AUTOMATED LICENSE PLATE RECOGNITION IN HELMETLESS ENVIRONMENT USING DEEP LEARNING

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I. ABSTRACT

Automated License Plate Recognition (ALPR) systems have emerged as critical tools for enhancing road safety and enforcing traffic regulations. However, conventional ALPR systems primarily rely on helmeted riders, limiting their effectiveness in diverse road environments. This paper introduces a novel approach to ALPR that operates effectively in helmetless scenarios, significantly improving road safety and enforcement capabilities.

Our approach leverages advanced computer vision techniques, machine learning algorithms, and deep neural networks to robustly detect and recognize license plates on vehicles, even in the absence of helmets. We explore various components, including image preprocessing, plate detection, character segmentation, and character recognition, optimizing each for helmetless environments. Additionally, we integrate a helmet detection system to address the safety concerns of riders who do not comply with helmet regulations.

The proposed system demonstrates remarkable accuracy in license plate recognition while adapting to the dynamic and challenging conditions of modern roadways. By reducing reliance on helmet presence, our ALPR system proves instrumental in enforcing traffic rules and promoting road safety, benefiting law enforcement agencies, traffic management, and public safety.

This research represents a significant advancement in the field of ALPR, addressing a critical gap in recognizing license plates in helmetless scenarios and contributing to safer and more secure road environments.

II. INTRODUCTION

In today's rapidly evolving world, the importance of road safety cannot be overstated. Whether for traffic management, law enforcement, or public safety, monitoring and regulating vehicular movement on our roads is a fundamental necessity. To this end, Automated License Plate Recognition (ALPR) systems have emerged as indispensable tools, capable of automating the identification and tracking of vehicles through their license plates.

Traditional ALPR systems have significantly enhanced the efficiency of traffic management and law enforcement by enabling swift and accurate recognition of license plates. These systems have been instrumental in identifying and penalizing traffic violations, locating stolen vehicles, and even aiding in criminal investigations.

However, a glaring limitation of traditional ALPR systems lies in their reliance on a specific contextual condition: the presence of helmets on riders. Many regions and jurisdictions mandate helmet use for motorcycle riders, and conventional ALPR systems have been optimized to work optimally when riders are wearing helmets. When helmets are not used, these systems may struggle to accurately recognize license plates, potentially leading to lapses in enforcement and compromising road safety.

This discrepancy in license plate recognition during helmetless scenarios raises serious concerns. It not only challenges the efficacy of traffic enforcement but also jeopardizes public safety by allowing traffic violations to go unaddressed. In an era where road safety remains a paramount concern, it is imperative to bridge this technological gap and develop ALPR systems that can operate effectively and reliably in helmetless environments.

This presentation explores the innovative field of "Automated License Plate Recognition in Helmetless Environments." Our research focuses on developing novel approaches and technologies to address this challenge, ensuring that ALPR systems can continue to play a pivotal role in enhancing road safety and enforcing traffic regulations, regardless of whether riders are wearing helmets. In the following sections, we will delve into the components, methodologies, and implications of our approach, highlighting the transformative potential it holds for road safety and traffic management.

III. IMPLEMENTATION OF DEEP LEARNING IN PROPOSED SYSTEM

The proposed system can be utilized to monitor traffic, where the technology can be used to identify bicycle riders wearing helmets or not utilizing deep learning-based neural networks. then take the license out. plate number to use ALPR (Automatic License Plate Recognition) to levy fines against them. A branch of machine learning techniques called "deep learning" makes use of artificial neural networks (ANN), often known as neural networks, are used to train make independent, wise decisions. The most popular type of machine learning that uses deep learning is called supervised learning, which uses a sizable dataset to train the system. Deep-learning models use very deep neural networks that are deeper than three layers to attempt to learn the deep aspects of the input data hierarchically. Through unsupervised training, the network is converted into a supervised setting. For training, it uses both structured and unstructured data. It is employed in a variety of fields, including medicine and computer science.

