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Implementation of You Only Look Once Version 8 Algorithm to Detect Multi-Face Drivers and Vehicle Plates

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Abstract

Checking the identity of motorcycle owners when leaving the college area is a mandatory activity for security officers to ensure that vehicles entering and exiting the college are the same driver. The conventional checking process often causes the impact of vehicle queues when the volume of vehicles increases. Therefore, an intelligent system is needed to detect multi-plate vehicles automatically. One approach in the world of image detection of an object is the use of the YOLO (You Only Look Once) algorithm. This algorithm predicts bounding boxes and possible classes in a single frame. This research divides objects into 3 classes, namely vehicles, driver's faces, and vehicle plates. The dataset used was 74 varied images consisting of 50 training data, 12 validation data and 12 testing data. The image was trained using 300 epochs and a batch size of 8 and resulted in an F1 score calculation for detecting objects reaching 92%.

Keywords: Driver's Faces, Multi-Face, Vehicle Plates

1. Background

Checking the identity of vehicle ownership when leaving the parking area is a mandatory activity for security officers to ensure that vehicles leaving and entering are driven by the same person. The conventional checking process or by looking at the Vehicle Registration Certificate often results in vehicle queues when the volume of vehicles increases (Dewiani et al., 2021; Galahartlambang et al., 2023). To reduce this impact, an intelligent system is needed to automatically detect plates.

Artificial Intelligence is the ability of machines to perform tasks that generally require human intelligence (Rifky, 2024). Artificial intelligence (AI) is perhaps the oldest and broadest field of computer science, dealing with all aspects of mimicking cognitive functions to solve real-world problems and building systems that learn and think like humans (Holzinger et al., 2019). One of the rapidly developing branches of artificial intelligence is computer vision (Yudistira Bagus Pratama & Nurzaidah Putri Dalimunthe, 2022).

Computer vision is basically a discovery in the field of computers that is often used in systems that almost resemble the human visual system (Susim et al., 2021). Computer vision is basically a discovery in the field of computers that is often used in systems that almost resemble the human visual system (Susim et al., 2021).

An image is a two-dimensional representation of the light intensity function (Firmansyah & Hermawan, 2023). One approach in the world of object image detection is You Only Look Once (YOLO) (Maleh et al., 2023). YOLO is an algorithmic method that can detect objects very realistically and has a high level of accuracy (Rahma et al., 2021). This algorithm predicts the bounding box and possible classes in one frame (Maleh et al., 2023).

In previous research entitled YOLO V5 for Vehicle Plate Detection in DKI Jakarta, the journal successfully detected vehicle license plates in DKI Jakarta using YOLO v5. The final result of the journal is a system that works well, with an accuracy above 90% (Illmawati & Hustinawati, 2022).

YOLO is a real-time algorithm capable of detecting objects in a one shot scan (Christoper Nugraha, 2023). Based on this explanation, problems concerning the detection of vehicle users need to apply multi-license plate detection using the You Only Look Once (YOLO) algorithm.

This research aims to facilitate checking more than one driver simultaneously in one frame, so as to save time in the checking process. The system automatically distinguishes, labels and stores each plate along with the driver's face.

2. Research Methods

Vehicle license plate detection using the YOLO algorithm.

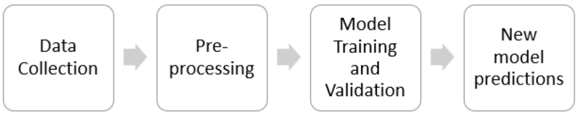

Figure 1. Research Stages

2.1. Collecting Data

Data collection was carried out by taking pictures of college students who were using motorbikes and had motorbike plates directly.

The dataset is divided into training data, validation data, and testing data. The model is built using 50 training images and 12 validation images. Then the model that has been built is detected using 12 test data.

