



Vehicle Entry Management System Using Image Processing

Africa Freedom Jatakalula and Eng Tirivangani Magadza

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VEHICLE ENTRY MANAGEMENT SYSTEM USING IMAGE PROCESSING

Jatakalula Africa Freedom¹ Eng. T Magadza²

Department of Information Technology, School of Information Sciences and Technology

Harare Institute of Technology P. O. Box BE 277, Belvedere, Harare, Zimbabwe

Abstract

ANPR is one of the technologies that Harare Institute of technology should utilize at the vehicle entrance. In most cases, security personnel manually verify the pass through the entrance. Therefore, the research context suggests that the Institute only requires an automated system for the management of vehicle entrances. Accordingly, the purpose of this project is to develop a system that automatically checks the entry state of the vehicle. The verification process is based on using image processing and various image processing techniques to recognize the vehicle's license plate and compare it with information previously stored in a database. The whole setup is compact enough to increase security while increasing portability and efficiency. Through advanced pattern recognition, the algorithms teach the computer to find license plates. However, to ensure security and prevent unauthorized access, the technology requires the physical presence of the vehicle, thereby restricting entry to only registered vehicles.

Key Words: ANPR, Image processing

1. Introduction

The use of Automatic Number Plate Recognition (ANPR) systems for security and administrative purposes is widespread globally, but Harare Institute of Technology still relies on manual inspection by security personnel to grant every vehicle access to the school premises. This process is not only time-consuming but also inefficient, as it makes it difficult to track vehicle details. Additionally, due to the human verification process, there is a possibility of error, which may result in unauthorized vehicles gaining access to the school premises, posing a potential threat to the institute's security. As a result, the student was inspired to develop a system that employs image processing to automatically validate vehicles entering the school grounds. This system aims to reduce entrance times and

improve the accuracy of vehicle verification, enhancing the effectiveness of the institute's security measures.

3. Methodology

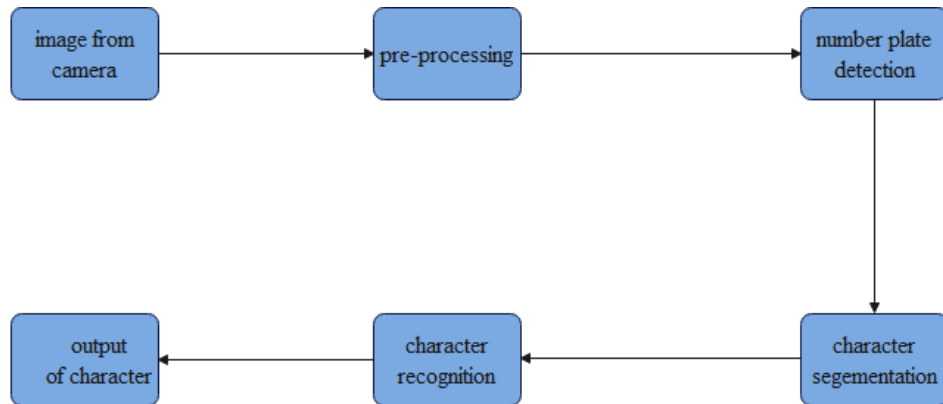


Fig 1 anpr process

Step 1: Image Capturing

The initial step in the number plate recognition process is to capture an image of the vehicle with a camera. It is crucial to ensure that the captured image displays either the front or rear of the vehicle, with the number plate prominently visible.



Fig 2 Image captured

Step 2: Plate Detection

The next stage is to recognize the number plate after acquiring an image of the car. Several tasks are involved in this process, such as resizing the image to an appropriate aspect ratio and converting the colored image to grayscale.



Fig 3 number plate detection

During the number plate detection stage, the input image undergoes a scanning process to detect specific characteristics that indicate the presence of a number plate. Searching through all the pixels of the image is not practical since the number plate can appear anywhere within the image. Therefore, the search is narrowed down to specific pixels that are more likely to contain the number plate.



