Real-Time QR Code License Plate Detection in Vehicles Using Pyzbar

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***Abstract*—In this work QR Codes are embedded in vehicle license plate to detect its information real-time, The objective of this work is to detect QRcodes in license plates, which can serve as a more secure replacement to the regular license plates. The experiment successfully detected 100 customized QRcode license plates, using the OpenCV Python-based library *PyZbar* and achieved a a detection accuracy of 100% from different image, video and webcam sources. This result shows that the detection accuracy varies directly with the pixel, and scanning distance while offering a suggestion towards a better license plate detection in vehicles using QR codes.**

***Index Terms*—QR Code, License plate, Machine Learning, detection.**

I. Introduction

LICENSE plate detection and recognition in vehicular systems is growing extensively. This is due to the increasing demand for car security, owner privacy, intelligent vehicular systems [1], and smart city advancement. Another major goal of the automotive industry is to provide an effective form of identification, control, and a reduction in crime rate by curbing identity theft of car license plates, which is considered to be personal information according to the GDPR laws [2]. However, due to poor file resolution of numbered license plate images when captured from a distance and bad weather conditions [3], these license plates may not be easily captured by high speed cameras. Hence, the need for an alternative means of detection. Quick response (QR) codes could be added to numbered license plates to create QR code license plates and encoded with the users' data. This is because the detection of QR codes will be faster considering that they take up less space.

The concept of utilizing QR codes for vehicle verification has already been previously explored in [4], [5]. In [4], an analysis of the QR Code detection and recognition system was used to enable police to scan the authenticity of vehicle documents. In [5], the authors proposed the use of QR codes to store vehicle and owner information. Although these works successfully proved the necessity of QR codes in vehicle verification, no detection was conducted. The core objective of this work is to develop a system that can detect QRcodes on QR code license plates securely, using the OpenCV Python-based library *PyZbar*.

II. Quick Response Codes (QR Codes)

A. QR Codes

The QR code is a simple and effective means of processing information readable two-dimensional barcodes that contain information about a system, object, or another system. QR codes reduce the complexity of visual recognition in AI with their simple and fast features [6].

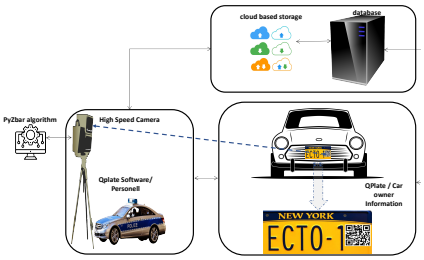

Fig. 1. Proposed QR code license plates Detection System

Some notable features of QR Codes that provide a high level of efficiency in modern technology include: (i) Steganographic qualities: private information, is hidden from an authorized user through the process known as ***Steganography*** [7]. (ii) Increased Data Capacity: QR codes can store about 7089 numeric characters, 4296 alphanumeric characters (741 words), 2953 bytes and 1897 kanji characters. (iii) 360 degrees direction scanning feature [6], and high speed scanning qualities.

B. Q-Plates

This paper proposes a QR code license plates detection system using Pyzbar, a Python library specially designed for detection tasks. As illustrated in Fig. 1 and Fig. 2, the law enforcement body generates the user's QRcode, containing the information of the vehicle owner, which is stored securely in the database or cloud service. Next, when the license plate reader system scans the Q-plate, it automatically detects the embedded information and prints the information while updating the database, which can be accessed in real time within the network. This proposed system prevents unauthorized access to the details of the vehicle owner.

III. System Model

A. Data Sources

In this work, we generated a dataset made up of 2 videos containing about 150 Q-plates, including 100 QR-Code images, 40 printed QR-code images, and 10 QR code license plates images. We also employed live footage capture from the webcamera. Next, we setup a virtualized ubuntu-desktop