2.2. *Pre-processing* data

Before carrying out the data training stage, the data first goes through a pre-processing stage. The pre-processing stage is an important stage for cleaning and preparing data before proceeding to further analysis (Aini et al., 2024; Christoper Nugraha, 2023; Nurussakinah & Faisal, 2023).

In this study, the pre-processing stage consists of the image resizing and automatically labeling stages. (Ratri Enggar Pawening et al., 2023).

The resizing stage is useful for reducing the size of the image, ensuring size consistency, and speeding up the process (Aprillia et al., 2024; Ratri Enggar Pawening et al., 2023; Saputra et al., 2023; Simbolon et al., 2024).

Labeling is done after the system applies the bounding box and separates each face and the different driver plates.

2.3. *Training, validasi,* and *testing* model

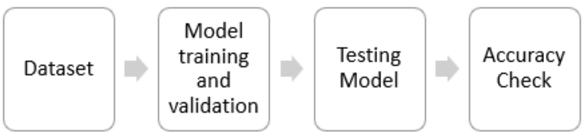

Figure 2. System flow

In the training stage, the model will be trained with the YOLO algorithm which is designed to identify and differentiate between motorcycle license plates 1 and other motorcycle license plates. The amount of training data used is 50 data (80%).

At the testing stage, the trained model will be retested with 12 new data (20%). Object detection is in the form of searching for and matching image patterns with model patterns, so that the highest prediction is obtained from all classes available in the model (Illmawati & Hustinawati, 2022).

Evaluasi performa pada penelitian ini menggunakan metrik evaluasi akurasi, presisi, recall, specificity, dan f1-score.

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}}$$

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

$$\text{Recall} \quad = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

$$\text{Specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}}$$

$$\text{F1 Score} = 2 \times \frac{\text{recall} \times \text{precision}}{\text{recall} + \text{precision}}$$

3. Result & Discussion

3.1. Collecting Data

This study uses a dataset of 74 images. The following are sample images used. Below is a sample of the image used.

Table 1. Sample Dataset

Sample	1 object	2 object	3 objects
1			
2			
3			

The image data used consists of motorcycle objects, rider faces, and vehicle plates in the same frame. Table 1 shows different data or samples. This shows that the camera can detect objects according to real conditions and clearly shows both the rider's face and the motorcycle plate owned by the rider. The data collection was carried out over several days

3.2. *Training* and *validasi* model

After the data is obtained, the dataset goes through a pre-processing stage which includes adjusting the size of the model data, determining the number of epochs, and dividing the batch size. The following is a display of the pre-processing results that have been carried out by the system.

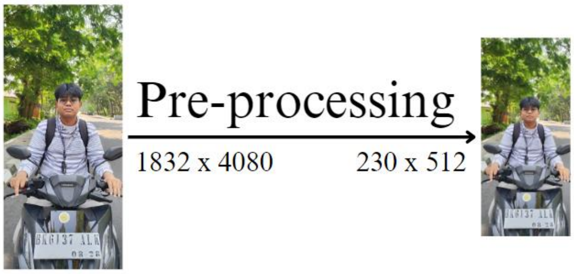

Figure 3. Pre-processing Result

After the entire dataset has gone through the pre-processing stage, each image has been labeled. The image size is also changed to 230 px wide and 512 px high. The labeling aims to distinguish each characteristic possessed by each object. The following is a display of the labels given by the system.

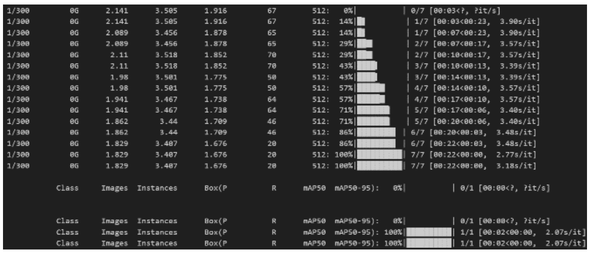

Figure 4. Training Model

Figure 4 shows the training model of 74 images recorded during dataset collection. The modeling carried out obtained special characteristics where later these characteristics were used as learning in the testing process (Rahma et al., 2021).