Fig 4 number plate

Step 3: Character Segmentation

Character segmentation is a crucial step in optical character recognition where an image containing a sequence of characters is divided into individual images of each character. The main objective of this technique is to break down the image into separate sub-images, with each sub-image representing an individual symbol or character. Essentially, character segmentation is a method that decomposes an image of a series of characters into smaller images of individual symbols, making it easier to recognize and interpret each symbol separately.

The objective of character segmentation is to separate the text component of an image from the background. This is a crucial step for accurate text recognition. The process typically involves segmenting the line of text first, followed by segmenting the words within the line, and finally segmenting the individual characters within each word. By isolating each character, the text recognition system can accurately identify and interpret the characters to generate the intended text.

Step 4 Character Recognition

In this approach, we will be focusing on the segmented image of each individual character. To recognize each character accurately, we will be using OCR (Optical Character Recognition) technique. This involves identifying and interpreting each character in the image separately. Once all the characters have been recognized, they can be combined to form the complete number that is displayed on the number plate, which was initially captured in the form of an image.

Step 5: Comparing vehicle number from Database

After the image has been acquired, the next step in the process is to recognize the number plate. This stage involves a series of tasks, such as resizing the image to an appropriate aspect ratio, as well as

converting the colored image to a grayscale image. These tasks are necessary for preparing the image for further processing and analysis. It's important to note that these steps are commonly used in number plate recognition systems, and are not unique to any one particular system.

4 Proposed Solution

The vehicle management system that's being proposed involves using a camera to capture an image of the vehicle, which will then be used to identify the license plate within the image. The system will employ image processing algorithms for optical character recognition to recognize the characters on the plate. Once the number has been read, the system will compare it with a database of authorized license numbers to determine whether to open the gate. The image processing component of the system will employ a variety of algorithms and tools including pattern recognition and character recognition.

Solution Architecture

Below is the solution architecture of vehicle entry management system that uses image processing.