Face recognition, computer vision, language identification, and other applications of deep learning are a few examples. With fewer training data sets available, deep learning can create new features. and is capable of using unsupervised learning methods. It decreases the amount of time needed to extract features from raw data.
With ongoing training, deep learning architecture is flexible and effective for a range of issues. As a result of the training process's reliance on a constant stream of data, there is less room for progress. The price of computer training rises as the amount of datasets does.
In the event of a specific error, an entire algorithm is rewritten to fix the problem.

For training datasets, expensive resources are needed, such as hardware for high-speed processing units and potent GPUs.

This technology can be used for traffic surveillance to monitor and catch bikers who are riding without a helmet in order to avoid catastrophic head injuries or life-threatening collisions. The rider who is found to be riding without a helmet will be penalized, and an SMS notification of the fee may be sent to their phone number.

IV. LITERATURE SURVEY

A YOLOv3 technique was presented by Aleksa Corovic et al. [1] for precise object detection of traffic participants. Real-time testing of the performance was done while driving in various scenarios. This Yolov3 algorithm that was suggested was based on a CNN (convolutional neural network). Real-time picture extraction from the input video is performed by the algorithm, which then resizes the image before representing it as input to the YOLO network. Then, based on comparing real-time data with trained datasets, the objects are spotted using a bounding box in real-time. The YOLO algorithm that was suggested was designed specifically for simultaneous detection and tracking of several objects. The system's performance was not optimal in several weather and illumination situations. However, it continued to operate with great accuracy and offered a stable foundation for detection of object.

An method for real-time picture recognition in a movie was presented by Duy-Nguyen Ta et al, [2] al. They haven't used many feature descriptors. Interest point and descriptor calculation are the two sequential phases present in many features. The Incremental Interest Point Detection, Interest Point Tracking, Motion Estimation, and Descriptor Computation. Then, Real-Time Object Recognition and Tracking includes Image procedures for initializing and organizing graphs. Despite the fact that the projected Despite being the best, algorithm has significant drawbacks, including camera motion. size of the search area, etc. When used outside, the tracker malfunctions when the camera notices a vacant area between twostructures. The suggested framework has significant potential for improvement in an outdoor environment.

For practical safety helmet wearing detection, Jie Li, et al. [4] suggested a method based on image processing and machine learning. They've employed the Vibe background modeling method to find moving targets underneath a stationary surveillance camera. a power substation camera. To describe internal human characteristics HOG attribute Using extraction. The Support Vector Machine (SVM) was used to categorize pedestrians. used to instruct the computer. Helmets were identified using color feature recognition as detected. The three stages of the framework approach are background modeling, Safety helmet detection and pedestrian classification. When it comes to the error rate, this The proposed approach concentrates on enhancing the speed and precision of wearing safety helmets.

An autonomous helmet detection framework was put up by Kang Li, et al. [5] to identify ambulatory employees' safety helmets in power substations. Image processing, machine learning, and computer vision are all used in this framework. This suggested framework is intended to identify employees wearing safety helmets or not. Moving object segmentation, classification of pedestrians in a power substation, and lastly safety helmet detection—which determines if the worker is wearing a helmet or not—make up this system. This framework had various limitations, such as distance and lighting, and was only effective up to a certain point.

An automated helmet recognition system for motorcycle riders and passengers was proposed by Rattapoom Waranusast et al. [6]. The suggested approach was tried in Thailand on a university campus with minimal traffic. They have classified items using the KNN (key-nearest neighbor) method and moving objects, and have employed machine learning and image processing to determine if the rider and passenger are wearing helmets or not. In a setting with little traffic, their technology was able to identify helmet use at 74% for both lanes. However, there were some detection errors in the distant lane, and when an item is moving and hits the detecting line while overlapping it, the categorization is incorrect.

A technique for classifying motorcycles and identifying motorcycle riders who are not wearing helmets was proposed by Romuere R. V. e Silva, et al. [7]. The two parts of this investigation are the categorization of the vehicles and the detection of the helmets. For the process of classifying vehicles, they employed the Wavelet Transformer (WT) as the descriptor and the Random Forest as the classifier. The picture properties were extracted using the helmet detection method, Circular Hough Transformer (CHT), and Histogram of Oriented Gradients (HOG). Multilayer Perceptron (MLP) was used as the classifier to categorize the items in the helmet detection procedure. There are still some changes that can be made to the image capture step, where the system may be adjusted to give better results, even though the results obtained were encouraging.