Based on the dataset obtained, a dataset of 50 images was trained using 300 epochs and a batch size of 8. In the next stage, the trained model will be validated using 12 images. The results show that all images were successfully classified into the correct class as seen in Figure 5.

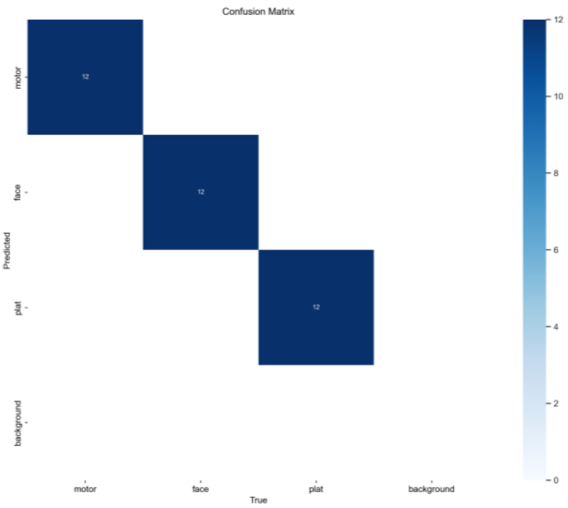

Figure 5. Confusion Matrix Model

Figure 5 shows the matrix for each dataset grouped in the system, namely 12 images consisting of face, license plate and motorcycle classes. After the dataset is grouped based on its class, the dataset enters the validation stage. The following model result curve can be seen in Figure 6.

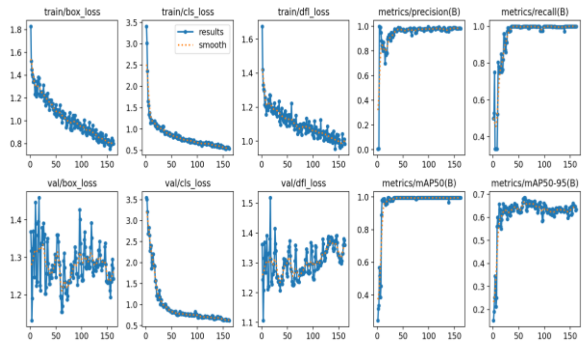

Figure 6. Training and Validation Result Curve

Figure 6 shows that the validation results of the irregular curve change model, but this only occurs in the loss curve. The model performance on the training set and the validation set based on the curve did not experience a significant increase or decrease, so it tends to be stable. So it can be concluded that the training and test models do not experience overfitting or underfitting.

These statistical results are very important for assessing the generalization of the model and the ability to handle changes in the size and location of items in the data set (Sarhan et al., 2024).

3.3. Testing and model accuracy

The testing and model accuracy stage is a process where the model that has been built is then tested using 12 testing data. Here are examples of vehicle object detection, driver faces, and vehicle plates.

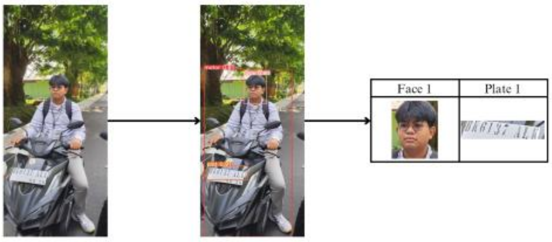

Figure 7. Example of 1 Object Detection

Figure 8. Example of 2 Object Detection

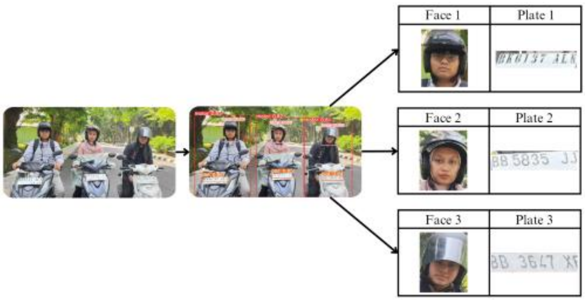

Figure 9. Example of 3 Object Detection

In the process of detecting the driver's object captured by the camera, there is a process of grouping faces with vehicle plates. If the real object is two drivers, the system automatically groups the face with the vehicle plate that is being driven correctly. The following are the details of the test results for 12 testing data as seen in Table 2.

