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Original Article

Motor Vehicle Loss Reporting System Utilizing ALPR and OCR

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Abstract *- The search for a vehicle that has just been lost can be done by reporting it to the Police officer. Allied parties are requested to fill out the form on the available system, then the data entered will be stored in the database as a list of missing vehicles that can be searched based on the data created on the MYSQL server. In searching, the officers are maximizing CCTV camera facilities located on the highway, such as red lights or at certain points. This CCTV camera is programmed using the Python programming language in image processing, matching data with databases and later providing notifications to the nearest officer via SMS. The results of this study are in the form of a system that can be used by the authorities (police) as an additional application that helps in resolving cases of motor vehicles loss. So, this system is utilized to support police officers to take action immediately after receiving notification.*

Keywords *- detection system, CCTV, ALPR, OCR, OpenCV, Python.*

I. INTRODUCTION

The loss of a motorized vehicle is a daily highlight in all public media. This has caused unrest and loss to society. The police, as the main actor in the security sector, has become the main pillar of this case. The development of technology is expected to help police performance overcome crime problems as they often occur. Information and Communication Technology Division is a working unit at the National Police Headquarters with the main task of supporting the performance of the police in public services in the field of Information and Communication Technology. In addition to supporting the performance of the police in that field, this division continues to seek and implement technological developments to maximize the performance of personnel in their basic daily tasks to maintain security and public order.

One way to identify a missing vehicle is to know the vehicle's license plate. Therefore, an automatic LPR license recognition method can be used to extract a vehicle's license plate. We will use OpenCV as an image processing library and Optical Character Recognition OCR with the Tesseract engine to extract text in images. In this study, the application of a motor vehicle loss reporting system is used to identify missing vehicles at certain places by using Python programming and libraries.

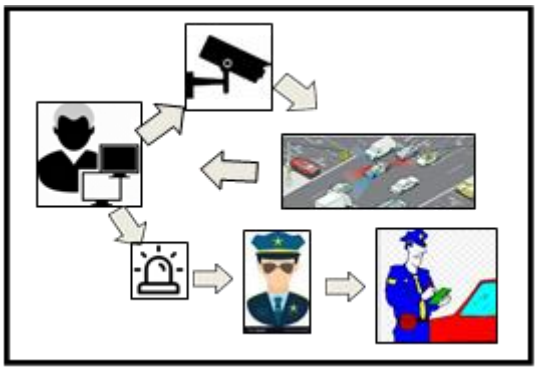

Fig. 1 Motor Vehicles Reporting System Procedure

II. LITERATURE SURVEY

Felix *et al.* [1] proposed "Monitoring In and Out Using License Plate Recognize". The advantage of this research is to maintain the safety of vehicles on their campus, utilizing a vehicle plate extraction accuracy of 100%. Meanwhile, Chandra *et al.* [2] proposed "Automatic systems for detecting and recognizing Bangladesh vehicle license plates". The advantage of this research is that it recognizes license plates in the Negara Bank district; with a dataset success rate of 96.8% in detection, 89.5% in extraction, 98.6% in segmentation and 98.0% in character recognition and have disadvantages of not being able to maximize when the vehicle is tilted, and light is poor in bad weather.

Afeefa and Pillai [3] developed the "Automatic License Plate Recognition (ALPR) Using HTM Cortical Learning Algorithm". The advantage of this study was that they could recognize vehicle plates with high fault tolerance and streamlined HTM memory to help each input vector size 1024 to SDR size 21.

Imran Shafiq Ahmad et *al.* [4] have studied Automatic License Plate Recognition: Comparative Study. Several plate detection algorithms have been reviewed in this paper, and the most promising methods will be applied. There are three main modes in the plate identification system: Plate Extraction, Plate Segmentation and Optical Character Recognition. The first and second modules are more challenging because they need to handle variations in

the input image. Although the plate extraction method applied here is very easy to configure, it is not flexible enough to handle variations in the dataset. There are at least five variations in the dataset: camera parameters, distance, angle, illumination, and background.

