Generates Warning Signals Based On Number Plate Recognition To Prevent Parking Violations

Ahmad Sony Alfathani[1], Rilwanu Ar Roiyyaan[2], Fahmy Rinanda Saputri[3*]

[1]Computer Engineering, Faculty of Engineering, Universitas Hamzanwadi, Indonesia.
[2]Research and Dissemination, Augmentshell Technologies, Indonesia.
[3]Engineering Physics Department, Universitas Multimedia Nusantara, Tangerang, Indonesia.
[*]Corresponding Author:
Email: fahmy.rinanda@umn.ac.id

Abstract.

Parking violations are very frequent around us, especially in urban areas, which greatly disturbs other road users so that the government imposes strict sanctions on parking violations. To solve this problem, a surveillance system is needed to immediately alert drivers to move their vehicles to the correct parking space. In this paper, a monitoring system for parking violations has been developed that focuses on carrying out license plate recognition on cars and giving warnings to drivers to move their cars from the wrong parking location via voice media. The steps involved in license plate recognition are license plate detection, character segmentation, and character recognition by performing OCR (Optical Character Recognition). Furthermore, the results of license plate recognition will be used as input for sound generation as a warning. In this paper, a GUI was also developed to help users run programs that have been developed. Finally, the experimental results show that a simple monitoring system to alert parking violations can be established.

Keywords: *Late detection, OCR, character segmentation and GUI.*

I. INTRODUCTION

Computer vision technology is increasingly being used in various applications such as face mask detection [1], skin cancer diagnosis [2], and transportation [3]. In recent years the field of transportation has concentrated on the areas of transport flow, recognition of moving objects [4], pedestrian surveillance, speed detection [5], and many more. In addition, recently, the issue of traffic violations, such as illegal parking, has become a problem that often occurs around us, especially in urban areas, which greatly disturbs road users and poses a safety risk to others so that the government imposes strict sanctions on parking violation as shown in Fig. 1. However, the analysis of traffic control systems for illegal parking is often done manually [6] and so far several studies on illegal parking have been reported, such as [7]–[10]. In this paper, a monitoring system for parking violations has been developed that focuses on conducting License Plate Recognition on cars and giving warnings to drivers to move their cars from the wrong parking location through sound media so as to prevent parking violations. The steps involved in license plate recognition are license plate detection, character segmentation, and character recognition by performing OCR (Optical Character Recognition). Furthermore, the results of license plate recognition will be used as input for generating sound as a warning. In this paper, a GUI was also developed to help users run programs that have been developed. Finally, the experimental results show that a simple monitoring system to alert parking customers can be established.

Fig 1. Parking Violation [11]

Following are some research related to parking violation, such as research on the development of deep learning-based object detection algorithms that have shown good performance [12]. In [13], presents an algorithm for detecting illegally parked vehicles based on a combination of several image processing algorithms using an adaptive Gaussian mixture model (GMM) for background reduction in complex environments. Development of a method for analyzing video obtained by surveillance cameras to automatically detect vehicles stopped in restricted areas [14]. The rest of this paper is organized as follows: Part II summarizes the proposed method used in this paper. Section III experimental results and discussion during the research. Section IV concludes this paper. Section V proposes some future work that could be done.

II. SYSTEM MODEL AND PROPOSED METHODS

In this section, we will discuss the model system and proposed methods that will be implemented as a solution to prevent parking violation problems.

System Model

Fig. 2 is the model system proposed in this study. Ideally, to be able to implement this parking violation monitoring system in the real world, some basic components are needed such as a camera as a sensor to capture images or videos of the object being observed, the processor as a center for processing data obtained by the camera sensor so that the system is able to make certain decisions. in this case it is as a trigger to activate or deactivate the speaker as an actuator to generate the audio signal. in this model, the system is only limited to being able to work on the object of observation of a car. In addition, the system to be studied only works on an image, not a video. Ideally, the monitoring system to avoid parking violations can work on a video in real time. However, this research is limited to the study of how to license plate recognition on an image of a car and generate an audio signal in the form of a warning to drivers to immediately move the car from a wrong parking location. So that this research will be able to be the beginning of developing the next minimizing parking violation system.