Table 2. Test Result

Data	Real Object			Detection		
	A	B	C	A	B	C
1	3	3	3	3	3	1
2	3	3	3	3	3	3
3	2	2	2	2	2	2
4	2	3	2	2	2	2
5	2	2	2	2	2	2
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1
9	1	1	1	1	1	1
10	3	3	3	3	3	3
11	2	2	2	2	2	2
12	3	3	3	3	3	3

Information:
A = Number of Motorcycle
B = Number of Face
C = Number of Plate

Figure 10 is used to simplify the reading of the test data detection results.

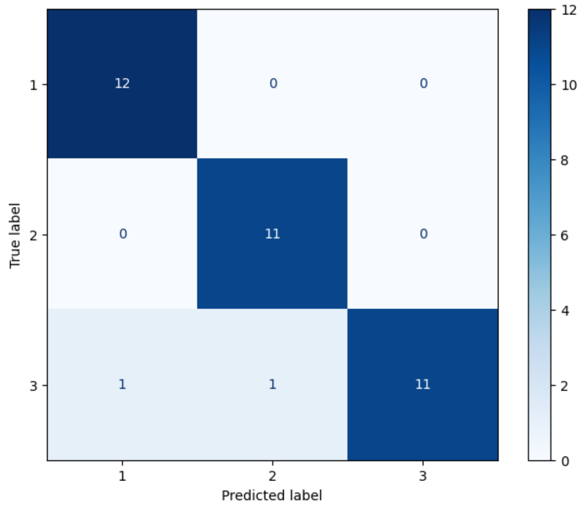

Figure 10. Test Results

Table 2 and Figure 10 shows the occurrence of detection errors made by the system on vehicle plate data 1 where there should be 3 vehicle plates in 1 frame, but only 1 vehicle plate is detected. Likewise for the driver's face in data 4 where there should be 3 driver faces, but only 2 driver faces are detected.

Calculation of the classification performance of each test method is performed using Confusion Matrix to obtain accuracy, precision, and recall results. Confusion Matrix is used to estimate how good the classification is in detecting unbalanced classes. Confusion Matrix can be seen in table 3.

Table 3. Confusion Matrix

Actual Value	Assigned Classes	
	Positive	Negative
Positive	True Positive	False Negative
Negative	False Positive	True Negative

So that the test data results show as shown in figure 11.

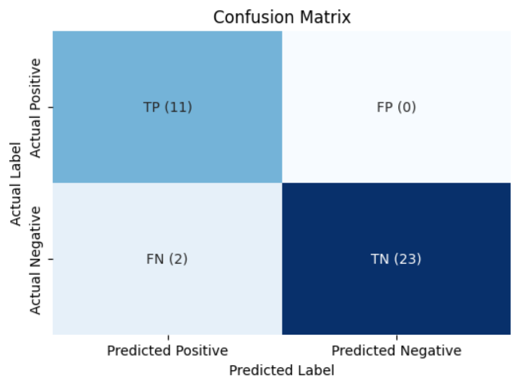

Figure 11. TP, FP, FN, and TN Calculation

Based on the data that has been tested, Figure 11 is the result of distribution using confusion matrix to determine precision, recall, and F1-score for each method.

$$\text{Accuracy} = \frac{11+23}{11+23+0+2} = 0.94$$

$$\text{Precision} = \frac{11}{11+0} = 1.00$$

$$\text{Recall} \quad = \frac{11}{11+2} = 0.85$$

$$\text{Specificity} = \frac{23}{23+0} = 1.00$$

The test data detection results are then checked for accuracy using F1 Score.

$$\text{F1 Score} = 2 \times \frac{0.85 \times 1.00}{0.85 + 1.00} = 0.92$$

The F1 Score calculation results reached 92%. Based on the results obtained, the model's strong performance, high accuracy, and low loss score that can be generalized well from training data to validation data indicate an effective and well-generalized model that is suitable for use.