Rasika et *al.* [5] proposed "Objects Talk - Object Detection and Pattern Tracking using TensorFlow". The advantage of this research is detecting objects in real-time video and training objects while still within camera range. 2D paths of objects captured by the camera are included as input for tracking and pattern detection algorithms.

III. METHOD

From the diagram above, it can be seen that when we lose a vehicle, the initial step taken is to report through the available web system. On the website, victims who have lost their vehicles must fill in their identity data and missing vehicle specifications. Then, the system that has been programmed in CCTV installed at a certain point will record directly when the lost vehicle crosses the monitor line of the camera. The system will capture the vehicle's license plate number and save it in an image format, which can be extracted into characters. Furthermore, it will be matched with data obtained from the reporting system. When the vehicle matches the reporting data, the nearest officer will get an SMS notification which the officer will then follow up.

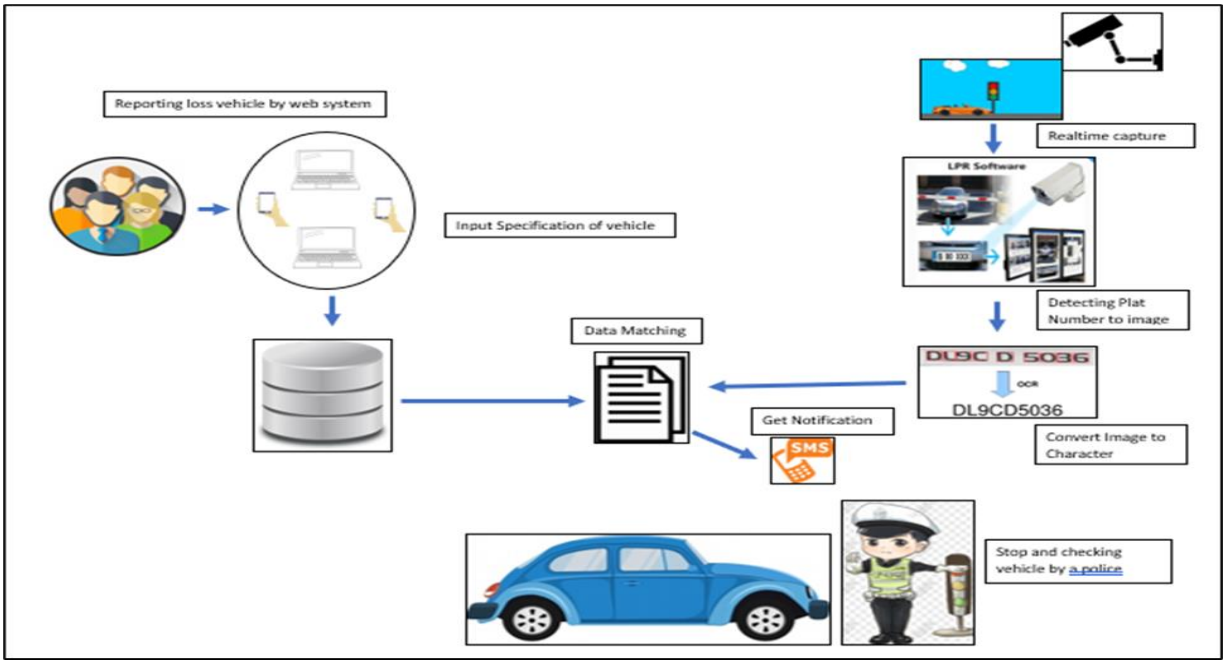

Fig. 2 Proposed System of Motor Vehicle Loss Reporting System Utilizing ALPR and OCR

A. Proposed System

There are about 9 things proposed in the motor vehicle loss reporting system using ALPR and OCR. First is the availability of a dynamic web as a forum for reporting losses. Second, there is a process of storing data in a database and adjusting it to a predetermined table. Third, CCTV cameras are available as vehicle recorders. Fourth is the use of ALPR, OCR and other libraries in python. Fifth is the use of Tensorflow for object classification with a single shot multibox detector. Sixth is the use of the Otsu Method to convert the image to Grayscale. Seventh, there are results after classification in the form of alphanumeric strings. Eighth, the data recorded on CCTV will be matched with vehicle search data through the Mysql Connector. And the ninth is giving notification to officers via SMS.