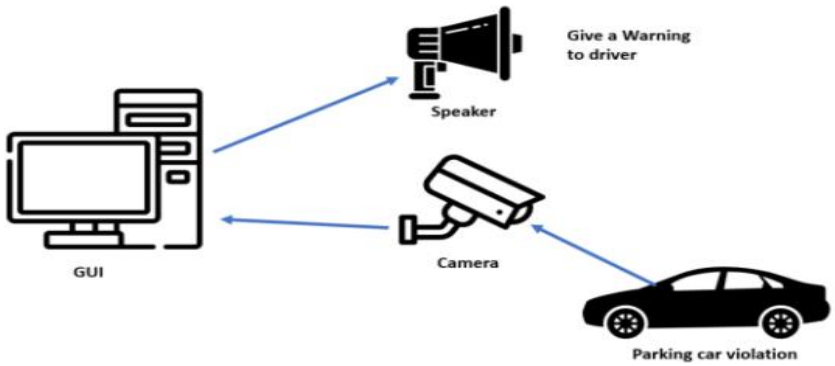


Fig 2. System Model

Proposed Method

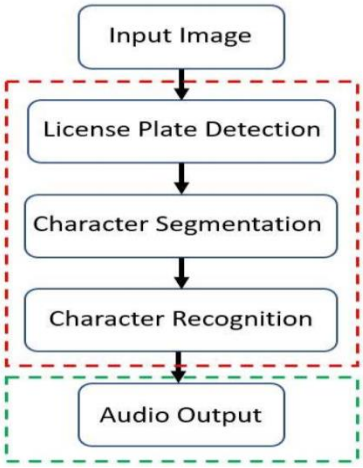
In this section, there are two main parts that are carried out in this research, namely license plate recognition to be able to read the license plate number of a car and generate an audio signal to be able to give a warning to the car driver with a certain license plate number based on the previous license plate recognition process as shown in Fig. 3. In order to know the license plate number, the license plate recognition process is carried out in three stages, namely license plate detection, character segmentation, and character recognition. while at the stage of generating an audio signal, it is done by changing the character number that was successfully read in the previous process and converted into an audio signal. for a detailed explanation will be discussed in this section.

A. Input Image

Image size, resolution, and image type are important parameters to pay attention to. so that not all images can be processed, importing the appropriate image will produce good results.

B. License Plate Detection

Number plate detection is performed using the contour option in OpenCV to detect the rectangular object to find the license plate number of cars. Accuracy can be increased by knowing the exact color, size and approximate location of license plates. The position of the camera when taking pictures of the car also determines the accuracy of this process. The number plate detection process will be carried out in several processes such as resize the image and converting the RGB to Grayscale of image, filtering to remove



unwanted image details, performing edge detection and then carrying out looking for contour to find the rectangle seen as the car number in the image.

Fig 3. Workflow diagram of proposed method

C. Character Segmentation

After detecting the position of the plate through the license plate detection process, then segment the number plate from the image by cutting it and saving it as a new image and then the new image can be used as input to the Character Recognition process.

D. Character Recognition

Furthermore, the characters (numbers / letters) are read in the new image that we get in the character segmentation step using the Optical Character Recognition (OCR) method. This OCR method is provided by the Python-tesseract library to recognize and read text embedded in an image into a text string. Python-tesseract is able to read characters in image types jpeg, png, gif, bmp, tiff, and others because it is supported by Pillow and Leptonica image libraries.

Fig 4. Text to mp3 file

E. Audio Output

At this stage, the string data from the previous stage will be stored in an mp3 file using the Google text-to-speech (gTTS) library which is available in Python. This library allows us to interact with the Google translation API so that it can convert text files into mp3 files as shown in Fig. 4. This mp3 file will be triggered to be activated as a warning when there is a parking violation.

III. EXPERIMENTAL RESULTS AND DISCUSSION

At the implementation stage, a Graphical user interface (GUI) has been developed to carry out License Plate Recognition and generate an audio signal as a warning to prevent parking violations as shown in Fig. 5. Experiments have been carried out more than six sets of publicly available data, some of which can be seen in Fig. 6.