4. Conclution

This study develops a plate and face detection system that utilizes YOLO. Through the stages of data collection and testing datasets from the images obtained, the drilled model shows high accuracy and does not experience overfitting. This study divides objects into 3 classes, namely vehicles, driver faces, and vehicle plates. The dataset used is 74 varying images consisting of 50 training data, 12 validation data, and 12 testing data. The images were drilled using 300 epochs and a batch size of 8 and produced an F1 score calculation to detect objects reaching 92%. The system that has been developed and has a high level of accuracy can help minimize congestion in parking lots. This has also been proven to help security in improving the security of vehicles owned by drivers

To develop the research to better support parking security, the researcher suggests that future research performs plate number extraction and ensures that the plate number matches the driver's face.

Referensi

Aini, N., Arif, M., Agustin, I. T., & Toyibah, Z. B. (2024). Implementasi Algoritma Random Forest untuk Klasifikasi Bidang MSIB di Prodi Pendidikan Informatika. *Jurnal Informatika*, *11*(1), 11–16. https://doi.org/10.31294/inf.v11i1.20637

Aprillia, D., Rohana, T., Al Mudzakir, T., & Wahiddin, D. (2024). KLIK: Kajian Ilmiah Informatika dan Komputer Deteksi Nominal Mata Uang Rupiah Menggunakan Metode Convolutional Neural Network dan Feedforward Neural Network. *Media Online*, *4*(4). https://doi.org/10.30865/klik.v4i4.1711

Christoper Nugraha, K. (2023). Deteksi Plat Nomor Kendaraan Menggunakan Algoritma Yolo (Vehicle License Plate Detection Using Yolo Algorithm). *Jurnal Algoritma, Logika Dan Komputasi*, *VI*(2), 605–611. https://doi.org/10.30813/j-alu.v2i2.4739

Dewiani, Syarif, S., Anshar, M., Areni, I. S., Palantei, E., Panggalo, S., Zaenab, Wardi, Hasniaty, A. D. A., Arief, A. B., & Hanan, M. (2021). Sosialisasi Penggunaan Parkir Cerdas Pada Departemen Teknik ElektroUniversitas Hasanuddin. *Jurnal Tepat(Teknologi Terapan Untuk Pengabdian Masyarakat)*, *4*(1), 94–100. https://eng.unhas.ac.id/tepat/index.php/Jurnal_Tepat/article/view/164/103

Firmansyah, G., & Hermawan, A. (2023). Implementasi Algortima Naive Bayes Untuk Klasifikasi Kesegaran Buah Jeruk. *Jurnal Informatika*, *10*(2), 180–184. https://doi.org/10.31294/inf.v10i2.16115

Galahartlambang, Y., Khotiah, T., Fanani, Z., Aprilia Yani Solekhah, A., Studi Teknologi Informasi, P., & Teknologi dan Bisnis Ahmad Dahlan Lamongan Jl Ahmad Dahlan No, I. K. (2023). Deteksi Plat Nomor Kendaraan Otomatis Dengan Convolutional Neural Network dan OCR Pada Tempat Parkir ITB Ahmad Dahlan Lamongan. *Jurnal Manajemen Informatika & Sistem Informasi (MISI)*, *6*(2), 114. https://doi.org/10.36595/misi.v5i2

Holzinger, A., Langs, G., Denk, H., Zatloukal, K., & Müller, H. (2019). Causability and explainability of artificial intelligence in medicine. In *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery* (Vol. 9, Issue 4). Wiley-Blackwell. https://doi.org/10.1002/widm.1312