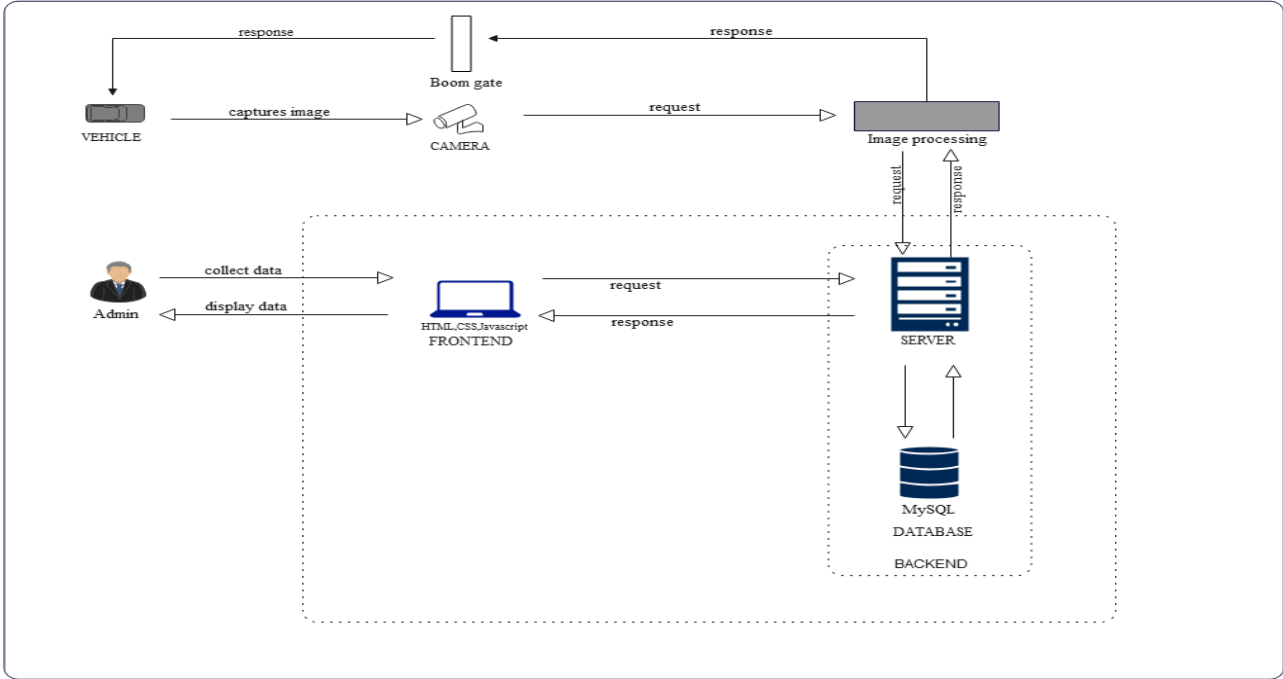


Fig 5 Solution architecture

Flow chart of the system

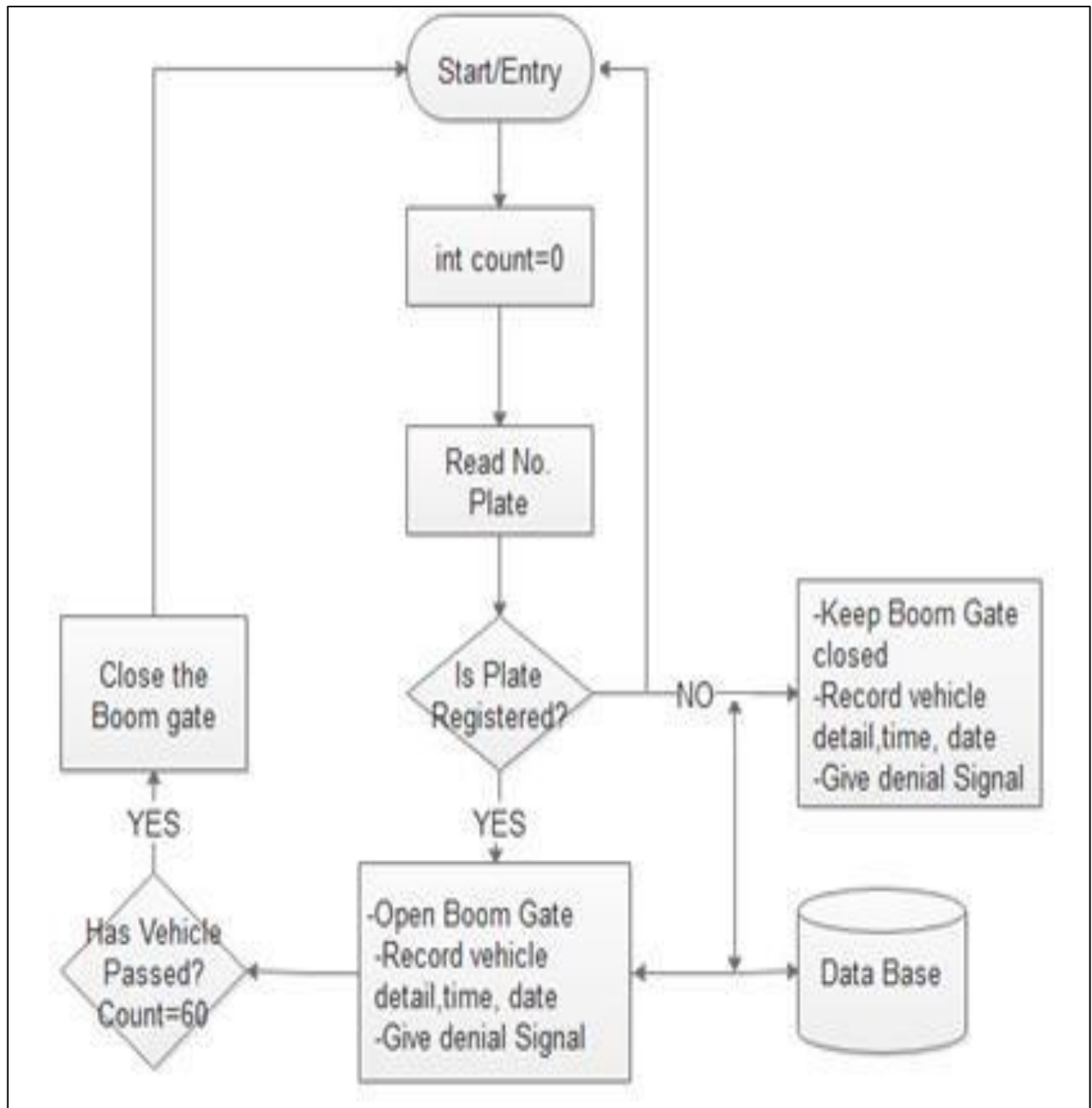


Fig 6 Flow chart

Use Case of the system

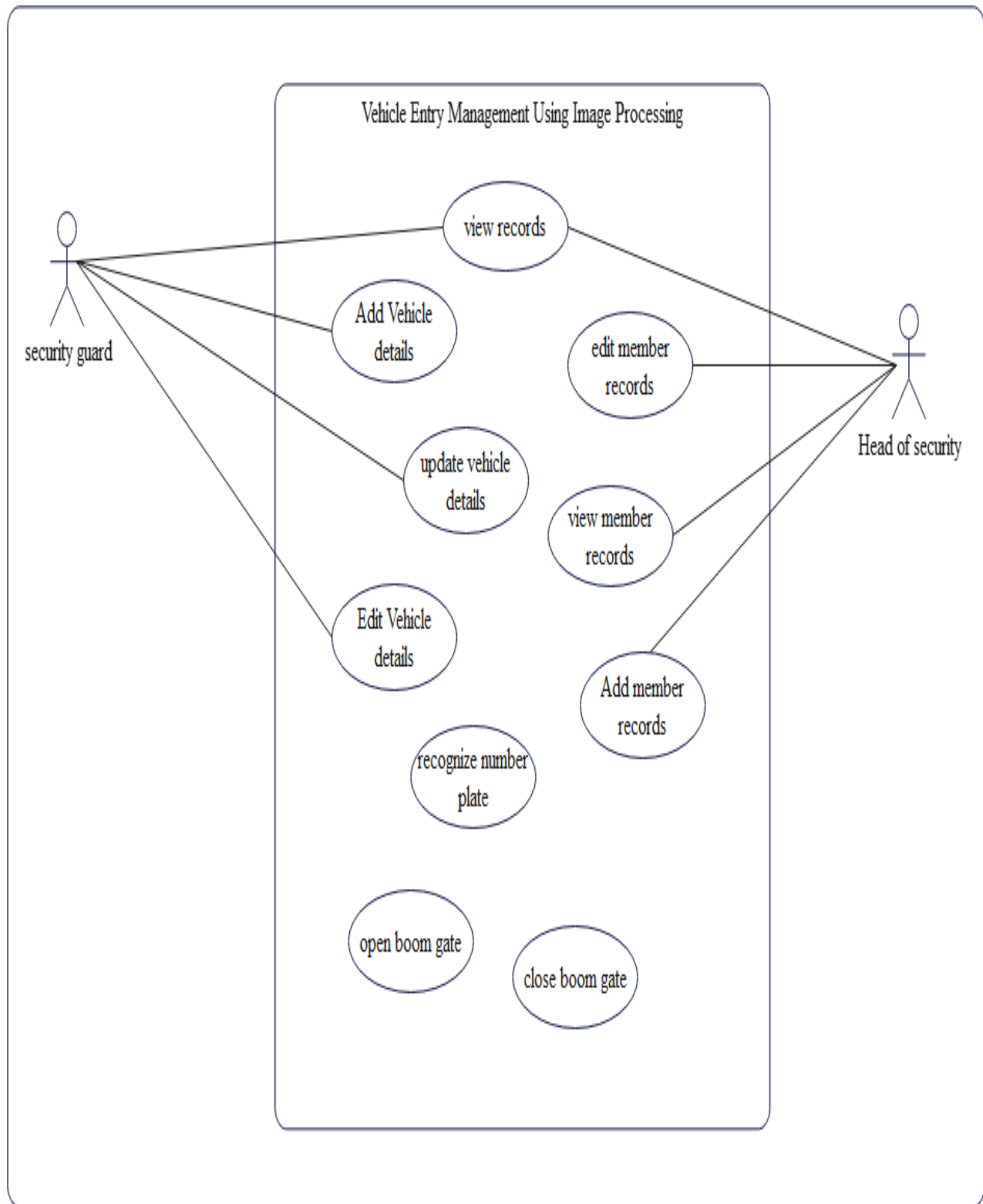


Fig 7 Use case of the system

