PROTOTYPE OF A VEHICLE COUNTING VOLUME SYSTEM FOR TRAFFIC ENGINEERING PLANNING IN DINAS PERHUBUNGAN SUKABUMI *CITY*

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ABSTRACT

The purpose of the study calculating the volume of the vehicle is to facilitate the calculation of the volume of vehicles as well as minimize the time made by officers of the Management Section and Traffic Engineering Department of Transportation in Sukabumi that personnel do not need to come to the field and the system can calculate the volume of car vehicle automatically and in real time. Counting system volume vehicles built using the device camera, raspberry pi and OpenCV where the web camera is placed on a red light with the condition of the vehicle the car went toward a national road. Input from the webcam will be processed by OpenCV as image processing library. Like Haar classification methods are used to detect objects Feature automobiles that require training data in the form of a positive image (RGB) and negative (greyscale) based on the pattern of the integral image. 4 vehicle from the test results, if the training data are used a lot and as far detection distance of 5 to 10 meters have a 100% success rate, more than 10 meters has a percentage of error of 50% in the morning, noon and night. The conclusion of the test results is if the detection distance farther, the result of image processing can not recognize the object automobiles. day and night. The conclusion of the test results is if the detection distance farther, the result of image processing can not recognize the object automobiles. day and night. The conclusion of the test results is if the detection distance farther, the result of image processing can not recognize the object automobiles.

Keywords :*Calculation of Volume Vehicle, Integral Image, Raspberry Pi, webcams, OpenCV, Haar Like Feature.*

1. INTRODUCTION

Sukabumi city transportation department is implementing government affairs in the fields of transportation, the city transportation department authority sukabumi namely in the field of land transportation that exist in the region in Sukabumi. Sukabumi City Department of Transportation is located on the road no.25 Arif Rahman Hakim. West Java Governor pursuant to Rule 59 2016 Article 8 of Duty, Principal, Functions and Duties details Land Transport Sector. As for the Land Transport Sector has a fundamental duty transportation sector held government affairs aspects of road transport, including infrastructure, transportation and road traffic and road safety[1],

The results of the interviews to the employees of the Department of Transportation of Sukabumi sexy management and traffic engineering vehicle is known that calculation is still done conventionally in which an agent assigned to the field usually consists of 4 to 5 officers in the street. The equipment used is quite simple, namely counter and vehicle counting scheduled time 1 year. According to the Department of Transportation employee of Sukabumi ideally vehicle counting is done every 6 months. That is because the statistical data obtained is used as a baseline for planning traffic such as road widening, traffic engineering, traffic light time and so forth. Noted road Ahmad Yani sukabumi city vehicles passing in a flow that is 3,679 vehicles.

Based discussed exposure, the researchers intend to create a system that can be the solution of the problem by Prototype System Volume Vehicle Counters To Planning Traffic Engineering Department of Transportation in the town of Sukabumi. So expect with such systems would help staff at the Department of Transportation Sukabumi in calculating the volume of the vehicle and perform calculations efficiently at the required time.

2. CONTENTS OF RESEARCH

2.1 Software Development Methods

The method used in software development that prototype. According to Rani Susanto and Anna Dara Andirana model of prototyping is a technique of gathering information for the user's needs quickly. Presentation of the software aspect is a requirement of the user. The prototype will be evaluated by the customer and is used to filter the software development needs[2], Here is a picture of a prototype model:

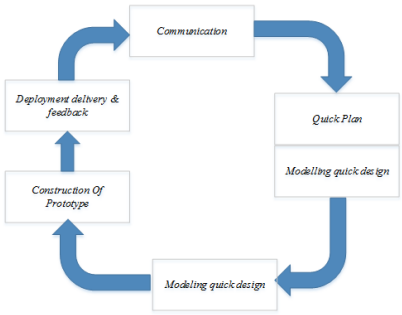

Figure 1. *Prototype Model*

2.2 Vehicles

A vehicle is a means of transportation, whether driven by the engine or by living things. The Meaning of the vehicle according to KBBI Noun (noun) something that is used to drive or ride (such as horses, trains, cars)[3],

2.3 Traffic

According to Widodo Hananto traffic is the movement of motor vehicles, non-motorized vehicles, pedestrians and animals on the road, which is one branch of operations involving transportation of road[4],

2.4 Traffic Volume

Traffic volume is the number of vehicles passing through a road section and measured at one time. The volume of traffic depends on the total volume of two-way traffic direction, the volume of daily, monthly and yearly on the composition of the vehicle[5],

