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Detection of Female Students' Room Neatness Using YOLOv5

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Abstract Room neatness is an important aspect in creating a clean, comfortable, healthy, and supportive learning environment for female students in an Islamic boarding school. In the Al-Hasyimiyah area of Nurul Jadid, room neatness assessment is routinely carried out by the Environmental Conservation and Hygiene Division and regional administrators. However, manual assessment may lead to differences in perception among evaluators and requires considerable time and effort due to the large number of rooms to be assessed. This study aims to develop a female students' room neatness detection system using the You Only Look Once version 5 (YOLOv5) method and implement it in a Flask-based web application. The dataset consisted of 1,000 room images divided into two classes: Neat Room and Untidy Room. The data were collected directly using a Canon EOS 1300D camera and then processed through resizing, annotation using Roboflow, and dataset splitting with a ratio of 70% training data, 20% validation data, and 10% testing data. The model was trained using YOLOv5s with an image size of 640 pixels, a batch size of 16, and 100 epochs. The training results achieved an mAP value of 0.989. Testing on 100 images showed that the Untidy Room class achieved a detection accuracy of 92%, the Neat Room class achieved 94%, and the overall accuracy reached 93%. The Flask web implementation allows users to upload room images and view detection results automatically. The findings indicate that YOLOv5 can be used as a supporting tool for assessing female students' room neatness more quickly and objectively.

Keywords *Computer Vision; Flask; Roboflow; Room Neatness; YOLOv5*

1. INTRODUCTION

A room is an important space for female students to rest, study, store personal belongings, and carry out daily activities in the Islamic boarding school environment. A neat, clean, and well-organized room can improve comfort, maintain health, and support a better learning atmosphere. In the boarding school context, room neatness is not only related to physical cleanliness but also forms part of discipline development, responsibility, and a healthy lifestyle culture. In the Al-Hasyimiyah area of Nurul Jadid, room neatness assessment is carried out by the Environmental Conservation and Hygiene Division and regional administrators. This activity aims to maintain the cleanliness and aesthetics of female students' rooms continuously. Female students are required to clean their rooms according to scheduled duties, while administrators conduct routine assessments. Rooms that achieve the best cleanliness status consecutively may receive rewards from the Environmental Conservation and Hygiene Division in the form of cleaning equipment. This activity shows that room neatness assessment has both educational and administrative functions in boarding school management.

However, manual assessment has several limitations. Differences in perception among evaluators may cause inconsistent assessment standards. In addition, the large number of rooms to be inspected makes the assessment process time-consuming and labor-intensive. This condition indicates the need for a technology-based support system that can assist room neatness assessment in a more consistent, faster, and well-documented manner.

The development of computer vision and deep learning provides opportunities to build image-based object detection systems. Object detection enables a system to recognize specific objects or conditions in images, assign class labels, and display bounding boxes on detected areas (Li et al., 2022; Raspati, 2023). Several previous studies have applied Convolutional Neural Network, Support Vector Machine, Neural Network, and YOLO for the classification or detection of room conditions, cleanliness, and garbage piles. Dharmali et al. (2021) showed that CNN could be used to classify hotel room neatness, while Rachmi and Al Kaafi (2022) compared SVM and Neural Network for detecting room cleanliness. YOLO is one of the deep learning-based object detection methods known for its speed and accuracy. YOLOv5 is widely used because it has a relatively lightweight model size, efficient training process, and good object detection capability (Horvat & Gledec, 2022; Mulyana et al., 2022). In this study, YOLOv5 is used to detect two room condition classes, namely Neat Room and Untidy Room. This method was selected because it can directly detect objects in images and provide a confidence score as an indicator of the model's certainty in its detection results.

The novelty of this study lies in the application of YOLOv5 to detect the neatness of female students' rooms in the Islamic boarding school environment, specifically in the Al-Hasyimiyah area of Nurul Jadid. This study not only trains a detection model but also implements it into a Flask web application so that it can be used more practically by administrators. Therefore, the developed system is expected to assist the Environmental Conservation and Hygiene Division and regional administrators in conducting initial room neatness assessments automatically.

