Dashcam for Traffic Object Detection

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***Abstract*—Dashcam is a camera stored in a vehicle. This tool serves to record all events in front of the vehicle. Security and safety have become a major concern in various sectors, including transportation and public security. On the highway, traffic accidents caused by the driver's ignorance of objects around the vehicle are still a serious problem. In this study, the development of a simple dashcam built from an edge computer was carried out by combining the number of cameras. Image stitching is applied to combine images that have been collected by each camera. Next, object detection is carried out on the images that have been collected. The object detection system approach is carried out using YOLOv8 which is the latest variant of the YOLO series. This research is expected to be one step in the development of an Intelligent Transportation System that is in accordance with traffic conditions in Indonesia. The results obtained in testing using the system created exist using the configuration of 78000 datasets, 3332 data validation with 8 epochs, batch size 32, linear learning rate and SGD optimization. Results are best in the morning and afternoon. The program can recognize predefined objects.**

***Index Terms*—object detection, YOLOv8, dashcam**

I. Introduction

Security and safety have become a major concern in various sectors, including transportation and public security. On the highway, traffic accidents caused by the driver's ignorance of objects around the vehicle are still a serious problem. Smart and effective object detection technology is becoming increasingly important for monitoring traffic [1].

Video captures from dashcams usually only show one side according to the camera position. However, this results in a lack of information about nearby objects. To overcome this problem, this study tried a solution by using two cameras or cameras placed at different positions in the vehicle. By using more than one camera, diverse viewing angles can provide more complete information about objects around the vehicle. For example, the camera on the left side helps detect objects on the left, while the camera on the right side helps detect objects on the right. This approach is expected to provide more comprehensive results according to the actual situation in front of the vehicle. Therefore, the study of the application of dual cameras to detect objects becomes very relevant and interesting. By optimizing the use of dual cameras, it is hoped that this technology will be able to provide effective solutions in increasing driver awareness and safety on the road. The application of dual cameras for object detection has the potential to reduce accident incidents, reduce the risk of collisions, and improve the safety of all road users.

II. Literature Review

A. Object Detection

Object Detection is one of the important task in computer vision field, mainly dealing with detecting instances of visual object then categorize them into several classes [2]. With this kind of identification and localization, object detection can be used to count objects in a scene and determine and track their precise locations, all while accurately labeling them. Object detection has been widely used for face detection, vehicle detection, pedestrian counting, web images, security systems and driverless cars. Within the past twenty years, object detection have been going through a lot of changes and development. Although it is commonly divided into two periods: "traditional object detection" and "deep learning based". In 2012, Krizhevsky et al. [3] proposed a deep convolutional network trained on a subset of ImageNet.

This network, called AlexNet, was the first to demonstrate that convolutional neural networks (CNNs) could be trained effectively on large-scale datasets and used to achieve state-of-the-art object detection results. A year later, Girshick et al. proposed a new object detection framework called R-CNN [4] because it used region proposals combined with CNNs to detect objects in images. Since then, the field of object detection has been rapidly advancing, with new models, datasets, and techniques emerging in a rapid pace.

B. YOLO (You Only Look Once)

With the born of AlexNet, YOLO `(You Only Look Once)` model was introduced in 2015. Base YOLO model can achieve 45 frame per second. While the sameller version, Fast YOLO can achieve 155 frames per second. YOLO outperform DPM and R-CNN on Picasso Dataset and People-Art Dataset [5].

In the early period of making this paper, YOLOv7 was the latest version of YOLO. However,as January 2023, YOLOv8 was introduced by Ultralytics, the same software company that release YOLOv3 and YOLOv5.

III. System Design

Before you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting. Please note sections III-A–III-F below for more information on proofreading, spelling and grammar.

Keep your text and graphic files separate until after the text has been formatted and styled. Do not number text heads—LaTeX will do that for you.

A. COCO Dataset

The COCO dataset is a large-scale object detection, segmentation, and keypoint dataset. For detection dataset it consists of 80 classes, 330K images, 1.5 million object instances, 80 object categories, 91 stuff categories, 5 captions per image, 250,000 people with keypoints. In total, The Microsoft Common Objects in COntext contains 91 common object categories with 82 of them having more than 5,000 labeled instances. In addition,

B. Dataset Filtering

As mention earlier, COCO dataset contains 80 classes. However, we only need traffic related object classess. Therefore, we filtered the dataset to only contain 12 classes. The classes are:

- Car
- Truck
- Bus
- Motorcycle
- Bicycle
- Traffic Light
- Stop Sign
- Train
- Hydrant
- Cat
- Dog

The result is 78000 images with 12 classes. This amount of data was reduced by 12000 images from the original dataset. By reducing the dataset, our model expected to be faster in training phase and also faster in inference phase.

C. Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive".
- Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
- Do not mix complete spellings and abbreviations of units: "Wb/m^2" or "webers per square meter", not "webers/m^2". Spell out units when they appear in text: ". . . a few henries", not ". . . a few H".
- Use a zero before decimal points: "0.25", not ".25". Use "cm^3", not "cc".)

D. Equations

Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

E. LaTeX-Specific Advice

Please use "soft" (e.g., `\eqref{Eq}`) cross references instead of "hard" references (e.g., `(1)`). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don't use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

Please note that the `{subequations}` environment in LaTeX will increment the main equation counter even when there are no equation numbers displayed. If you forget that, you might write an article in which the equation numbers skip from (17) to (20), causing the copy editors to wonder if you've discovered a new method of counting.

BibTeX does not work by magic. It doesn't get the bibliographic data from thin air but from .bib files. If you use BibTeX to produce a bibliography you must send the .bib files.

LaTeX can't read your mind. If you assign the same label to a subsubsection and a table, you might find that Table I has been cross referenced as Table IV-B3.

LaTeX does not have precognitive abilities. If you put a `\label` command before the command that updates the counter it's supposed to be using, the label will pick up the last counter to be cross referenced instead. In particular, a `\label` command should not go before the caption of a figure or a table.

Do not use `\nonumber` inside the `{array}` environment. It will not stop equation numbers inside `{array}` (there won't be any anyway) and it might stop a wanted equation number in the surrounding equation.

F. Some Common Mistakes

- The word “data” is plural, not singular.
- The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
- A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
- Do not use the word “essentially” to mean “approximately” or “effectively”.
- In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
- Do not confuse “imply” and “infer”.
- The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
- There is no period after the “et” in the Latin abbreviation “et al.”.
- The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

G. Authors and Affiliations

The class file is designed for, but not limited to, six authors. A minimum of one author is required for all conference articles. Author names should be listed starting from left to right and then moving down to the next line. This is the author sequence that will be used in future citations and by indexing services. Names should not be listed in columns nor group by affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization).

H. Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced.

I. Figures and Tables

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

TABLE I
TABLE TYPE STYLES

Table	**Table Column Head**		
Head	***Table column subhead***	***Subhead***	***Subhead***
copy	More table copy[a]		

[a]Sample of a Table footnote.

Fig. 1. Example of a figure caption.

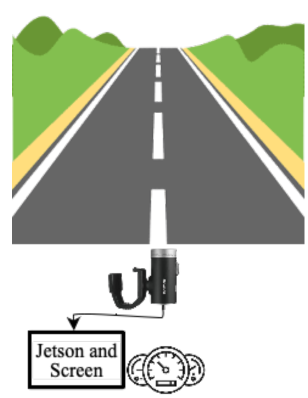

Fig. 2. captions

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization", or "Magnetization, M", not just "M". If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write "Magnetization (A/m)" or "Magnetization {A[m(1)]}", not just "A/m". Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)", not "Temperature/K".

IV. Experiments

A. Experimental Setup

In this section, we will discuss about the experimental setup. We are using Pytorch as our deep learning framework in Python 3. MNodel training was conducted on Geforce RTX 3090, 24 GB VIdeo RAM, 32GB RAM, Intel Core i3-12100 4 Core 8 Thread, running on Windows 10 Model inference and testing was performed on Macbook Air M1, and Jetson Nano 4GB. The camera used in this experiment LifeCam Studio by Microsoft.

B. Dataset

As mention earlier, we are using COCO dataset. However, we filtered the dataset to only contain 12 classes. The classes are: Car, Truck, Bus, Motorcycle, Bicycle, Traffic Light, Stop Sign, Train, Hydrant, Cat, Dog. The result is 78000 images with 12 classes. For inference and real world testing, we gather our own data by recording traffic condition in Bandung, Indonesia. The data was recorded using camera mentioned earlier.

C. Training

Before we begin training process of our YOLOv8n-Traffic model with high number of epoch, we want to find the optimal hyperparamater configuration for our use case. We are doing some experimenttion training with 8 epoch.

D. Real World Testing

V. Conclusion

Dashcam has became a popular device for drivers to record the road condition. However, the dashcam video is not only used for recording the road condition, but also used for other purposes, such as the insurance claim. In this paper, we proposed a dashcam system to detect traffic object. The object detection system is based on the YOLOv8n model. We also proposed a dataset for dashcam traffic object detection. Our dataset created by filtering MS COCO Dataset. The dataset contains 78000 images with 12 traffic objects class.

Acknowledgment

The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g". Avoid the stilted expression "one of us (R. B. G.) thanks …". Instead, try "R. B. G. thanks…". Put sponsor acknowledgments in the unnumbered footnote on the first page.

References

Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first …"

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors' names; do not use "et al.". Papers that have not been published, even if they have been submitted for publication, should be cited as "unpublished" [4]. Papers that have been accepted for publication should be cited as "in press" [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

References

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