Sequence Diagram of the System

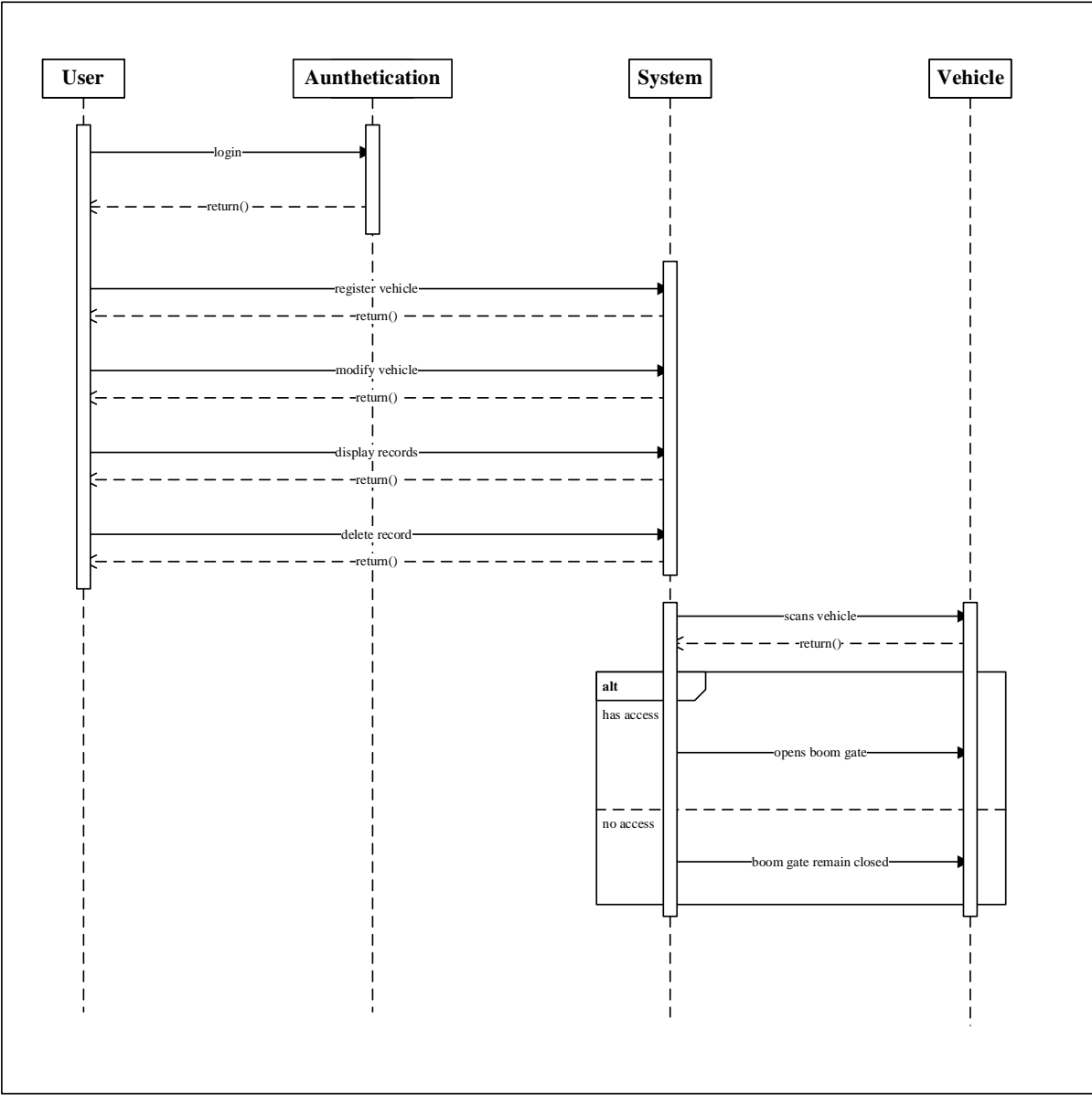


Fig 8 Sequence diagram

5 How the System works

The vehicle entry management system using image processing is a modern way of controlling access to restricted areas. It works by using image processing technology to scan the license plate of a vehicle when it enters a secure area. The system then compares the license plate to a database of authorized vehicles. If the license plate is found in the database, the vehicle is allowed entry. If not, the vehicle is denied access.