An ALPR approach and many ways to remove a license plate off a vehicle were proposed by Shyang-Lih Chang et al. [9]. The majority of the suggested solutions were successful in constrained environments, such as dim illumination, low vehicle speeds, etc. This Two modules make up the proposed LPR approach, which served as the foundation for the ALPR. They are modules that locate and identify license plate numbers. Many experiments were carried out for each module, and the outcomes have been recorded, with a 97.9% success rate for the license plate location module, and The success percentage for the license number identification module is 95.6%.The aggregate success percentage of the two modules was 93.7%. This suggested system had some limitations, including the fact that it could only read license plates from a single country and that it didn't take lighting, reflectance, or depth pictures into account. The system-affecting element should be improved by the suggested approach.

V. ARCHITECTURE OF PROPOSED SYSTEM

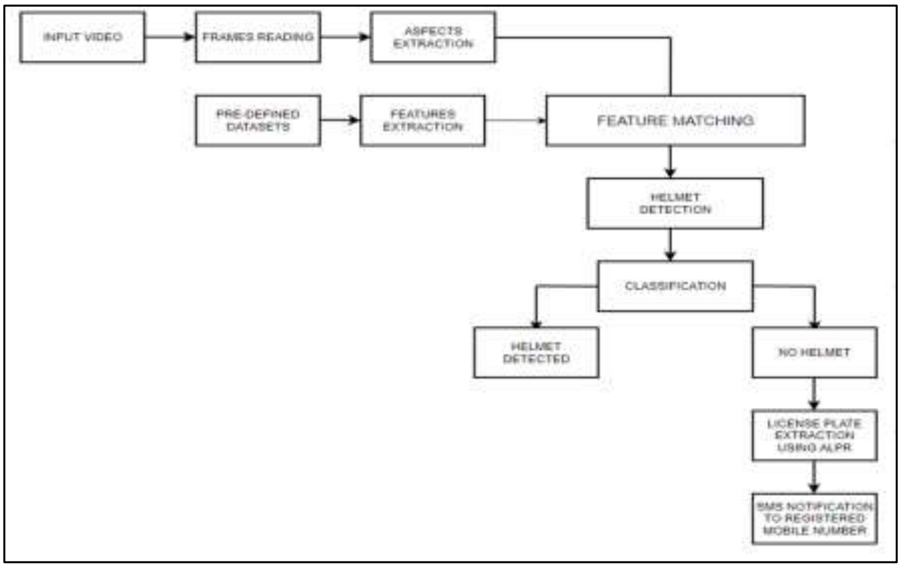

Figure:1 SYSTEM ARCHITECTURE

Real-time video of the input is recorded, and each frame is examined for readability. between each pause. The characteristics of the item, in this case the helmet, are retrieved and compared with those derived from pre-defined databases. Comparing extracted features with pre-established or pre-trained datasets is a procedure. the process of feature matching. then, with the feature descriptor implemented . The object's final categorization is decided by the algorithm and DNN-classifier. suggested system. Helmet detected and no helmet are the two potential outcomes. when the algorithm spots a rider wearing a helmet in the input footage, it shows a helmet. if the supplied video's biker's helmet cannot be identified, it will display On the output screen, there is no helmet. The license plate extraction module of the proposed system will then be used to identify and recognize the license plate and the characters on it. This module operates on the ALPR framework. Finally, the suggested system would use the SMS API to implement an SMS notice to the biker's cellphone number.

VI. PROPOSED METHODOLOGY

The input of the proposed system is either a recorded videotape or videotape sluice through web cam. It's reused in two phases as Discovery of Bike- riders and specifically Discovery of Bike- riders without helmet.

A. INPUT VIDEO DETECTION

Either an IP camera or a webcam was used to record the input footage. It is then translated into pictures, and the haar cascade classifier algorithm is used to identify the biker's face and determine whether or not the cyclist is wearing a helmet.

