was appropriate and performed well on the batik Besurek motif dataset. Even for images with multiple motifs, the built model could still accurately detect various motifs. The results of this research can facilitate people in recognizing and distinguishing the types of motifs on batik Besurek fabrics in Indonesia, in an effort to preserve the local cultural heritage in Indonesia. Additionally, the results of this research can be applied to assist people from outside Indonesia in learning about the various motifs of batik Besurek fabrics. However, in reality, there are still some shortcomings in this research that provide suggestions for further development, such as increasing the dataset with more varied motifs, improving data augmentation techniques using various combinations of augmentation techniques, and the technique of dividing the dataset into train, valid, and test sets, as the dataset in this research was only divided randomly. Another suggestion is to develop the results of this research into an application that can be used on various devices.

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