2.5 Imagery

Literally, the imagery (image) is a two-dimensional image on the field. The image is a continuous function of the intensity of light in two-dimensional plane. The light source illuminates an object, the object returned reflect some of the light beam[6], Meanwhile, according to A. Sunyoto image is an image that continue are converted into discrete form, either in the coordinate space and the intensity of light[7],

2.6 OpenCV

OpenCVis a library that contains programming for computer vision technology in real time. OpenCV open source in which there is an interface for C ++, C, Python, and Java that will run on Windows, Linux, Android, and Mac. There are more than 2500 algorithms in OpenCV, has more than 2.5 million times downloaded and used more than 40 thousand people[8],

2.7 Python

Python is a programming language open source multiplatform terinterpretasi by the type of dynamic and powerful and has a lot of library as well as data structures, multithreading, files, and network[9],

2.8 System

The system is a collection of elements that interact to achieve specific goals and a network of procedures that are interconnected to achieve a specific goal [10],

2.9 Analysis of Current System

Analysis of the current system conducted by interview to the chairman of the management section and traffic engineering. The following is a calculation procedure volume vehicle:

1. Head of Transport and Traffic instructed the Head of Traffic Management and Engineering to create a schedule for the calculation of the volume of vehicles.
2. Kasi Traffic Management and Engineering made a calculation schedule vehicle volumes
3. Kasi Traffic Management and Engineering calculation schedule vehicle volumes handed to the clerk
4. Officers received a schedule calculation
5. Officers calculating the volume of vehicles on the road that has been scheduled.
6. Officers assigned to the field consists of 4 to 5 people.
7. Officers perform calculations per 15 minutes.
8. The results of calculations carried out in the recap in a form that is provided.
9. Officers menyerrahkan count results to the Head of Traffic Management and Engineering.
10. Kasi Traffic Management and Engineering to enter the counting results from the officers to Ms.Excel.
11. Kasi Traffic Management and Engineering report count results to the Head of freight traffic volume and traffic.
12. Head of Transport and Traffic obtain vehicle volume calculation report

counting procedures the volume of vehicles can be seen in the figure below:

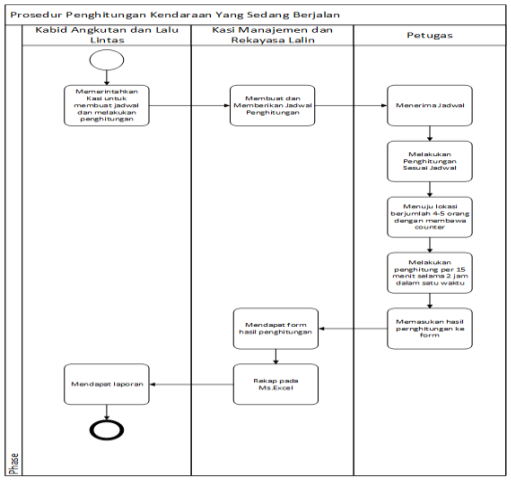

Figure 2*. Procedures That Progress*

2.10 Total Vehicle Exit Sign

The following is the number of vehicles out into the town sukabumi based waypoint. Can be seen in the following table:

***Table 1**. Total Exit Sign Vehicle*

No.	*Street*	*Time*	*total*
1	Ahmad Yani	*Morning (06-08)*	*2,720*
		Lunch (13-15)	*1,895*
		Evening (16-18)	*2,195*
2	Baros	*Morning (06-08)*	*959*
		Lunch (13-15)	*1,303*
		Evening (16-18)	*1,420*
3	pelabuhan II	*Morning (06-08)*	*724*
		Lunch (13-15)	*933*
		Evening (16-18)	*1,027*
4	Lkr. Selatan	*Morning (06-08)*	*1,340*
		Lunch (13-15)	*875*
		Evening (16-18)	*1,132*

From the above table it is known that road with the highest number of vehicles that Ahmad Yani street where kendaraan out of Cianjur.

2.11 Traffic Planning Analysis

Perancanaan traffic analysis is a collection of data for the planning done by the Transportation Agency of Sukabumi based on the volume of vehicles on the road. The following traffic planning has been analyzed:

***Table 2**. Traffic Planning*

No.	*Path Type*	*volume Vehicles*	*Capacity Street*	*plan*
1	*2/1 UD*	*1640*	*2107*	*One way system*

Based on the above table, the parameters for traffic planning can be done if the type of road 2 direction 1 lane (2/1 UD) and the capacity of the road to be able to accommodate as many as the number of vehicles in 2107 while the number of vehicle volume is greater than the 1640 vehicle traffic planning is done namely the one way system.