Figure 2: An illustration of video taken by a camera when a rider is either wearing a helmet or not.

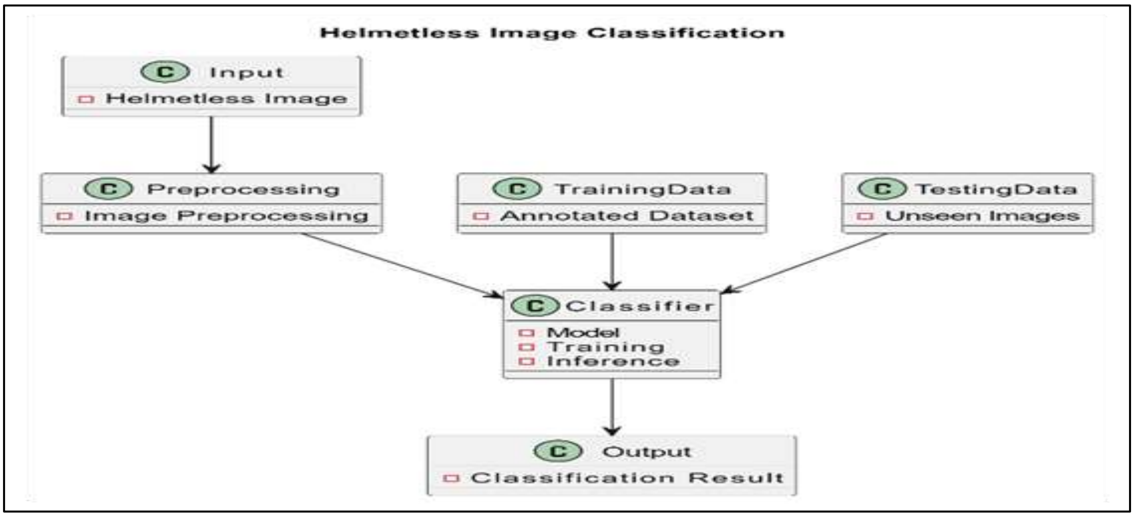

Figure3: Process for recognizing helmetless picture categorization.

B. CLASSIFICATION OF IMAGES

The first step in image classification is to transform the collected pictures into binary, grayscale, and color images. photos are converted, and after that, for assessment, they are compared to trained photos in the database.

C.IMAGES STORED IN GREYSCALE

Deep learning neural networks include convolutional neural networks. To find complicated characteristics in data, it has a unique design using a multi-layered neural network. In order to recognize complicated features, CNN uses a feature descriptor known as the kernel or filter, which transforms the pictures into matrix representation.

D.RESULT INTERPRETATION

In the final step, after the classification of images and comparison of images with trained images, the system detects whether the person is wearing a helmet or not and shows the result. If the person is not wearing a helmet, it captures the license plate of the bike and generates SMS with a fine amount.