Fig 5. Graphical User Interface (GUI)

Fig 6. Four Samples of Datasets

The GUI that has been built consists of three buttons, namely Select Image, Process, and exit as shown in the Fig. 7. When the user clicks the select image button, the GUI will issue a form to be able to select a dataset image from a directory on the user's computer. and display the image in the GUI. Furthermore, when the user clicks the process button, the license plate recognition process and audio generation will be carried out in succession. Next, we will explain the license plate recognition process and generate audio step by step.

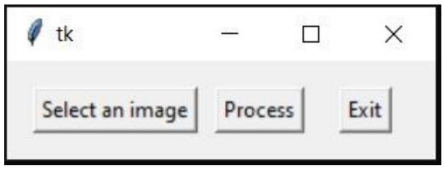


Fig 7. Button types on the GUI

Resize the Image

Resizing helps us avoid problems that can occur due to image resolution that is too large. The plate number that remains on the frame after resizing must be considered. In Fig. 8, there is (a) the image size is normal and (b) the image size after resizing becomes 60%

Fig 8. (a) Normal Size (b) After Resize

Greyscale and Filtering

After converting from RGB to Grayscale and filtering the image, the results will be produced as shown in Fig. 9. Converting RGB to grayscale aims to speed up image processing in the next steps because you don't have to deal with color details during image processing. Furthermore, the filtering process is carried out which aims to remove unwanted image details that are deemed noise. Bilateral filters have been implemented in this system provided by OpenCV, where we can set several parameters such as Sigma Color, Sigma Space, and pixel diameter with values 17,17, and 11 respectively. High sigma color and sigma space values to blur out more background information.

Fig 9. Grayscale and Filter

Edge Detection

Edge detection is an interesting process. There are many ways that can be used, but for simplicity, we will use the Canny method which is available by OpenCV. Edge detection using the Canny method allows us to set the minimum and maximum threshold values to be displayed, in other words, only edges that have an intensity value between the minimum and maximum thresholds that we have set can be displayed. In this program, the minimum threshold value is 30 and the maximum threshold value is 200. Fig. 10 shows the results of the Canny method that has been used.

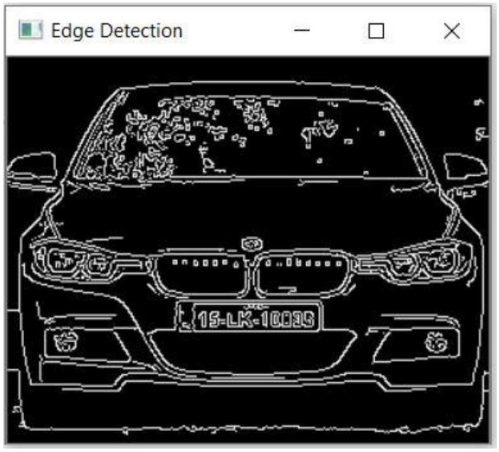


Fig 10. Edge Detection

Looking for Contours to Detect License Plate

At this step, observing anything that has a closed surface from all the results obtained because it identifies the plate number because the plate number is a closed surface. Next, filter the license plate image between the results obtained and check anything that has a rectangular contour with four sides and a closed image because the license plate number will definitely be a rectangle with four closed sides. After doing the proper calculations we next save the image and draw a rectangular box to make sure we have detected the correct license plate number as shown in Fig. 11.

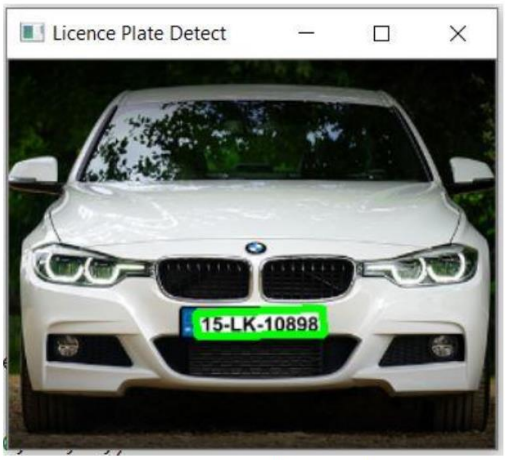


Fig 11. Detection License Plate

Masking the License Plate

After knowing the position of the license plate number in the image, cover the entire image except where the number plate is as shown in Fig. 12.