B. Algorithm

For the algorithm itself, we propose that there are 12 steps in using this system, namely: first, there is the process of filling out the form available on the motor vehicle loss reporting system web. Then, the vehicle data will enter into the database as a search list. After that, this system enters and uses CCTV camera video recordings. This system triggers the CCTV camera to photograph the Number Plate in the frame. Furthermore, this system will convert the photographed image to a grayscale image, which is then converted into a black and white image. It will be converted again from a black and white image to a binary image. From here, OCR will be used to identify the strings presented in the number plate and then use Tensorflow to classify objects and a single shot multibox detector to detect objects in multiple boxes. After that, there will be a process. Matching the recorded data with the data that has been available in the table using the Mysql Connector. Finally, the system will send an SMS notification using the Nexmo API to the authorized party (police).

The following is the algorithm for Otsu Method Greyscale:

(1)

$$\sigma_\omega^2(t) = \omega_0(t)\sigma_0^2(t) + \omega_1(t)\sigma_1^2(t)$$

Weight ω_0 and ω_1 are the probabilities of the two classes separated by a threshold *t*, σ_0^2 and σ_1^2 are variances of these classes. The class probability $\omega_{0,1}(t)$ is computed from the *L* bins of the histogram:

$$\omega_0(t) = \sum_{i=0}^{t-1} p\,(i) \qquad (2)$$

$$\omega_1(t) = \sum_{i=t}^{L-1} p\,(i) \qquad (3)$$

For 2 classes, minimizing the intra-class variance is equivalent to maximizing inter-class variance:

$$\sigma_b^2(t) = \sigma^2 - \sigma_\omega^2(t) = \omega_0(\mu_0 - \mu_T)^2 + \omega_1(\mu_1 - \mu_T)^2$$

$$= \omega_0(t)\omega_1(t)[\mu_0(t) - \mu_1(t)]^2 \qquad (4)$$

which is expressed in terms of class probabilities *and* class means μ, where the class means $\mu_0(t)$, $\mu_1(t)$, and μ_T are:

$$\mu_0(t) = \frac{\sum_{i=0}^{t-1} ip\,(i)}{\omega_0(t)} \qquad (5)$$

$$\mu_1(t) = \frac{\sum_{i=t}^{L-1} ip\,(i)}{\omega_0(t)} \qquad (6)$$

$$\mu_T = \sum_{i=0}^{L-1} ip\,(i) \qquad (7)$$

The following relations can be easily verified:

$$\omega_0\mu_0 + \omega_1\mu_1 = \mu_T$$
$$\omega_0 + \omega_1 = 1 \qquad (8)$$

To support this algorithm, several modules are prepared for this application.

C. Modules

Some of the modules needed in this system are the creation of a web system with PHP MYSQL; the presence of a camera module; image processing with Python libraries; vehicle classification with TensorFlow; the introduction of license plates with the LPR algorithm; converting Grayscale with Otsu Method; there is segmentation using OCR; connected to Mysql in Pyhton; and the SMS gateway with Nexmo API.

IV. RESULT

The development stages of the module are explained as follow. This stage will describe the module's performance so that this application can be run smoothly.

A. Web System

In making this system divided into 2 parts, namely:

- Back end Display
- Front End System

Fig. 3 The Front-End Display

The user uses this front-end display to input the identity and specifications of the missing vehicle. Here the user must enter the name, address, mobile phone number, email and vehicle specifications.

After filling in, the input will enter the database, which will be a list of lost vehicle searches. Then, the data can be managed by the admin.

B. Camera Module

A CCTV camera is an input to record a moving vehicle; this camera is installed in a particular place so that it can record or capture a vehicle's license plate. This camera is placed on highways, crossroads, junctions, and other locations.

