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AutoID GateKnight: Empowering Gate Security with License Plate Recognition and Vehicle Colour Detection

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Abstract: ***AutoID gateKnight represents a significant breakthrough in gate security technology. Its utilization of License Plate Recognition and vehicle color detection technologies not only strengthens access control but also offers a level of adaptability and customization that is unparalleled. At the entrance gate, the system will be able to identify licence plates from passing cars and determine whether or not to allow the vehicle access. The gate will operate automatically, with no human interaction. The device is made up of a video camera that records video frames, which contain a picture of the licence plate and the colour of the car. In order to build the suggested system, colour detection using a colour histogram, easyocr to extract the number plate from the image, and Haar cascade for number plate detection have all been used. We process the number plate and colour of the car after properly identifying it, and then we compare it to the vehicle's authorization and registration status. By compiling both the number plate and color of the vehicle, this system provides a robust and highly accurate result. Additionally, the system maintains an updated database of the cars that have left and entered into the required places within a particular duration.***
Keywords: Number plate recognition, OCR ,Vehicle Color Detection, Automation, Security.

I. INTRODUCTION

Ensuring security in restricted areas is of utmost importance, and surveillance cameras play a vital role in this regard by maintaining digital records of individuals and vehicles accessing these locations. Leveraging computer vision and image processing techniques, automated systems analyze these recordings efficiently. As vehicle numbers continue to rise, these technologies offer increasingly convenient and rapid solutions to address security concerns. License plate recognition technology, also known as Automatic License Plate Recognition (ALPR) systems, is a vital tool in modern transportation and security. These systems use picture processing automation to identify and classify vehicles by their license plate numbers and color, providing valuable information for various applications. ALPR systems are essential for storing and analyzing captured images and license plate text, employing infrared light for clarity in all lighting conditions. They serve as automated tools for traffic control, toll collection, inspection enhancement, and safety administration. Innovations in digital image processing have advanced automobile technology, with license plate recognition systems widely used in e-parking management, traffic violation detection, and stolen vehicle identification. This research focuses on developing an automated gate control system combining license plate detection and vehicle color recognition. Leveraging technologies like Raspberry Pi and OCR, it aims to enhance security and streamline access protocols. ALPR's significance in security infrastructure cannot be overstated, with advancements enabling adaptation to diverse font styles and positions. This research extends to vehicle color recognition, aiming to improve accuracy in identifying white, silver, and gray vehicles.

Subsequent sections will detail methodology, dataset utilization, and proposed color recognition methods. Experimental results will be discussed to evaluate system efficacy, aiming to contribute to security technology advancement by integrating license plate and vehicle color recognition for robust verification.

II. LITERATURE REVIEW

F. Ali, H. Rathor, et al.(2021) [1] It looks into the potential of employing licence plate recognition to obtain all the information related to a vehicle. We may utilise the fusion technique to enhance the quality of the vehicle photos. Next, we can extract the licence plate, isolate the characters on the plate, and apply an artificial neural network to recognise the characters on the licence plate.

Research has demonstrated that a neural network can identify licence plate characters with a 95% chance of accuracy, even when 50% of the noise is present. Police can use this suggested LPR method to find speeders, people parking in no-parking zones, parking lots, highways, bridges, and tunnels. Also the prototype of the system is going to be integrated and tested as part of the sensor network being developed by Ayers Island, LLC as part of their Intelligent Island system.

A.Tariq , et al.(2021) [2] The paper introduces a novel approach for vehicle color recognition in Intelligent Transportation Systems (ITS) using Faster R-CNN, a deep learning algorithm. It addresses limitations of previous methods, achieves a high accuracy of 95.31%, and contributes to a dataset tailored for vehicles in Pakistan. The proposed system not only detects and classifies vehicle colors but also generates statistical reports. The methodology involves preprocessing, a well-designed architecture, and training with a curated dataset. The results surpass other techniques, highlighting the effectiveness of the proposed model in enhancing security and surveillance in the Pakistani context.

G Saadouli , et al.(2020) in their work [3] proposes a real-time automatic gate system incorporating three individual modules: car make and model recognition, license plate recognition, and face detection. The car detection utilizes an ultrasonic sensor and employs algorithms such as Difference of Gaussians (DoG) and Scale Invariant Feature Transform (SIFT) for make and model identification. License plate recognition involves connected components identification and Optical Character Recognition (OCR). Face detection relies on the Viola Jones algorithm. The system matches the captured data with a database for authenticity confirmation, allowing the gate to open when all details align. The prototype, using a webcam, LEGO NXT, and toy cars, demonstrates a 75% accuracy in experimental evaluations. The paper emphasizes the potential security benefits and efficiency improvements in various scenarios. The literature review provides an overview of related works in automatic number plate recognition (ANPR), vehicle make and model recognition (AVMMR), and face detection techniques. It covers diverse methods such as SIFT-based ANPR, LDA for AVMMR, and Viola-Jones face detection. The significance of the proposed secure automatic gate system is discussed in terms of enhanced security, reduced waiting times, and improved parking management. The methodology involves pre-processing, region of interest (ROI) extraction, and individual modules for make and model recognition, face detection, and license plate recognition.