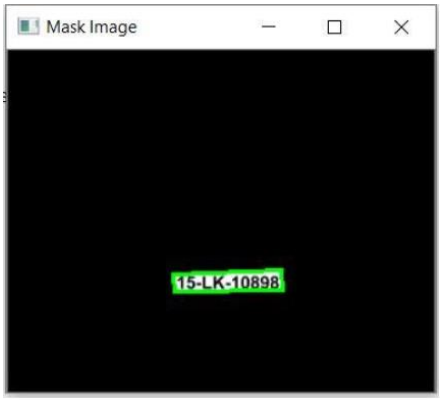


Fig 12. Masked Image

Character Segmentation

The next step is segmenting the number plate from the image by cutting it and saving it as a new image like Fig. 13. This new image can be used as an input image for step character recognition.

Fig 13. Character Segmentation

Character Recognition

Step recognition plate number is the step to read the character or number information from the license plate image number segmented in the previous step. To perform OCR, python-pytesseract has been used to recognize and read text embedded in an image into a text string. the results of this step can be seen in Fig. 14. It can be seen that we have produced a recognition value of 15-LK-1089 which is in accordance with the value displayed in the segmentation image.

Fig 14. Character Recognition

Generate Audio Signal

On this lever, conversion is carried out from a text file to an mp3 file which will then be generated after the license plate number has been completed. As in Fig. 15. The pre-built GUI is developed with the thinter package which is available on most Unix platforms, as well as on Windows systems. The tkinter package is the standard Python interface for Tk GUI tools. The resulting GUI display in this study is as shown in Fig. 5. the image on the left is an image that is input while the image on the right is an image that shows the license plate number has been detected by the system. From the results of the experiments that have been carried out, we can find out that the simple system Generating Warning Signal based on Number Plate Recognition to prevent Parking Violation has been successfully to built.

Fig 15. File mp3

IV. CONCLUSION AND FUTURE WORK

Conclusion

In this paper, we mainly focus on license plate recognition using OCR and generating an audio signal to warn motorists who are doing parking violations to move the car to the correct position immediately. License plate recognition is carried out in three main stages, namely license plate detection, character segmentation, and character recognition. while the generation of audio signals is done by utilizing the Google Translate API using the gTTS package that is already available in Python based on the data from the previous step recognition. Besides that, we have also succeeded in building a simple GUI to make it easier for users to process images. These results are expected to provide an overview for future researchers to be able to develop a better system so that it is ready to be implemented.

Future Work

The system we have built to avoid parking violations is currently only able to work for an image, not a moving object (video) and there are many other drawbacks. So that for future work, several developments will be carried out such as adjusting algorithms to be able to work on moving objects (video), developing algorithms to detect vehicles that will park or just stop for a moment, and the system can be implemented on IoT devices so that it is easy to implement in real situations. The things mentioned above are a small part of the development so that the initiate avoid parking violation system is implemented. The issue of parking violations is a very interesting issue, so it needs continuous development.

V. ACKNOWLEDGMENTS

The authors are grateful to the Universitas Multimedia Nusantara and Universitas Hamzanwadi for supporting this project.

REFERENCES

[1] G. Phan, Suryasari, H. Setiawan, and A. Rizal, “Real Time Web-based Facemask Detection,” in *2022 Seventh International Conference on Informatics and Computing (ICIC)*, 2022, pp. 1–5. doi: 10.1109/ICIC56845.2022.10006952.

[2] S. Johan, F. Natalia, F. V. Ferdinand, and S. Sudirman, “Image-Based Skin Cancer Early Detection using CNN Algorithm,” in *2021 6th International Conference on New Media Studies (CONMEDIA)*, 2021, pp. 78–83. doi: 10.1109/CONMEDIA53104.2021.9616993.

[3] A.Y.Nasirudin, K.Usman, and S.A.Wibowo,“Surveillance System Scheme using Multi- detection Attribute with Optimized Neural Network Algorithm on Intelligent Transportation System,” vol.10,no. 3, pp. 2262–2267, 2023.