This study aims to test the YOLOv5 method for detecting female students' room neatness and to produce a Flask-based web application that can display detection results automatically. The findings are expected to support a more efficient room monitoring process, reduce assessment subjectivity, and serve as a basis for developing a computer vision-based cleanliness evaluation system in the Islamic boarding school environment.

2. RESEARCH METHODS

This study used an experimental approach based on deep learning. The research stages included problem analysis, dataset collection, preprocessing, data annotation, YOLOv5 implementation, model training, model testing, Flask web implementation, and conclusion drawing.

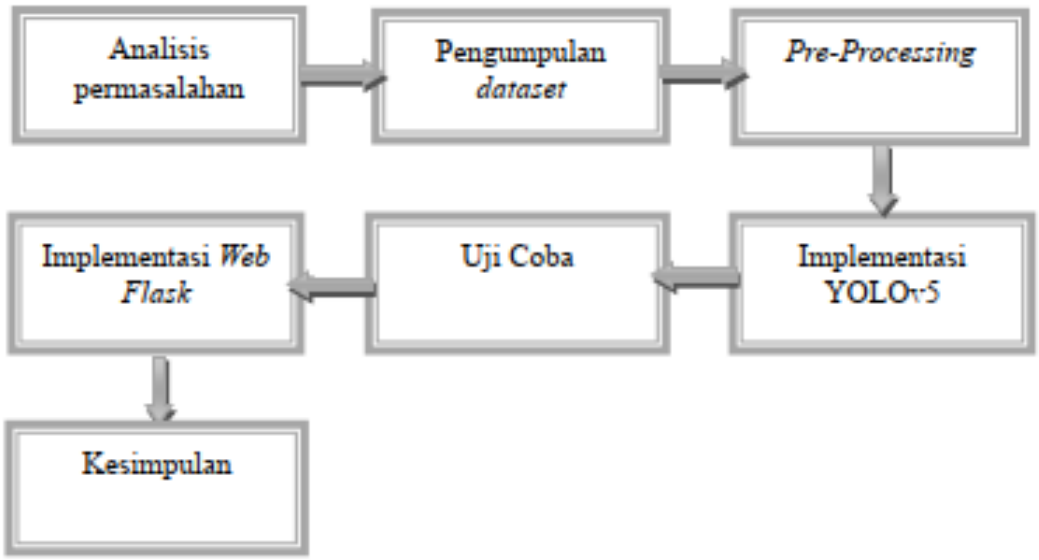

Figure 1. Research Framework

2.1. Research Object and Dataset

The research object was the neatness condition of female students' rooms in the Al-Hasyimiyah area of Nurul Jadid. The dataset was collected directly using a Canon EOS 1300D camera. Images were captured from different angles and lighting conditions so that the model could recognize variations in room conditions. The dataset consisted of two classes: Neat Room and Untidy Room.

Table 1. Dataset Composition

Class	Number of Images	Description
Neat Room	500	Room images with organized conditions according to neatness criteria
Untidy Room	500	Room images with unorganized conditions or not meeting neatness criteria
Total	1,000	Complete dataset

The dataset was then divided into training, validation, and testing data with a ratio of 70:20:10. This division was carried out to ensure that the model had separate training data, validation data during training, and final testing data.

Table 2. Dataset Splitting

Data Type	Percentage	Number of Images

Training	70%	700
Validation	20%	200
Testing	10%	100
Total	100%	1,000

2.2. Room Neatness Criteria

The criteria for a neat room refer to the standards of the Environmental Conservation and Hygiene Division of the Al-Hasyimiyah area. A room is categorized as neat if the items are arranged properly, there are no hanging objects that disturb the room's aesthetics, no wet clothes are dried inside the room, the floor is clean, cleaning tools are available, and personal belongings are placed according to the rules. These criteria were used as the basis for labeling the dataset.