M T Qadri, et al. (2009) [4] This paper presents the automatic licence plate-based vehicle identification system. The vehicle is identified by the system using a number of image processing algorithms from the information kept on the PC. Real photos are used to test the system's performance after it has been implemented in Matlab. The findings of the simulation demonstrate that the system may be used at the entry to severely restricted regions and can reliably detect and identify a vehicle using its licence plate under various lighting conditions. Though there is certainly need for development, the implementation functions very effectively. Because of its long shutter duration, the camera utilised in this project is sensitive to vibration and rapidly changing targets. If a high-resolution camera is employed, the system's speed and resilience can be increased. The affine transformation can be used to enhance OCR recognition from varying sizes and angles, as the OCR algorithms employed in this research are sensitive to misalignment and differences in size. It is also possible to determine the likelihood that the car number plate will be found and recognised using statistical analysis.

In their study [5], P. Chen et al. (2014) proposed an efficient solution for vehicle colour recognition. We show that the BoW representation of local patch features is an effective way to characterise the colour of objects. By employing a classifier to assign weights to each subregion, it is possible to implicitly choose the visually appealing portions of a vehicle's primary colour. The comprehensive tests conducted on both picture and video data show the suggested method's potential for use in practical settings. In order to more precisely localise the intriguing colour zone, our future work may involve merging the suggested method with established image segmentation tools.

C. Hu, X. Bai, et al(2015) In this work [6] They have described a deep learning-based method for vehicle colour detection in this study [6]. This method makes maximum use of the structural information of automobiles while combining the CNN architecture with the SP strategy, which naturally catches the variances in vehicle images. Experiments conducted on a common benchmark in this domain verify that the suggested algorithm achieves cutting-edge performance. It also performs well in a variety of difficult scenarios and does away with the need for pre-processing, which was an essential step in earlier approaches. Furthermore, the approach put out in this paper is generic and easily transferable to many issues and fields. Given that the suggested approach runs quite quickly and delivers extremely high vehicle colour recognition accuracy. Since the proposed method achieves very high vehicle colour recognition accuracy and runs reasonably fast, we plan to integrate it into real-world applications and systems in the future.

C.N. Anagnostopoulos, et al.(2010) By combining several computer vision modules, the vehicle inspection system proposed in this study [7] greatly improves the security of vehicle identification. Three distinct subsystem implementations were showcased, which included the under-vehicle inspection, vehicle manufacturer/model detection, and licence plate recognition system. The three unique modules were examined and spoken about. Each approach achieves good success rates, according to the results, which suggests that these modules can be utilised to improve an integrated platform for security inspection and access control's overall performance. Lastly, a quick discussion of topics including installation and operation principles was held. The suggested technique greatly facilitates quick and efficient vehicle screening and might be implemented at entry checkpoints with high security requirements, such as government buildings, army camps, or national borders. The potential to lower the number of employees needed to operate security gates and raise their awareness while guaranteeing their personal safety are immediate benefits.

A Kashyap ,et al.(2018)[8] The existing methodologies on this sketch and algorithms proposed in for quantity and car the no Plate recognition have been seen through. Because of the unavailability of such an ANPR gadget off the shelf in tune with our requirements, it's far our endeavour to personalize an ANPR system for instructional institutions.Template matching become used on quantity plates acquired from static photos and an average Accuracy of 82.6% has been obtained.The accuracy of each character (number 1-9,alphabet A to Z and a to z) has been shown. This accuracy can be advanced significantly by way of putting the digicam definitely to capture the perfect body and the use of neural networks in two layers. The execution of the given method can be moved further for the popularity of quantity number plates of multiple vehicles in a solo photo body by way of the use of multi-level genetic algorithms.Additionally, a extra easier model of this gadget can be carried out by way of capturing pictures from stationery clip and choosing the great car border for category of vehicles and spotting the quantity plates the use of neural networks.