C. Python Library

Python library is used to process images in making this system, and the following libraries are used:

- NumPy
- OpenCV
- Sklearn
- Scikit Image
- Simplejson
- Imutils

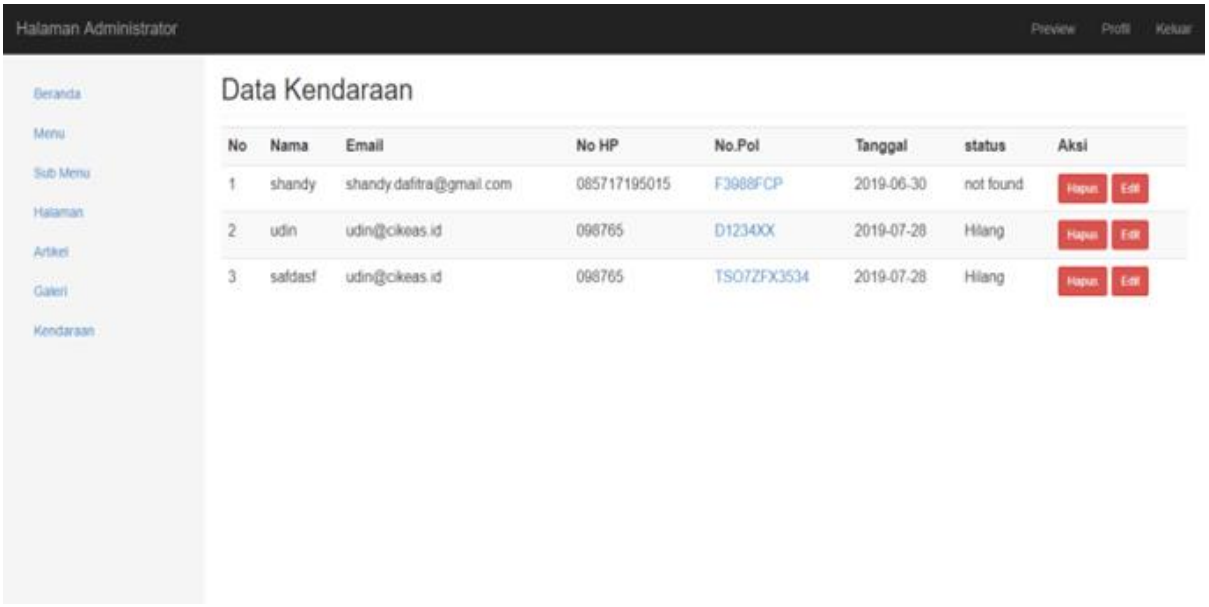

Fig. 4 The Back-End Display

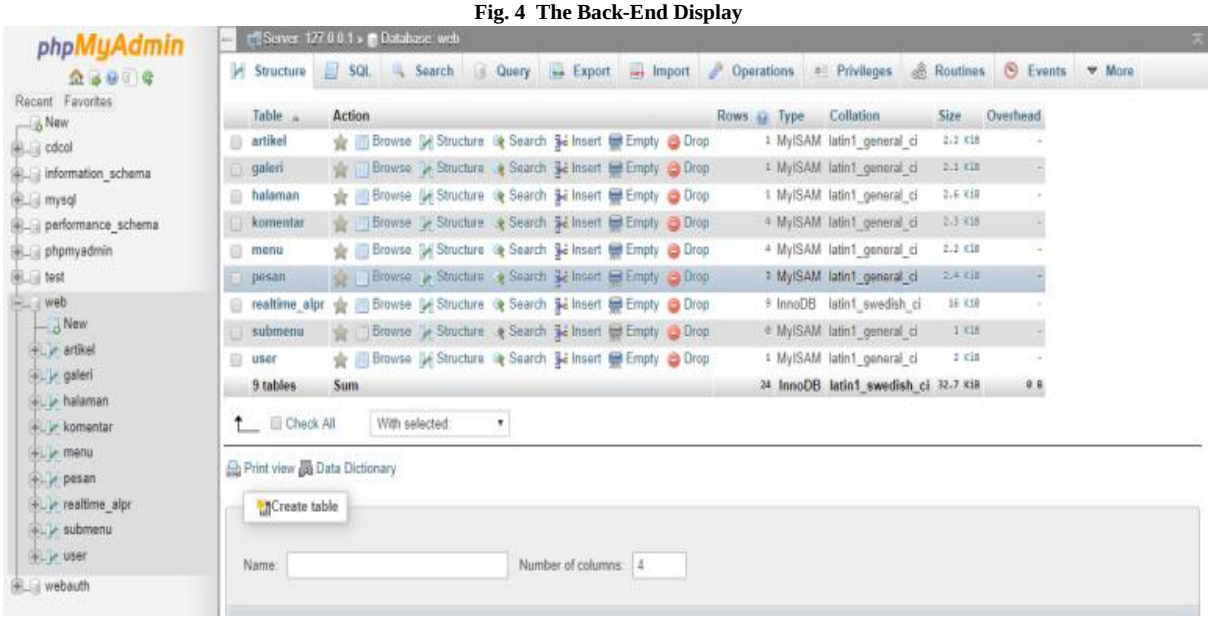

Fig. 5 MySql Database System

D. Classification with TensorFlow

TensorFlow is used as a detector of an object recorded by the camera, which will then classify the object based on its colour and size.

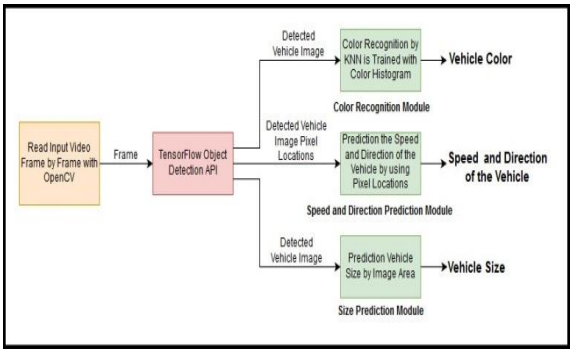

Fig.6 Tensor Flow Working System