Table 3. Neat Room Criteria

No	Criteria
1	No items are hung carelessly on cupboard doors
2	No wet clothes are dried inside the room
3	The floor and room area are clean
4	Items are neatly arranged according to the rules
5	Labels or identities are attached to certain belongings
6	Cleaning tools are available and properly arranged

Figure 2. Examples of Neat Room and Untidy Room Datasets

2.3. Preprocessing and Annotation

The preprocessing stage was conducted to standardize image size before being used in YOLOv5 training. The original large images were converted to a resolution of 1024 × 1024 pixels using Python and OpenCV. After that, the images were uploaded to Roboflow for annotation. In Roboflow, the images were annotated with bounding boxes according to the Neat Room and Untidy Room classes. The dataset resolution in Roboflow was then adjusted to 640 × 640 pixels to match the YOLOv5 training configuration.

Figure 3. Dataset Image Resizing Process

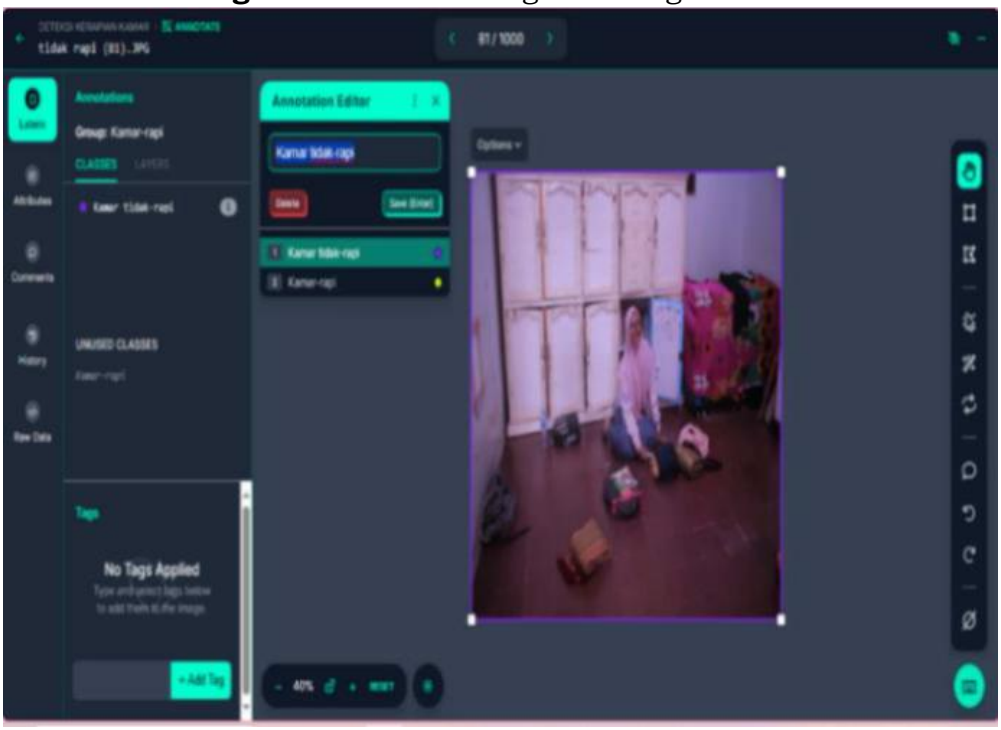

Figure 4. Dataset Annotation Process Using Roboflow

2.4. YOLOv5 Implementation

The model used in this study was YOLOv5s. YOLOv5s was selected because it has a lighter model size and faster training time compared to larger YOLOv5 variants. The implementation was carried out using Google Colaboratory with PyTorch support and the YOLOv5 repository from Ultralytics. The annotated dataset from Roboflow was downloaded in YOLOv5 format and used as training input.