B V Kakani ,et al(2017) [9]The proposed algorithm designed after all the work and survey gives an accuracy of 94.45% in less than 1 second when tested upon 300 odd images of vehicles at different viewing angles and environmental conditions. Using Artificial Neural network the system showed better results on single set of templates. The training period taken by ANN was 12 seconds and once trained, it recognizes the test samples fed to the network efficiently. The chief advantages of the system is less time complexity, High Adaptability to untrained test inputs with much less features to calculate. On the other hand, it has some limitations; The image deskew algorithm applied for skewed image up to 30 degrees, Accuracy of the algorithm is largely dependent on the change in the environmental conditions and also depends upon the quality of the image captured by the device (CCTV or Camera) and Matlab software, which we used for processing of the image, which is not good for real time because of its large processing time. The system still has a large scope for further developments

M. A. Awaimri ,et al.(2021)This paper[10] presented a summary of vehicle number plate recognition systems used to identify vehicles from their plate number. A vehicle number plate recognition system is developed using different image processing algorithms. Although the processing levels are mostly the same in different studies starting from collecting and preprocessing plate images until character and number recognition, they have provided different accuracy rates. Using deep learning algorithms such as neural networks in recognition has shown to be is the most popular and useful choice because it takes less time and results in high recognition accuracy rate. The discussed studies in this paper are based on real because they are using real plate numbers to evaluate the performance of each algorithm in several situations.

Table 1: Literature Overview

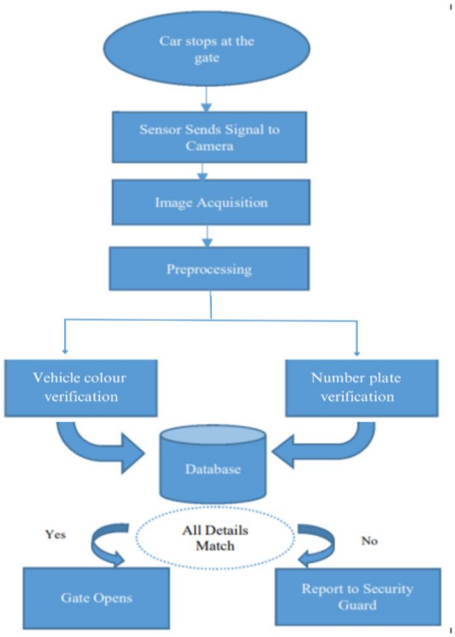
Title	Authors	Technologies Used	Limitation
Automatic License Plate Recognition System Based on Color Features and Vehicle tracking	K. Subhalakhsmi and V. Siva Soundharam, 2015	SVM, MTCNN (CNN Extension), image recognition Deep Learning	The problem of low accuracy and generality in the system.
Automatic Number Plate Recognition	A. Kashyap, B. Suresh, A. Patil, S. Sharma and A. Jaiswal,2018	HOG, Decision Tree, SVM	The anti-Spoofing feature is not in this system and Encoding is time-Consuming.
Improved OCR based automatic vehicle number plate recognition using features trained neural network	B. V. Kakani, D. Gandhi and S. Jani, ., June 2021	SVM, LBPH Algorithm, HAAR Cascade Classifier.	for specific environmental conditions or vehicle types take more time in training
Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition	M.T Qadri, 2019	USB camera, infrared sensor, motor with motor driver circuit	The OCR method used might be sensitive to misalignment and varying sizes..
Vehicle Color Recognition on Urban Road by Feature Context	Pan Chen,Xiang Bai, Wenyu Liu , 2014	Machine Learning Algorithms, LBPH HOG (using only Normalization).	Chances of Spoofing and Portability issues.

III. PROPOSED WORK

The proposed work outlined in the AutoID GateKnight project report focuses on revolutionizing gate security through the implementation of a sophisticated security system. Here is a summary of the proposed work:

1) *Introduction:* The project aims to introduce AutoID GateKnight as a cutting-edge security system that enhances safety within communities by leveraging License Plate Recognition (LPR) and vehicle color detection technologies.
2) *Vehicle Registration Process:* Community members are encouraged to register their vehicles by providing essential details such as number plates, owner names, flat and tower numbers, and car colors. This information is crucial for establishing a comprehensive database for efficient gate security management.
3) *Number Plate Detection:* The system utilizes advanced number plate detection techniques, including Optical Character Recognition (OCR), Haar classifier, and Histogram of Oriented Gradients (HOG), during entry and exit sessions. This ensures accurate identification of vehicles for seamless entry and exit authorization.
4) *Database Matching:* Images of vehicles are converted for efficient database matching, enhancing the overall accuracy of the system. Object detection mechanisms further improve the matching process, ensuring reliable access control.
5) *Verification Stage:* The system includes a verification stage to confirm the authorized status of vehicles. Upon successful entry or exit, the database log is updated, maintaining a transparent record of community movement for enhanced security monitoring.
6) *Community Integration:* AutoID GateKnight aims to seamlessly integrate technology with peace of mind for the community, offering a secure and efficient automatic security system tailored for gated communities, housing societies, and commercial complexes.