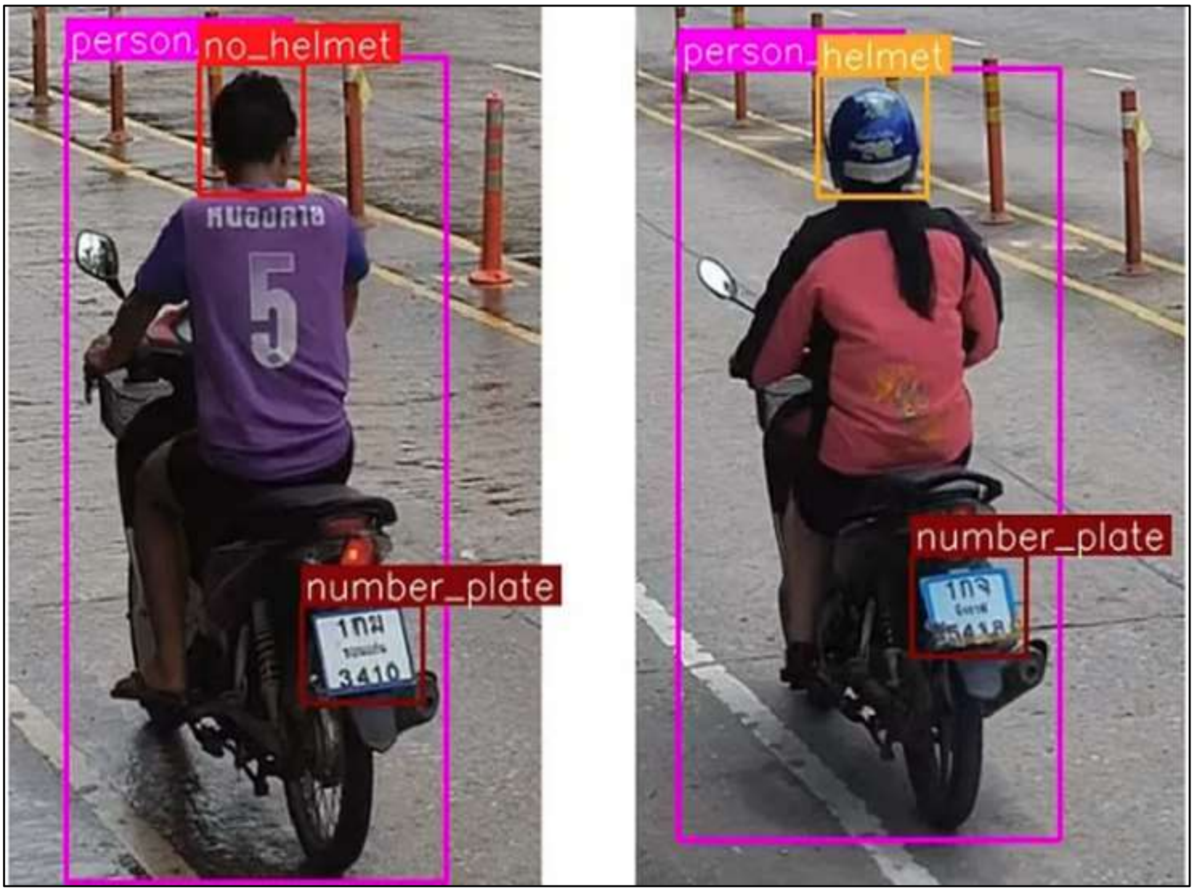

Figure4: It demonstrates that if a person is not wearing a helmet, the bike's license plate is taken and an SMS with the fine amount is generated.