Table 4. YOLOv5 Training Configuration

Parameter	Value
Model	YOLOv5s

Image size	640 × 640 pixels
Batch size	16
Epochs	100
Dataset format	YOLOv5
Training platform	Google Colaboratory
Implementation framework	Flask

2.5. Model Evaluation

The model was evaluated using precision, recall, mAP, confusion matrix, and detection accuracy based on the testing data. The mAP value was used to assess the overall object detection capability of the model, while manual testing was conducted on 100 testing images. The detection accuracy formula used in this study is as follows:

[
Accuracy = \frac{\sum Correct\ Data}{\sum Testing\ Data} \times 100%
]

Testing was conducted on two classes, namely Neat Room and Untidy Room. Each detection result was compared with the actual label to determine the number of correctly and incorrectly detected images.

2.6. Flask Web Implementation

After the YOLOv5 model was trained and tested, it was implemented into a web application using Flask. The application was designed so that users could upload room images, and the system would display the detection result, including the room class and confidence score. This web implementation aims to make it easier for administrators to use the model without directly running the code manually.

3. RESULTS

3.1. Dataset and Preprocessing Results

The dataset used in this study consisted of 1,000 images with two main classes: Neat Room and Untidy Room. The images were collected directly in the Al-Hasyimiyah area of Nurul Jadid. The preprocessing stage successfully standardized the image sizes so that the data were ready for annotation and YOLOv5 training. After the annotation process in Roboflow, the dataset was exported in YOLOv5 format and used in Google Colaboratory.

Figure 5. Dataset Annotation Results in Roboflow

3.2. Training Results

YOLOv5 training was conducted using 100 epochs, a batch size of 16, and an image size of 640 pixels. The training results showed that the model could learn the visual patterns of the two room classes well. Based on the training results, the model achieved an mAP value of 0.989. This value indicates that the model has high detection capability for the Neat Room and Untidy Room classes.

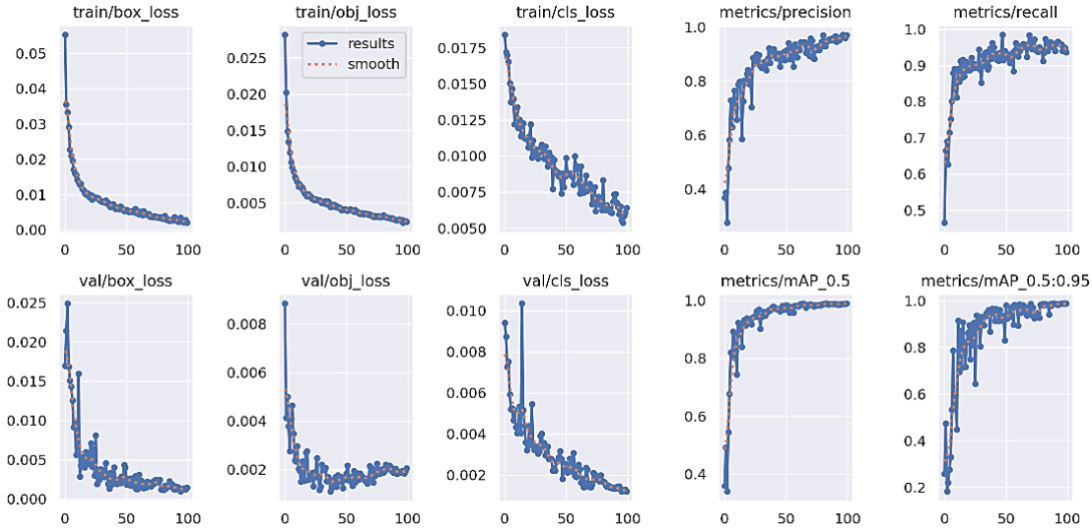

Figure 6. YOLOv5 Model Training Graph

In general, the training graph showed a decrease in loss values and an increase in evaluation metrics during the training process. The decrease in loss indicates that the model became better at predicting bounding boxes and object classes. Meanwhile, the increase in precision, recall, and mAP indicates that the model achieved better detection performance on training and validation data., adultery, and polygamy were the least frequent factors in the analyzed data.