Illmawati, R., & Hustinawati. (2022). YOLO v5 untuk Deteksi Nomor Kendaraan di DKI Jakarta YOLO V5 for Vehicle Plate Detection in DKI Jakarta. *Jurnal Ilmu Komputer Agri-Informatika*, *10*(1), 33–43. https://journal.ipb.ac.id/index.php/jika/article/view/46746/25834

Maleh, I. M. D., Teguh, R., Sahay, A. S., Okta, S., & Pratama, M. P. (2023). Implementasi Algoritma You Only Look Once (YOLO) Untuk Object Detection Sarang Orang Utan Di Taman Nasional Sebangau. *Jurnal Informatika*, *10*(1), 19–27. https://doi.org/10.31294/inf.v10i1.13922

Nurussakinah, N., & Faisal, M. (2023). Klasifikasi Penyakit Diabetes Menggunakan Algoritma Decision Tree. *Jurnal Informatika*, *10*(2), 143–149. https://doi.org/10.31294/inf.v10i2.15989

Rahma, L., Syaputra, H., Mirza, A. H., & Purnamasari, S. D. (2021). Objek Deteksi Makanan Khas Palembang Menggunakan Algoritma YOLO (You Only Look Once). *Jurnal Nasional Ilmu Komputer*, *2*(3), 2746–1343.

Ratri Enggar Pawening, Meliana Eka Puteri, Agmelita Dwi Jianika, & Fitriyah Hidayati. (2023). Deteksi Objek pada Citra Makanan Sebagai Rekomendasi Diet Menggunakan Metode Mask R-CNN. *Jurnal Ilmiah Teknik Informatika Dan Komunikasi*, *4*(1), 87–97. https://doi.org/10.55606/juitik.v4i1.733

Rifky, S. (2024). Indonesian Journal of Multidisciplinary on Social and Technology Homepage Dampak Penggunaan Artificial Intelligence Bagi Pendidikan Tinggi. *Indonesian Journal of Multidisciplinary on Social and Technology*, *2*(1), 37–42. https://doi.org/10.31004/ijmst.v2i1.287

Sainui, J., Thepporn, C., & Chusuwan, P. (2024). Thai License Plate Recognition using SSD MobileNet and EasyOCR. *ACM International Conference Proceeding Series*, 36–41. https://doi.org/10.1145/3645259.3645266

Saputra, D. H., Imran, B., & Juhartini. (2023). Object Detection Untuk Mendeteksi Citra Buah Buahan Menggunakan Metode YOLO. *Jurnal Kecerdasan Buatan Dan Teknologi Informasi*, *2*(2), 70–80.

Sarhan, A., Abdel-Rahem, R., Darwish, B., Abou-Attia, A., Sneed, A., Hatem, S., Badran, A., & Ramadan, M. (2024). Egyptian car plate recognition based on YOLOv8, Easy-OCR, and CNN. *Journal of Electrical Systems and Information Technology*, *11*(1), 32. https://doi.org/10.1186/s43067-024-00156-y

Simbolon, I. N., Fernandez Lumbanraja, D., & Tampubolon, K. (2024). Analysis And Implementation Of YOLOv7 In Detecting Pin Del In Real-Time. *Jurnal Teknik Informatika (JUTIF)*, *5*(2), 579–587. https://doi.org/10.52436/1.jutif.2024.5.2.1286

Susim, T., Darujati, C., & Artikel, I. (2021). Pengolahan Citra Untuk Pengenalan Wajah (Face Recognition) Menggunakan OpenCV. *Jurnal Syntax Admiration*, *2*(3).

Yudistira Bagus Pratama, & Nurzaidah Putri Dalimunthe. (2022). Implementasi Teknik Computer Vision Untuk Deteksi Viridiplantae Pada Lahan Pasca Tambang. *Bulletin of Computer Science Research*, *3*(1), 64–72. https://doi.org/10.47065/bulletincsr.v3i1.193