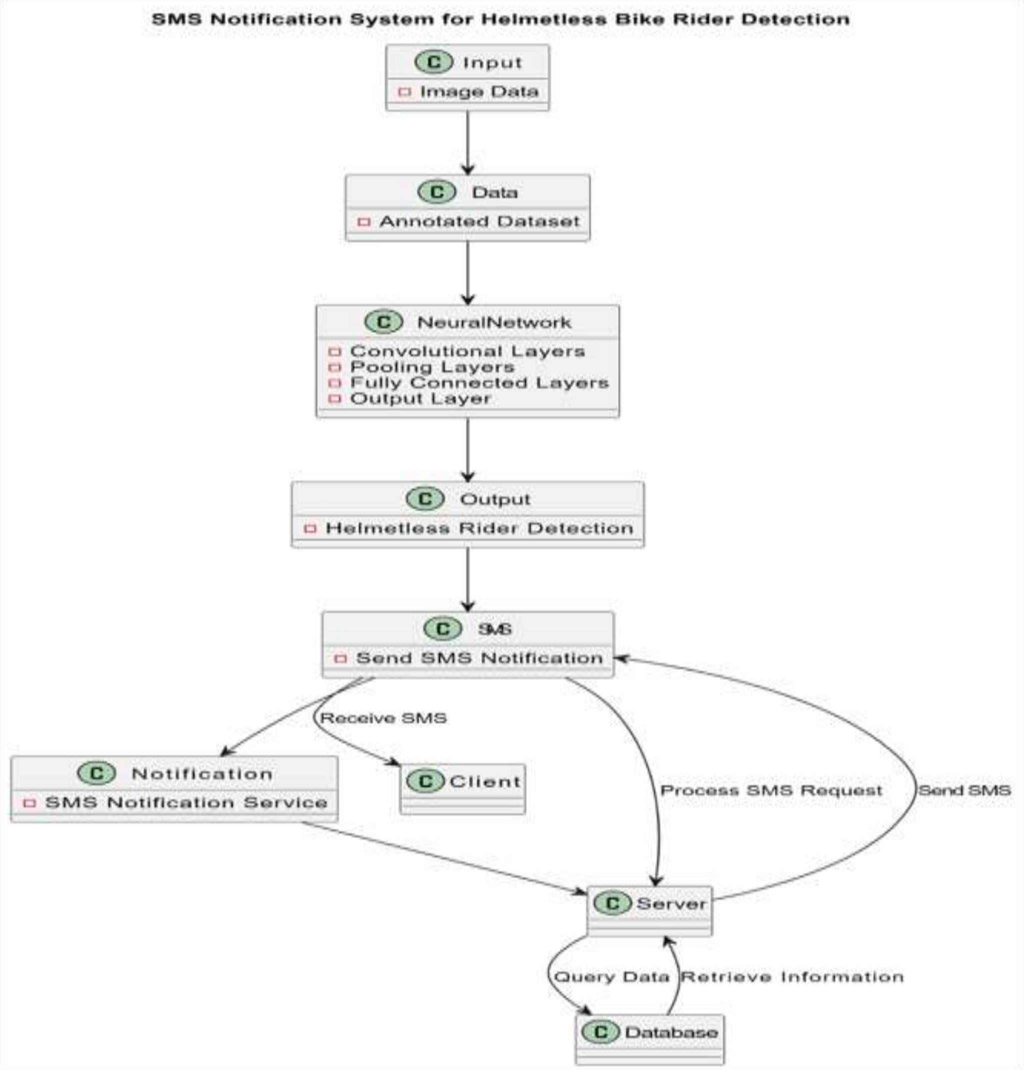

Figure5: shows how to use deep learning to detect helmetless bike riders automatically and send an SMS message. The neural network, input data (pictures), annotated dataset, helmetless rider recognition output, SMS sending component, notification service, client-side interaction, server-side processing, and database interaction are among its crucial components.

VII. APPLICATION OF PROPOSED SYSTEM

This suggested technique may be employed primarily in the traffic control division, where it would be simple to track and spot motorbike riders who are not wearing helmets. In addition, the following application can make advantage of the suggested systems.

- Video surveillance: this technique is frequently employed to keep an eye on purposes. The suggested approach is applicable to traffic management department responsible for policing cyclists who ride without helmets. Personnel security, where the technology may be utilized to keep an eye on employees and staff in court cases, building sites, electricity substations, etc.
- systems for recognizing items: The suggested system also has the ability to identify several objects. The system may be trained to recognize certain things both inside and outside of buildings. The

system is applicable to fruit or Vegetable detection, roadside car detection, persons detection, etc. or may be used in offices to recognize individuals by their faces.

- Security Process: Tollgate checkpoints can employ the suggested system. to recognize and save the car's license plate number for security reasons. or to keep tabs on how many cars use that route each day. In the event of a calamity, the data recorded may be helpful afterwards. Also, it is be utilized in public malls, supermarkets, shops, theaters , and private Where the system may be trained: businesses, offices, workplaces, schools, institutions, etc. to identify persons, keep track of information about their activities or services, or the items they are purchasing, etc. These facts can help with the in the event of a catastrophe or issue.

VIII. RESULTS AND DICUSSION

HELMET DETECTION:

The suggested system classifies objects or the properties of an item using deep neural networks, feature descriptors, and a DNN classifier. Real-time video and predetermined datasets can be compared. to identify or categorize the elements of a frame The system use the YOLO algorithm to identify the helmet by first identifying the rider or individual . If the motorcyclist is wearing a helmet, it is checked on his head. The system would notice that the cyclist is wearing a helmet. by locating the helmet within a bounding box. and following it around in the real-time input video the biker's helmet and the region around his head [1] Precision level. Lastly, the system makes advantage of feature classification terms for the object's characteristics (helmet), and with the assistance of the DNN-classifier, it Analyze the extracted data in comparison to the training datasets. and finalize the object's classification, show the output on the output window will be as Helmet detected.