6. Results

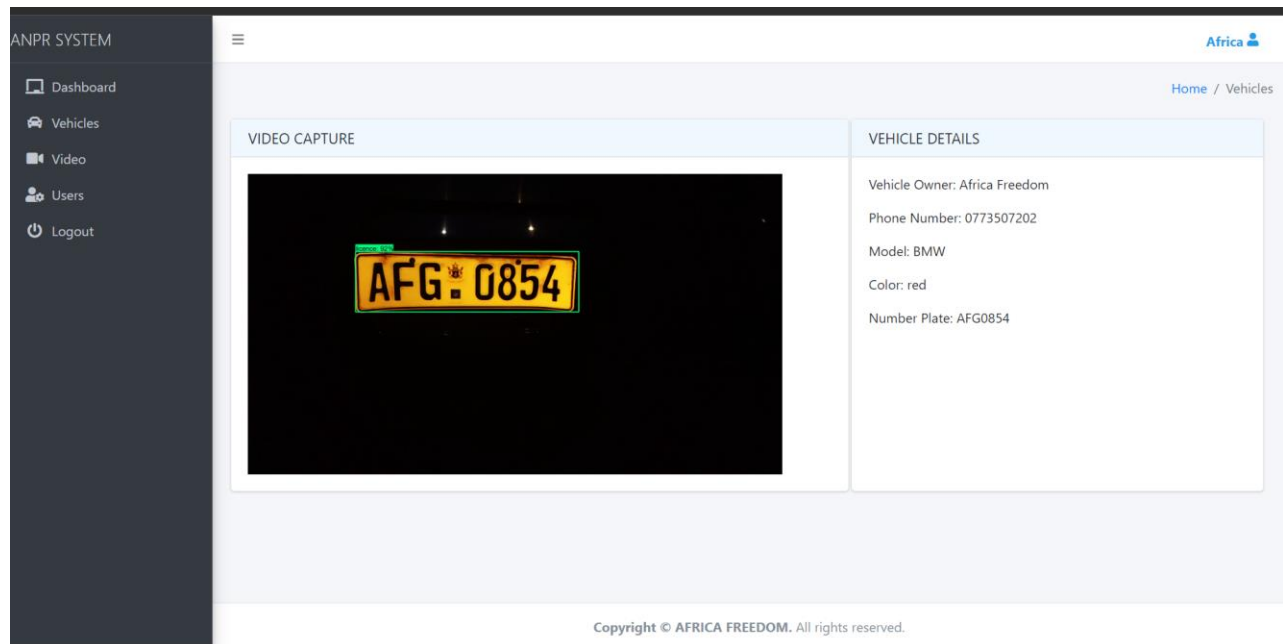


Fig 9 results

The number plate is registered in the system and also system returns the details of the given number plate which is used to determine if the vehicle has access to the parking lot. The security personnel can register new vehicles and also can flag out vehicles that should not be allowed in the parking lot.