Table 5. Summary of YOLOv5 Training Results

Metric	Value
Epochs	100
Batch size	16
Image size	640
mAP	0.989
Best F1 confidence	0.652
Highest precision	1.00 at confidence 0.961

3.3. Testing Results

Testing was conducted using 100 testing images consisting of 50 Untidy Room images and 50 Neat Room images. The results showed that the model correctly detected 93 images and incorrectly detected 7 images. In the Untidy Room class, 46 out of 50 images were correctly detected. In the Neat Room class, 47 out of 50 images were correctly detected.

Table 6. YOLOv5 Testing Results

Class	Number of Testing Images	Correctly Detected	Incorrectly Detected	Detection Accuracy
Untidy Room	50	46	4	92%
Neat Room	50	47	3	94%
Total	100	93	7	93%

Based on Table 6, the overall detection accuracy was calculated as follows:

[
Accuracy = \frac{46+47}{100} \times 100% = 93%
]

These results indicate that YOLOv5 can detect female students' room neatness with good performance. Detection errors may be influenced by several factors, such as variations in image-capturing angles, similar backgrounds, different lighting conditions, and limited training data variations that do not fully represent all possible room conditions.

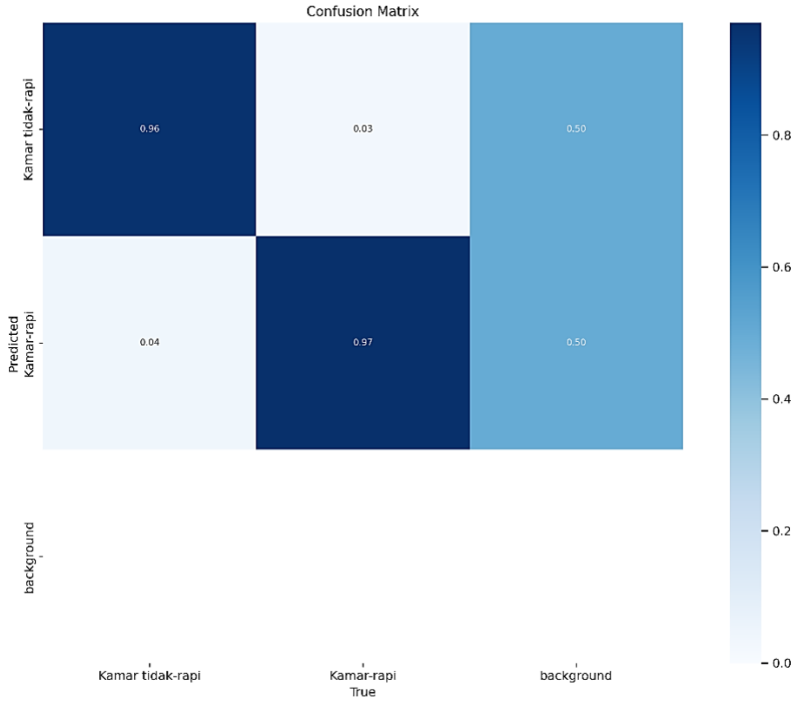

Figure 7. Confusion Matrix of YOLOv5 Detection Results

Figure 8. Example of Correct Detection Result

Figure 9. Example of Incorrect Detection Result

3.4. Detection Result Interpretation

YOLOv5 detection results display class labels and confidence scores. The confidence score indicates the model's level of certainty toward its prediction. For example, a Neat Room detection result with a confidence score of 0.87 indicates that the model has high confidence that the image belongs to the Neat Room category. Similarly, an Untidy Room detection result with a confidence score of 0.92 indicates high confidence in that class. In practice, the confidence score can be used as supporting information for assessment. However, it should not be used as the sole basis for decision-making, especially when the image has poor quality, insufficient lighting, or important objects are obscured. Therefore, system results should still be reviewed by administrators when the image condition is uncertain.