[4] Lubis, H., & Pratama, K., Safrida, S. (2022). HR related antecedes to sustainability reporting in Indonesian public listed firm: The mediating role of employee committeemen. *Cuadernos de Economía*, *45*(128), 87-97.

[5] K. Moriwaki, Y. Katayama, K. Tanaka, and T. Shinkyo, “Recognition of moving objects by image processing and its applications,” 2009, pp. 12–17. doi: 10.1109/ARSO.2009.5587082.

[6] O. Ibrahim, H. ElGendy, and A. M. ElShafee, "Speed Detection Camera System using Image Processing Techniques on Video Streams," ***Int. J. Comput. Electr. Eng.***, vol. 3, no. 6, pp. 771–778, 2011, doi: 10.7763/ijcee.2011.v3.418.

[7] C. S. Regazzoni, A. Cavallaro, Y. Wu, J. Konrad, and A. Hampapur, "Video Analytics for Surveillance: Theory and Practice [From the Guest Editors]," *IEEE Signal Process. Mag.*, vol. 27, no. 5, pp. 16–17, 2010, doi: 10.1109/MSP.2010.937451.

[8] Siregar, Z., Tarigan, N. M. R., & Sahnan, M. (2022). Strengthening Human Resources Through Introduction and Stunting Prevention. East Asian Journal of Multidisciplinary Research, 1(7), 1221-1228.

[9] G. X. Li and J. W. Lu, "Design of Notification System Illegal Parking Vehicles on Campus," in *Engineering Solutions for Manufacturing Processes IV*, in Advanced Materials Research, vol. 889. Trans Tech Publications Ltd, 2014, pp. 1284–1287. doi: 10.4028/www.scientific.net/AMR.889-890.1284.

[10] S. G. Kashid and S. A. Pardeshi, "Detection and identification of illegally parked vehicles at no parking area," in *2014 International Conference on Communication and Signal Processing*, 2014, pp. 1025–1029. doi: 10.1109/ICCSP.2014.6950002.W. Hassan, P. Birch, R. Young, and C. Chatwin, "Real-Time Occlusion Tolerant Detection of Illegally Parked Vehicles," ***Int. J. Control. Autom. Syst.,*** vol. 10, pp. 972–981, 2012, doi: 10.1007/s12555-012-0514-2.

[11] Tarigan, N. M. R., & Wasesa, S. (2020). The Influence of Organizational Culture on Increasing Employee Motivation in Sumut Bank of Sharia Unit, North Sumatera. ***Britain International of Humanities and Social Sciences (BIoHS) Journal,*** 2(2), 440-449.

[12] F. Porikli, "Detection of temporarily static regions by processing video at different frame rates," in *2007 IEEE Conference on Advanced Video and Signal Based Surveillance*, 2007, pp. 236–241. doi: 10.1109/AVSS.2007.4425316.

[13] Sarkum, S., Syamsuri, A. R., & Supriadi, S. (2020). The role of multi-actor engagement. ***Journal of Open Innovation: Technology, Market, and Complexity***, 6(4), 176.

[14] "Parking Ticket Strategies in New York City," *Lets Go To NYC!* https://letsgotonyc.com/parking-ticket-strategies-nyc/

[15] Z. Liu, W. Chen, and C. K. Yeo, "Automatic Detection of Parking Violation and Capture of License Plate," in *2019 IEEE 10th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)*, 2019, pp. 495–500. doi: 10.1109/IEMCON.2019.8936164.

[16] Rahayu, S., & Riana, Z. (2020). Determinants of Fraud Pentagon Theory Perspective and Its Effects on Fraudulent Financial Statement in Mining Companies Which Is Listed In Indonesia Stock Exchange. ***Budapest International Research and Critics Institute-Journal (BIRCI-Journal),*** 3(3), 1995-2010.

[17] M. M. K. Sarker, "Detection and recognition of illegally parked vehicles based on an adaptive gaussian mixture model and a seed fill algorithm.," vol. 13, pp. 97–204, 2015, doi: 10.6109/jicce.2015.13.3.197.

[18] V. Carletti, P. Foggia, A. Greco, A. Saggese, and M. Vento, "Automatic detection of long term parked cars," in *2015 12th IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS)*, 2015, pp. 1–6. doi: 10.1109/AVSS.2015.7301722.