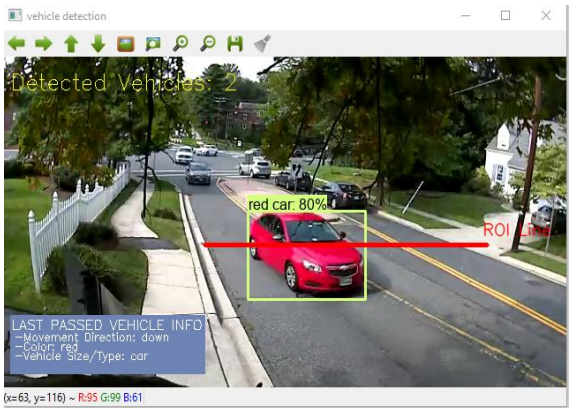

Fig. 7 TensorFlow Result

E. License Plate Recognition (LPR)

This LPR is used as a vehicle plate detector recorded from the camera. Then, it is formed from the frame, and later it defines the license plate based on the size of the

number plate.

Fig. 8 LPR Detection

F. Otsu Method Grayscale

This method is used to convert RGB images to Grayscale.

Fig. 9 Otsu Method Grayscale

G. Tesseract OCR:

Used to convert the text in images into typed text. Then the text will be saved into a database which a lookup table will later match.