3.5. Flask Web Application Results

The YOLOv5 model was then implemented into a Flask-based web application. The application provides a main page for uploading room images. After an image is uploaded, the system processes it and displays the detection result.

This implementation makes the model easier for administrators to use because detection can be performed through a browser.

```
PS D:\YOLOv5> python -u "d:\YOLOv5\app.py"
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server i
nstead.
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
 * Restarting with watchdog (windowsapi)
 * Debugger is active!
 * Debugger PIN: 119-632-749
 * Detected change in 'C:\\Python\\Python312\\Lib\\site-packages\\werkzeug\\datastructures\\__init__.py', reloa
ding
 * Restarting with watchdog (windowsapi)
 * Debugger is active!
 * Debugger PIN: 119-632-749
```

Figure 10. Flask Application Running Process

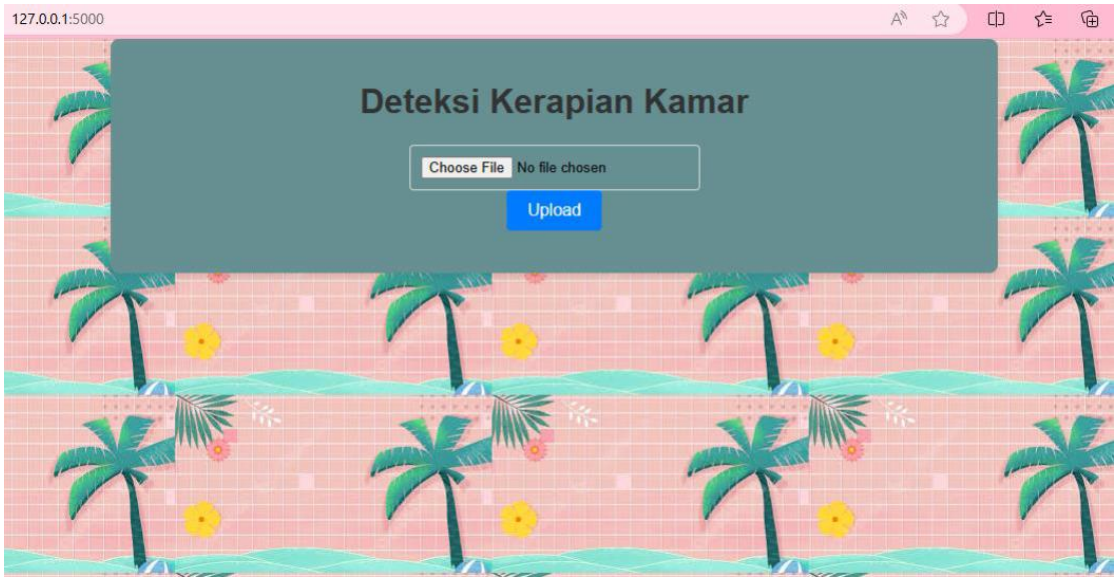

Figure 11. Room Detection Application Homepage

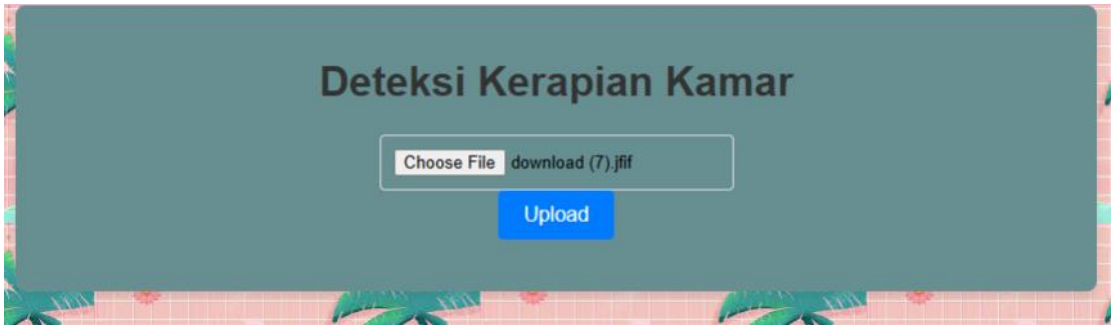

Figure 12. Image Upload Display in the Flask Application

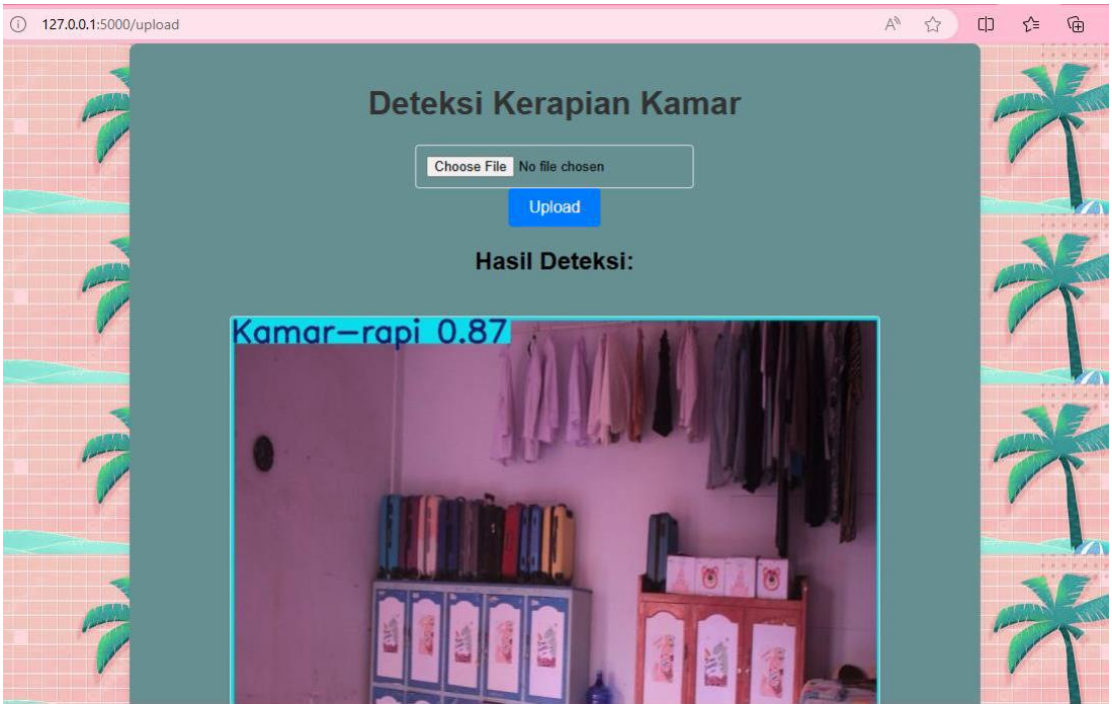