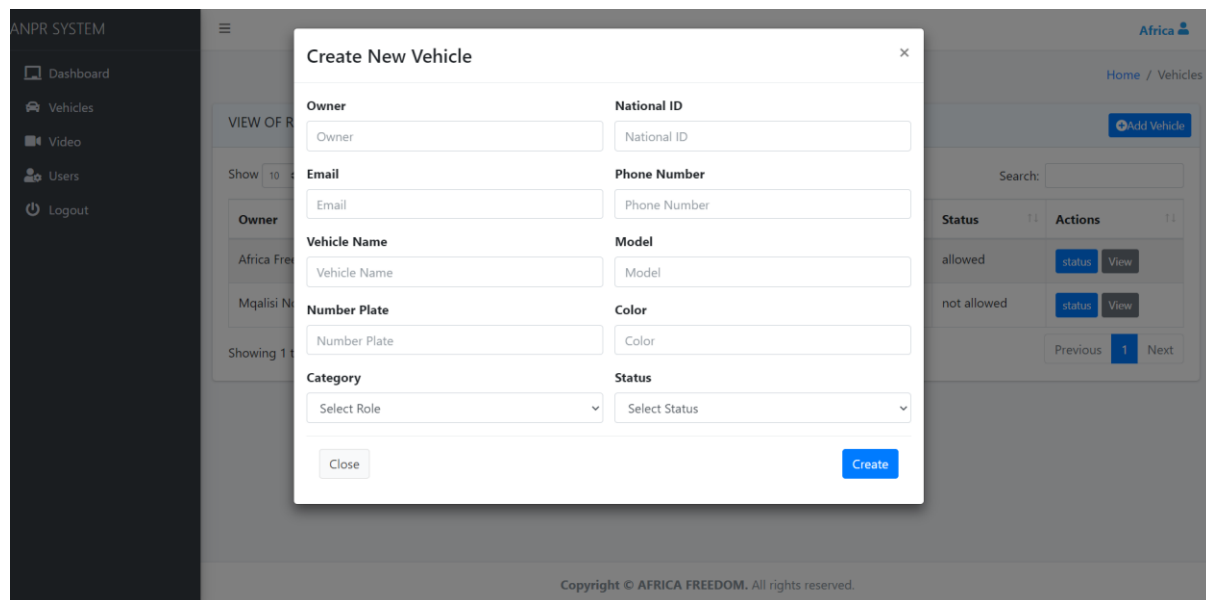


Fig 10 vehicle registration

7. Recommendations

The researcher strongly recommends that the Harare Institute of Technology adopt a Vehicle Entry Management System that uses image processing technology. Such a system would allow the institute to effectively monitor the movement of vehicles on the school premises and improve the security of the institution. With a reliable system in place, security personnel would be able to identify authorized vehicles and take appropriate action if unauthorized vehicles are detected quickly and easily.

To ensure the system's effectiveness, it is essential to comply with data privacy regulations and maintain the system's security from potential breaches or unauthorized access. Regular maintenance and updates of the system would also be necessary to ensure its smooth functioning and address any potential issues promptly.

8. Conclusion

Implementing a vehicle entry management system that utilizes image processing technology has the potential to greatly enhance the security and efficiency of parking lot and facility access. By automating the verification process, errors can be minimized, and entrance times can be significantly reduced. Additionally, with the use of high-definition cameras and deep learning algorithms, future extensions such as vehicle and driver recognition can be implemented. This system has the potential to revolutionize the way we manage traffic and access to facilities, providing safer and more efficient solutions.

References

- [1] Adewale, O. S., & Aremu, A. O. (2016). Design and implementation of a vehicle entry management system using image processing. *International Journal of Innovative Research in Computer and Communication Engineering*, 4(1), 449-454
- [2] Upadhyay, S., & Singh, S. K. (2019). Automated vehicle entry management system using image processing. *International Journal of Computer Applications*, 179(23), 30-34
- [3] Bhatnagar, N., & Mittal, M. (2018). Automated vehicle entry management system using image processing techniques. *International Journal of Advanced Research in Computer Science*, 9(4), 335-338.
- [4] Vaidehi P. De, D. Ragavesh (2012). Automated Parking Management System Using Image Processing Techniques. *International Journal of Applied Information Systems*, Volume 2
- [5] Gupta, M., & Singh, R. (2017). Vehicle entry management system using image processing. *International Journal of Computer Applications*, 173(9), 36-39.
- [6] Anuj Gupta, Anand Kumar Gupta, Anmol Singh, Sherish Johri (2018). Vehicle Number Plate Detection Using Image Processing. *International Research Journal of Engineering and Technology*, Volume:05.
- [7] Chinmayi Gurav (2019). A Review Paper on Vehicle Number Plate Recognition. *International Journal of Engineering Research and Technology*, Volume 8.