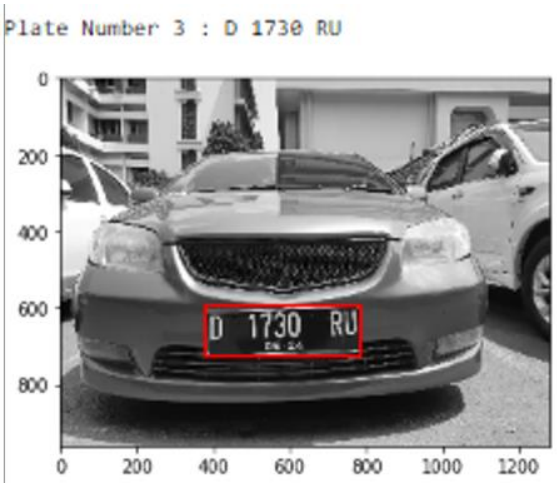

Fig. 10 Tesseract OCR

H. MySQL Connector

A library in python is used to connect MySQL. This is used as data input from the camera to be matched with the lookup table.

```
In [4]: from __future__ import print_function

        import mysql.connector
        from mysql.connector import errorcode

        DB_NAME = 'ALPR'

        TABLES = {}
        TABLES['REALTIME_ALPR'] = (
            "CREATE TABLE `REALTIME_ALPR` ("
            "  `TIMESTAMP` BIGINT,"
            "  `PLATE_NUMBER` varchar(10),"
            "  `VEHICLE_COLOR` varchar(16) ,"
            "  `VEHICLE_TYPE` varchar(16),"
            "  `VEHICLE_DIRECTION` varchar(16)"
            ") ENGINE=InnoDB")
```

Fig. 11 My SQL Connector

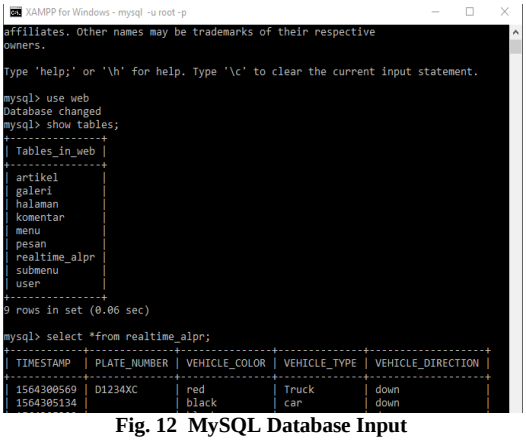

Fig. 12 MySQL Database Input

I. SMS Gateway with Nexmo API

This is an SMS gateway service used as a notification server to officers via SMS. Hence, as the officers receive notification from SMS, they can take action immediately.

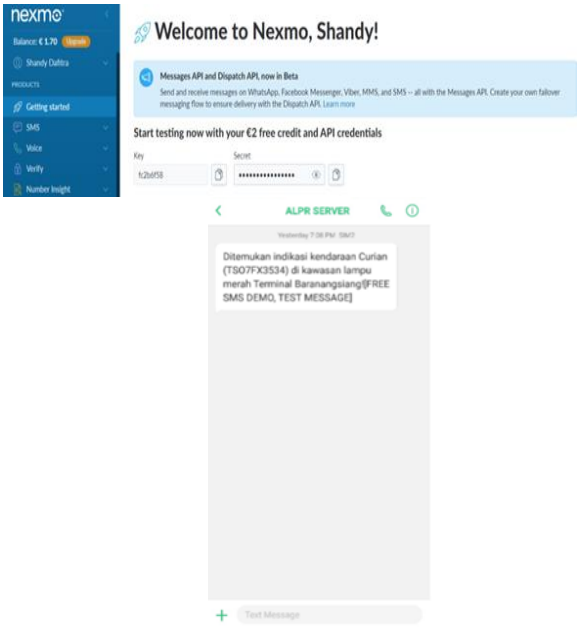

Fig. 13 Nexmo API Appearance and its notification

V. CONCLUSION AND FUTURE WORKS

This reporting system produces a system that will automatically make finding a lost car or vehicle easier and faster. This system is integrated with data from the police regarding vehicle information. This system, the Loss Reporting System for motorized vehicles, is expected to support the police in maximizing the search for lost vehicles when receiving SMS notifications. All lost vehicle data can be found and always updated through the system. This system can be used in tracking based on CCTV footage to find out where the vehicle is moving for further development.

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