2.12 Data Analysis Training Vehicle Car

analysis data car vehicle training is required for the analysis of the system to be built. Wherein the training data is used as data for recognizing automobiles. Here is a picture of the training data:

***Figure 3**. Data Analysis Training*

Training data like the above picture is positive and negativ training data. Where is the image size used depends on the needs of the system.

2.13 Workflow System

The system will be built aims to facilitate employees in calculating the volume of the vehicle. The workings of the system can be seen in the figure below:

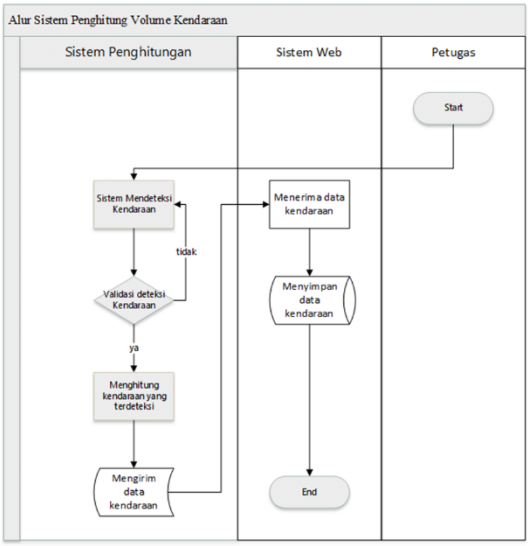

***Figure 4.** Workflow System*

2.14 System Architecture

Arsitektur the system aims to identify the system architecture to be built. Here is an architecture that will be built in this study:

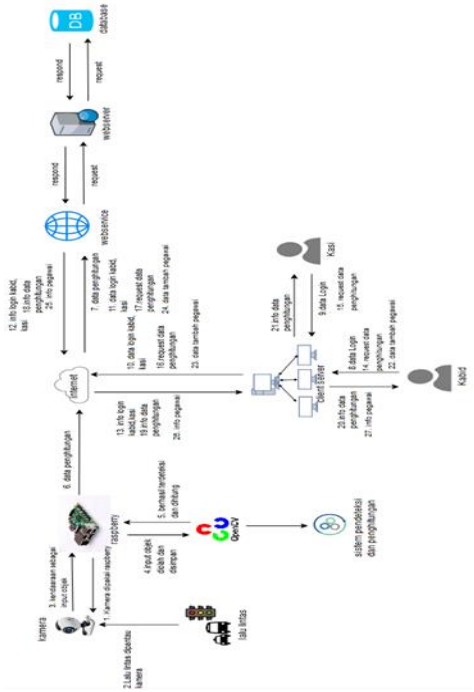

***Figure 5**. System Architecture*

Below is an explanation of Figure 5:

1. *Cameras used to monitor traffic raspberry.*
2. *Kendaaraan monitor camera as an object.*
3. *The monitored vehicles will be used as the input object on OpenCV.*
4. *input processed and stored by the object detection system contained in OpenCV.*
5. *Objects that are successfully stored retrieved value to calculate the number of the vehicle.*
6. *Data is sent via webservice calculation using the internet.*
7. *webserver receive data calculation of webservice and saved to the database.*
8. *Head and Head pass login to the webserver by entering your login data via client server connected to the Internet.*
9. *webserver Head received the login data and then pass the data validation cation logged into the database.*
10. *webserver Head and cation transmit information over the Internet.*
11. *Head login info and cation received client server.*
12. *client server calculation data request to a webserver via the internet.*
13. *webserver receives requests for data calculation and display data calculation exist in the database.*
14. *Info counting of data sent over the internet to a web server client server.*
15. *client server receive data info tally.*
16. *Head-added employee requested data to the webserver and displaying data existing employees added to the database via the Internet*

2.15 Analysis of Data Communications

Analysis of data communication is an important issue because of the absence of data communication, a system that is built can not run properly or optimally. Own data communication with regard to the data transmission system of electronic transmission of the terminal to another terminal. Here is a picture of the communication data from the system:

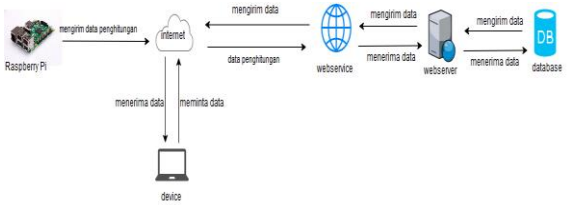

***Figure 6**. Data communication*

Here's an explanation of the Figure 6:

1. *Raspberry pi calculation of the vehicle send data over the Internet.*
2. *webservice receiving data sent Raspberry calculation over the internet and stored on the database through websever.*
3. *database send data calculations on the request by the user.*

2.16 Analysis Tool

Stages analysis tool intended to illustrate the concepts of the tools used in the construction of the system, where the tool used is the Raspberry Pi and webcam. Raspberry Pi mini computer that is used is a model of 3 B Raspberry Pi as a means of processing between input and output devices. The specifications of the Raspberry Pi device 3 is as follows in Table as follows:

***Table 3**. Specifications Raspberry Pi*

No.	*Type*	*Specification*
1	*System On Chip*	*Broadcom BCM2837*
2	*CPU*	*4x ARM Cortex-A53, 1.2GHz*
3	*GPU*	*Broadcom VideoCore IV*
4	*RAM*	*1GB LPDDR2 (900 MHz)*
5	*Networking*	*10/100 Ethernet, 802.11n 2.4GHz wireless*
6	*Bluetooth*	*4.1 Classic Bluetooth, Bluetooth Low Energy*
7	*storage*	*At least 12 GB MicroSD*
8	*GPIO*	*40-pin header*
9	*Port*	*DMI, 3.5mm analogue audio-video jack, 4x USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface*

Analysis of webcam device is required in the development of this system as a webcam is used to input the object to be detected. The specifications of the devices webcam as follows:

***Table 5**. specifications Webcam*

No.	*Type*	*Specification*
1	*Logitech C310*	*HD 720p, 5 Mp*
2	*Light*	*automatic correction*
3	*USB Type*	*2.0*
4	*Software*	*Pan, tilt control, Zoom, Video, Capture, Face Tracking, Detection Movement*

2.17 How to Work Tool

Here is the workings of the tools used, the explanation can be seen in the following picture:

1. *The unit is on where Raspberry pi and webcam has been connected.*
2. *webcam as a monitoring tool will be used as input yaag object's.*
3. *The detected object will be stored on the local penyimpnan Raspberry pi.*
4. *Raspberry pi will transmit the data stored on the server.*

Here is the flow of how the tool works:

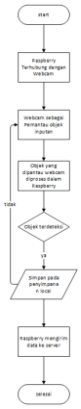

***Figure 7**. How to Work Flow Tools*

2.18 Analysis Methods

The method used for the detection of vehicles in the system to be built is a method Haar Like Features. The following explanation of the method and its Features Haar Like therein features:

1. *Haar-Like Feature where Haar function to create a bounding box on the object to be detected which drove the vehicle that was speeding on the street.*

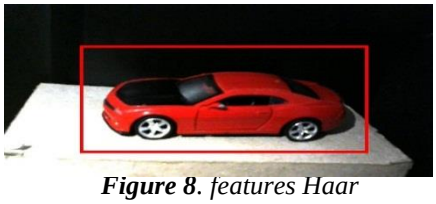

***Figure 8**. features Haar*

2. *integral Image is an image of each pixel its value is the sum of the pixel values above and left.*
3. *grayscaleis an image that has an RGB value (combination of red, green and blue). Of the RGB value can be known the value of grayscale (degrees grayish).*

***Figure 9.**First and greyscale image difference*

4. *Region Of Interestis one of the features available in the JPEG2000. Region Of intereset allows for encoding differently in certain areas of the digital image, so as to have a better quality than the surrounding area.*

Haar cascade classifier method is a method that is modified by Viola and Jones .Here is an object detection with haar like feature:

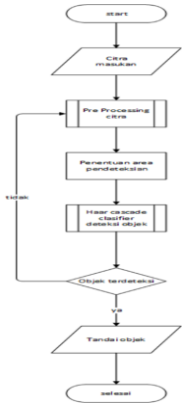

***Figure 10.** Flow Detection Haar Cascade Classifier*

2.19 Entity Relationship Diagram (ERD)

Entity Relationship Diagram(ERD) is a data model that was developed based on the object. Entity Relationship Diagram (ERD) is used to describe the relationship between data in the database to the user logically. Here is an ERD design of the system to be built:

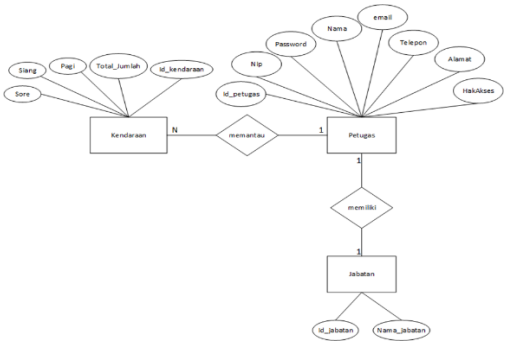

***Figure 11.** Entity Relationship Diagram*

2.20 Diagram Context

Context diagram is the flow of a process by which describes the exit and entry of data from a system. Here is a context diagram of the system countervolume vehicles:

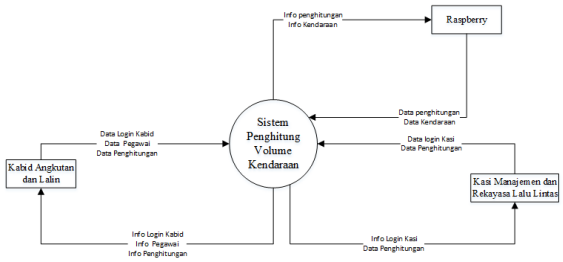

***Figure 12.** diagram Context*

2.21 DFD Level 1

Here is a DFD levels 1 of the system vehicle volume counters:

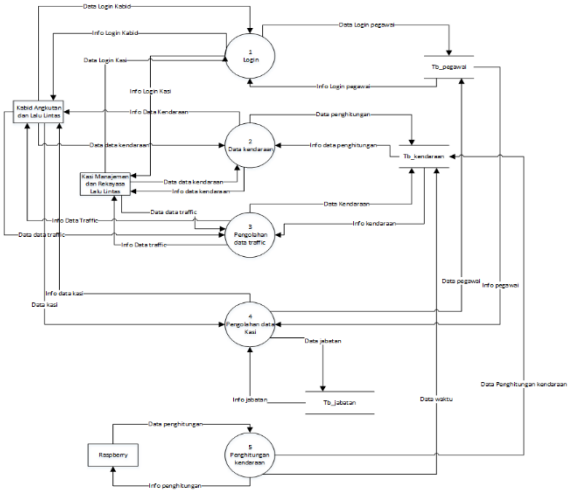

Figure 13. *DFD level 1*

2.22 Relation Scheme

Merupkan relation schema relationships of sequences between two or more tables in the database. Where each table has antributnya respectively and interconnected. Here is the relation scheme of the system vehicle volume counters:

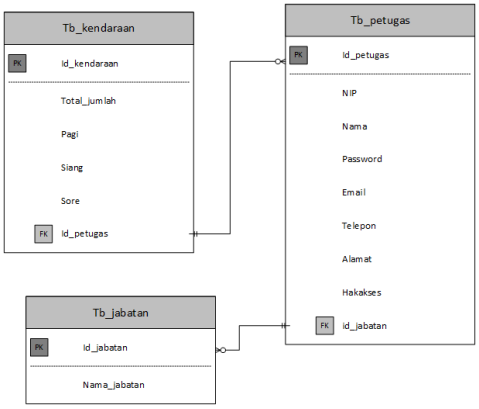

Figure 14. *Relation scheme*

2.23 Implementation Roadmap

Map that has been analyzed is implemented as an area of the entrance and exit of the vehicle from the outside to the town of Sukabumi. Here is the implementation of the access roads in and out of vehicles to the city of Sukabumi can be seen in the following table:

Table 6*. Implementation Way*

Street name	*flow Path*	*The width of the road*	*long Way*
Ahmad Yani	*Two Opposite Flow and One Way*	*10 Meters*	*1,290 Meters*
Baros	*Two Opposite Flow*	*5.2 Meter*	*3,680 Meters*
	Flow		
Piers II	*Two Opposite Flow*	*9 Meters*	*5. 291 Meter*
South Rim	*Two Opposite Flow*	*20 Meters*	*4,500 Meters*

2.24 Traffic Planning Implementation

Implementation of traffic planning is planning done based on the data that has been calculated and analyzed first. Here are the results of calculation and analysis of traffic planning:

Table 7*. Implementation of Traffic Planning*

No.	*Path Type*	*volume Vehicles*	*Capacity Street*	*plan*
1	*2/1 UD*	*1640*	*2107*	*One way system*

2.25 Implementation Training Data

Implementation of the training data is the data that is used in a system that aims to make the system created to recognize the object being detected. The training data in the form of an image of the object where the number of training data depends on the object to be detected. Here is a form of training data can be seen in the image:

Figure 15*. Implementation Training Data*

Here are the results of the data inu training XML form:

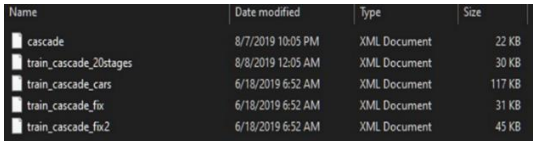

Figure 16*. XML Data Training*

2.26 Implementation of Data Communications

Implementation of data communication is the flow of data transmitted from raspberry pi to envy to the database where the data is to do with the source code as follows:

```
alamat='http://tcsdishubsukabumi.co.nf/log.php?idkendaraan='+str(_id)+'&waktu='+str(datetime.datetime.now())+'&jumlah='+str(vehicle_count)
respon = urllib.request.urlopen(alamat).read()
```

Figure 17*. Implemntasi Data Communications*

2.27 Implementation Tools

Implementation of the tool is the result of a series of tools that have been created for a prototype of the vehicle system volume counters in Sukabumi

city Department of Transportation. Implementation tools can be seen in the picture as follows:

***Figure 18**. Implementation Tools*

2.28 Alpha Testing

1. *Testing Tool*

Testing is done with a series of experimental tool in certain circumstances which may affect the effectiveness of volume calculation system performance vehicles. In some experiments the turn of the methods of using haar cascade classifier, Tensorflow and Yolo who attempted on raspberry pi, haar cascade classifier method most likely be used due to the low specification raspberry pi. But less possible using the method Yolo or Tensorflow requiring high hardware specifications for process object yag move.

***Figure 19**. Testing Tool*

2. *Testing Accuracy*

Accuracy testing was conducted to test the accuracy of the counting system of the volume of vehicles tested against two things, first that is testing the effect of distance on the accuracy of volume calculation and the second vehicle is testing the effect of lighting on the accuracy of object detection vehicle

***Figure 20**. Testing Counting*

Here are the results of testing accuracy:

***Table 8**. Accuracy Of Distance*

No.	*Number of vehicles*	*Distance*	*Accuracy rate in percent (%)*
1	*4*	*5 meters*	*100%*
2	*4*	*7 meters*	*100%*
3	*4*	*10 meters*	*100%*
4	*4*	*13 meters*	*50%*
5	*4*	*18 meters*	*25%*

The table above shows that the object of accuracy within 5 to 10 meters have an accuracy of 100% while the distance is more than 10 meters have an accuracy of below 50%.

***Table 9.** Accuracy Of Lighting*

No.	*exposure*	*number of cars*	*Number of Cars That terdekteksi*	*Accuracy rate in percent (%)*
1	*Bright*	*4*	*4*	*100%*
2	*Dark*	*4*	*2*	*50%*

The above table address that lighting affects the accuracy of the object detected.

3. *GUI Testing Detection*

Can be seen in the table below:

***Table 10**. Open Testing and Detection Camera*

Cases and Test Results			
Data Input	***Which are expected***	***Observation***	***Conclusion***
-	*Open the camera and object detection*	*Managed to open the camera and object detection*	*[✓] Be accepted [ ] Rejected*

4. *Web Testing Data Traffic*

Can dilihap in the table below:

***Table 11**. Shown Testing Data Calculation*

Cases and Test Results			
Data Input	***Which are expected***	***Observation***	***Conclusion***
-	*Showing all the data computation vehicle*	*Successfully display data calculation*	*[✓] Be accepted [ ]Rejected*

2.29 Beta Testing

The test is conducted directly to the section chief of management and traffic engineering and his staff as users of the system are made. The method used is direct interview to the informant. Of 8 questions, 80% get a positive answer to the conclusion that a system built to help sexy management and traffic engineering

3. CLOSING

3.1 Conclusion

Based on interviews and testing of the prototype of the vehicle volume counters systems for planning, traffic engineering in the transportation department in Sukabumi can be concluded as follows:

1. *System volume counters can help the sexy vehicle management and traffic engineering in the calculation of the volume of vehicles.*
2. *The system can detect vehicles with fairly accurate car.*

3.2 Suggestions

Based on the testing that was done then the advice needed to be taken into consideration in the future so that the system can be better is as follows:

1. *Using a similar machine learning as Tensorflow and Yolo for more dynamic and does not require a lot of training data, but requires hardware specifications mempuni.*
2. *Cameras used are advised to have a high resolution.*

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