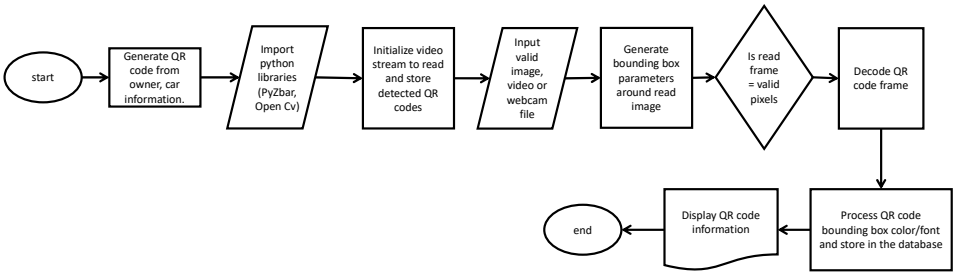

Fig. 2. Flowchart of Proposed System

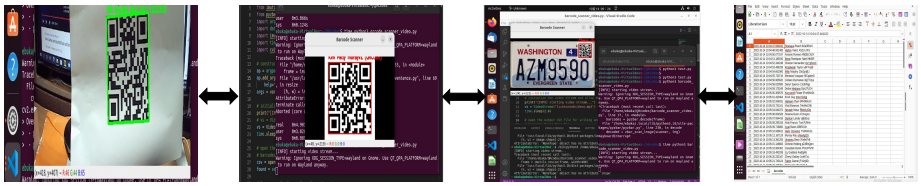

Fig. 3. Stages of the Experiment

environment, and imported the necessary libraries *Open CV* (computer vision tool), *Pyzbar* (localizing the QR codes), *numpy* (python library for working with arrays), libzbar0, amongst others. Furthermore, a folder was created which automatically saves the information of the detected users in a csv file, after scanning the QR Code images, video recording and live web camera feeds.

B. QR Code License Plates Detection System

In the QR code license plates detection experiment, the csv file is initialized to collect the information of detected QR codes with timestamps. For each file, the Python program reads the QR Code image, or video stream, and finds the QRcode itself. Afterwards, the program grabs the frame from the threaded video stream and resizes it to a maximum of 400 pixels. It draws a bounding box on the QR code image with the desired fonts or colors and displays the required information. Since the QR Codes are in bytes, they are converted to a string and, finally, the QR Code image details are updated to a csv file with a timestamp if they are not in the prior database. The different stages of the experiment are illustrated in Fig. 3

IV. Result

From the experimental results, the two videos totalling 310 seconds in length, and containing 150 QRcode images with embedded user information, were correctly identified by the python program in an average time of 220 seconds. The web camera was also able to scan an average of 40 QR Code images in an average of 0.2 seconds per image. The system achieved a detection accuracy of 100%. The detection accuracy D was calculated with the formula: $D = \frac{i}{I}$, Where i is the number of images detected and I, the expected number of detected images.

V. Conclusion

In this work, we propose to detect QRcodes in numbered license plates using PyZbar Python library in realtime. Overall, our detection experiment was able to detect the QR Code bounding boxes, and accurately provide the embedded information in the database real-time. In the future works, we recommend further explorations on license plate recognition, using QR codes.

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References

[1] T. Huynh-The, C.-H. Hua, and D.-S. Kim, "Learning action images using deep convolutional neural networks for 3d action recognition," in *2019 IEEE Sensors Applications Symposium (SAS)*, 2019, pp. 1–6.

[2] GDPR, "The gdpr a guide for business," in *Journal of the European Union Personal Data, Art. 4 GDPR Definitions*, vol. 58, no. 4, 2015, pp. 8–9. [Online]. Available: https://https://gdpr-info.eu/art-4-gdpr/https://www.algoodbody.com/media/TheGDPR-AGuideforBusinesses1.pdf

[3] J. Shashirangana, H. Padmasiri, D. Meedeniya, and C. Perera, "Automated license plate recognition: A survey on methods and techniques," *IEEE Access*, vol. 9, pp. 11 203–11 225, 2021.

[4] A. Einstein, "ZSumeena, Muhammed Hassan, Varsha Vasav, Amrutha Vishnupriya . (Indian) [On engineering and technology irjet]," *Unique QR Code for Vehicle Verification*, vol. 07, no. 17, pp. 1140–1141, 2020.

[5] A. V. Ghodke and R. V. Dagade, ""electronic secure vehicle verification system using advanced digi-locker system"," in *2018 3rd International Conference for Convergence in Technology (I2CT)*, 2018, pp. 1–4.

[6] E. Alpaydin, *Maschinelles Lernen*. Berlin, Boston: De Gruyter Oldenbourg, 2022. [Online]. Available: https://doi.org/10.1515/9783110740196

[7] N. Subramanian, O. Elharrouss, S. Al-Maadeed, and A. Bouridane, "Image steganography: A review of the recent advances," *IEEE Access*, vol. 9, pp. 23 409–23 423, 2021.