Overall, the proposed work emphasizes the importance of combining advanced technologies with traditional gate security measures to address evolving security challenges faced by communities. By enhancing access control, surveillance, and database management, AutoID GateKnight promises to redefine gate security standards and provide a multifaceted approach to ensuring the safety and security of residents and visitors.



IV. CONCLUSION

The AutoID GateKnight project represents a significant advancement in gate security technology by integrating License Plate Recognition and vehicle color detection systems and highlights the benefits of combining automation with security systems to increase reliability, reduce human dependency, and enhance overall security measures. The project's successful outcomes underscore its potential for broader applications in an increasingly interconnected world, paving the way for improved gate security solutions in various settings.

V. ACKNOWLEDGMENT

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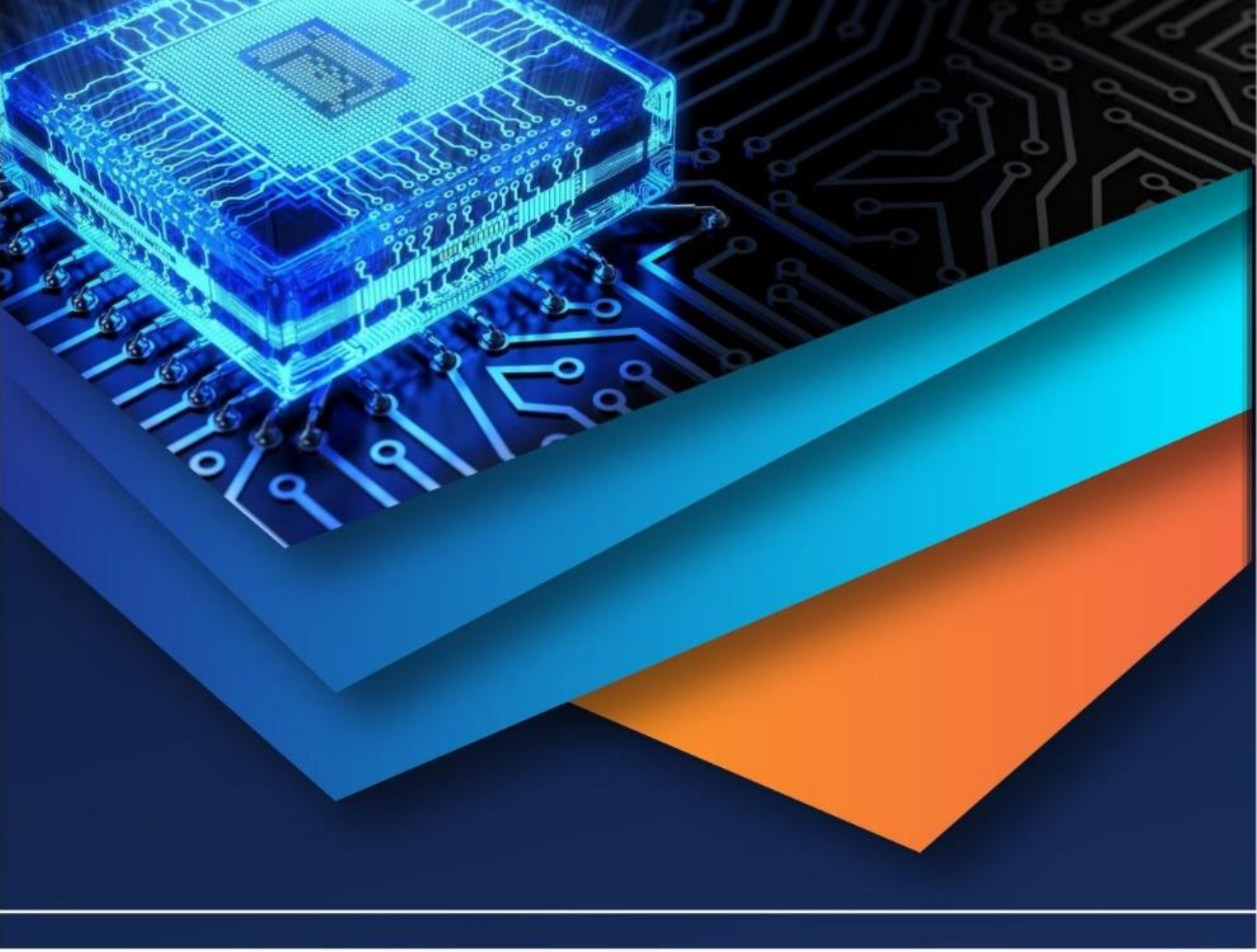

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