Figure 13. Neat Room Detection Result in the Flask Application

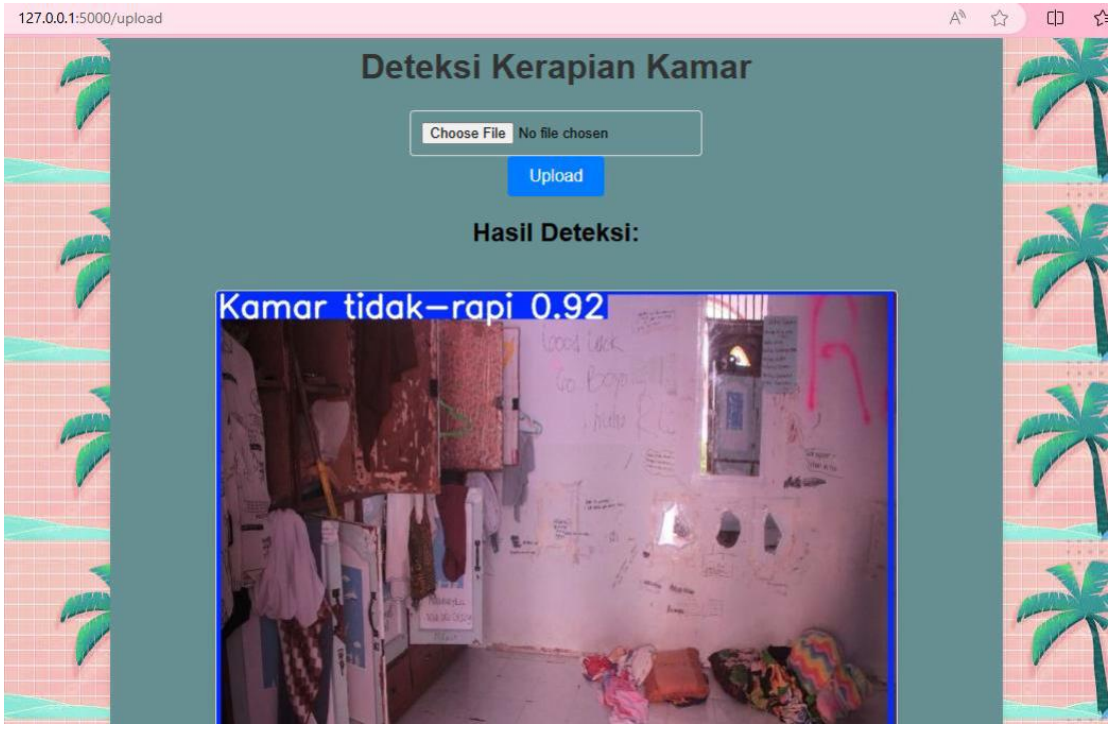

Figure 14. Untidy Room Detection Result in the Flask Application

The Flask web implementation shows that the YOLOv5 model can be used in a simple application form. This system can assist the Environmental Conservation and Hygiene Division and regional administrators in conducting initial assessments of female students' room neatness automatically. Therefore, room monitoring can be carried out more quickly, although final decisions still need to consider field conditions and assessment standards set by administrators.

4. CONCLUSIONS

This study successfully applied the YOLOv5 method to detect female students' room neatness in the Al-Hasyimiyah area of Nurul Jadid. The dataset consisted of 1,000 images divided into two classes: Neat Room and Untidy Room. The dataset was split into 700 training images, 200 validation images, and 100 testing images. The preprocessing process included image resizing, annotation using Roboflow, and dataset export in YOLOv5 format. The YOLOv5s model was trained using an image size of 640 pixels, a batch size of 16, and 100 epochs. The training results achieved an mAP value of 0.989. During testing, the model correctly detected 46 out of 50 Untidy Room images and 47 out of 50 Neat Room images. Therefore, the detection accuracy for the Untidy Room class was 92%, the Neat Room class was 94%, and the overall accuracy was 93%. The trained model was successfully implemented into a Flask-based web application. The application allows users to upload room images and view detection results automatically. This system can assist the Environmental Conservation and Hygiene Division and regional administrators in conducting initial monitoring of female students' room neatness more quickly and objectively. This study still has several limitations, particularly in dataset variation, image-capturing angles, lighting conditions, and the number of represented room conditions. Future research is recommended to increase image variation, add object-level estimation related to room neatness, use data from several boarding school areas, and compare YOLOv5 with other models such as YOLOv8, Faster R-CNN, or EfficientDet to achieve more optimal performance.

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