Figure(a): Real-time input camera footage without helmet.

LICENSE PLATE CHARACTER EXTRACTION:

A license plate picture is manually recorded using an IP cam (mobile application) and uploaded to the internet in this section of the proposed system. utilized as a source. Utilizing ALPR with K-Nearest License plate, Neighbour (KNN) algorithm, and Extracting its characters (letters and numerals) by the system from the supplied picture. Four are present. the following are the steps in APLR:

Identifying items in a picture, such as a car or a license plate, using input image processing:

Figure (b): Input image processing.

- Extraction of the license plate -The plate is taken out of the picture.

Figure (c): License plate extraction

- Character thresholding for license plates present in the image of the extracted license plate become threshold images and filers used to determine the characters a part of the license plate.

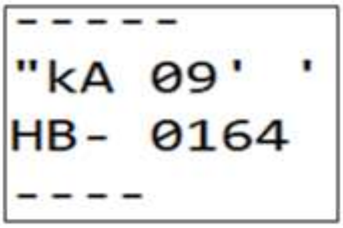

Figure (D): License plate thresholding

character Recognition: The characters included in the license plate are retrieved using segmented photos of license plates.

Finally, as soon as the license plate character extraction is finished, the system will instantly switch to SMS Notification to deliver a concise SMS.

Figure(E): . SMS NOTIFICATION

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X.CONCLUSION

The suggested technology for automatically spotting cyclists without helmets has the potential to alter the traffic management division with surveillance in the most secure and effective method. The system architecture consists of three processes that are anchored in various algorithms and techniques license, helmet detection SMS notification and plate extraction. YOLO, deep neural networks for deep learning, feature description detection of helmets. Using the KNN algorithm, ALPR for extraditing license plate data. Also, SMS API were used. to send an SMS notice. Despite the intended Whilst the system works as planned, there are some shortcomings can impact the results generated. illumination, whether the camera is positioned at a certain angle, the angle at which the picture was shot is processing. The procedure for identifying the license plate and detecting a helmet may be impacted by the pace at which the rider is moving together with the vehicle.

Additionally, it is challenging for the system to identify the characters on the license plate due to the usage of third-party license plates, various font sizes and styles, spaces between letters, and the location of the license plate. Low network signal, speed, and other factors might interfere with SMS notification. The suggested system performs better when deep learning is used for detection, classification, and identification tasks. Future development on the suggested system will concentrate on integrating the SMS notification process, the license plate character extraction method, and the helmet identification mechanism into a unified framework.

XI. FUTURE SCOPE

Deep learning-based Automated License Plate Recognition (ALPR) in areas without helmets has a huge potential to transform law enforcement and traffic safety. ALPR systems will grow more sophisticated and accurate in their capacity to recognize license plates even in difficult situations as deep learning techniques continue to progress. Convolutional neural networks (CNNs) and other cutting-edge structures, such as transformers, are examples of deep neural networks that will be crucial to reaching unparalleled precision and real-time processing capabilities.

The combination of ALPR and AI-based helmet detection systems is one of the most exciting future breakthroughs. By identifying motorcyclists who are not wearing helmets in addition to identifying license plates, this synergy will enable thorough monitoring of road safety.

Additionally, intelligent traffic control systems will be tightly connected with ALPR in areas without helmets. To control congestion, enhance incident detection, and optimize traffic flow, these systems will leverage ALPR data. Additionally, the data produced by ALPR devices will provide sophisticated analytics, providing perceptions into parking, traffic, and vehicle monitoring, which may guide security and urban planning initiatives.

ALPR technology will need to handle privacy and ethical issues as it develops. It will be essential to implement privacy protection measures, such as blurring license plates for non-law enforcement uses, to strike a balance between security and individual private rights.

Overall, deep learning-based ALPR has the potential to make our roads safer, more effectively controlled, and more technologically sophisticated. With further study and development, we may anticipate that these technologies will become increasingly important in years to come for improving traffic management and road safety.

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