COST-EFFECTIVE VEHICLE ACTIVITY MONITORING FOR APARTMENTS AND QR CODE AUTHENTICATION FOR RESIDENTIAL COMMUNITIES.

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Abstract: In present world where there is an increasing number of vehicles, it has become more apparent that manual record-keeping is insufficient to manage the vast influx of vehicles. Having a continuous human presence to record license plate numbers is not only labor-intensive but also challenging. Additionally, there are concerns about the legibility of manually stored data.

Instances of theft within residential societies are often linked to insufficient authentication procedures during exit, especially during nighttime hours. Authorization for exit is granted only if the information associated with the vehicle and the individual aligns with the database records. To enhance authentication, QR codes are employed. During the time of entry, the number plate recognition serves to be an exceptional solution. The user enters without any obstruction if found to be a resident, and if not, registers himself as one and moves ahead for his own business. At the time of exit, a protected QR code scanner is accomplished by the number plate recognition. This QR code scanner works in a protected manner where the individual consents to their identity. It will be used to match the encrypted key using the designated software or application and when found to be illicit, is denied the exit from the premises. Hence, a protected QR code scanner prioritizes user safety by inspecting content and employing encrypted measures to avoid risks and misleads that may occur.

The combination of Python for development, Yolo V8 for real-time object detection, Easy OCR for precise character recognition, and a protected QR Code scanner for authentication reasons, propel this system to an unprecedented level of performance and reliability. This system has the potential to revolutionize security and management at various entry points, ensuring smoother operations and heightened security measures at all times.

Index Terms - License Plate Detection, License plate Extraction, Character Segmentation, Character Recognition, Protected QR Code Scanner

I. Introduction

In today's world, with an increasing number of vehicles on the road, traditional methods of manual record-keeping are insufficient to manage the vast influx. The need for human presence around the clock to record number plates is both difficult and demanding. Furthermore, manually stored data is prone to errors and illegibility, which raises concerns about its reliability over time. To withstand these limitations, a cutting-edge system has been formulated, gripping technologies such as Python, Yolo V8 (You Only Look Once), and Easy OCR. This system autonomously detects number plates and seamlessly stores them in a robust database,

ensuring the longevity and accessibility of information. This stored data can be firmly retrieved and utilized, whenever required [1].

The system's functionality is ideal upon a vehicle's entry into the gated society or area, it promptly captures vehicle number plate via camera. Subsequently, these images undergo the processing stage facilitated by the integrated software [6][7]. If the vehicle's number plate matches an entry in the database of apartment vehicles, it receives clearance to proceed through the gate and a notification is sent to the vehicle owner about vehicle entry in the apartment with date and timestamp [8]. Significantly, vehicles that go unrecognized by the system are non-resident vehicles and those vehicles are authenticated and registered by the security person using the mobile app for future reference [1][16].

Instances of theft within residential societies are often attributed to insufficient authentication procedures during exit, particularly during night time hours. In cases where the information associated with the vehicle and the individual aligns with the data stored in the database, authorization is granted for the person to exit with the vehicle. Conversely, if a mismatch is detected between the provided data and the stored records, the security personnel are prompted to manually verify the individual's identity before allowing the vehicle to leave the premises[2][3].

For authentication purposes, a QR code can be employed. The automated Number Plate Detection programme is taken into rumination throughout the day. A protected QR code is to be scanned during dusk, upon the exit of the vehicle from its corresponding site. This would be an inescapable approach accompanied by the number plate scanning alongside. The QR code must be encrypted to prevent unauthorized access. To access the information lying under in the QR code, individuals must scan the QR code using the devoted application or software capable of handling password-protected QR codes. The QR code can be designed in such a way that it exhibits high-contrast colours, bold patterns and reflective materials to ensure readability in misty and darkened outline.[11] Thus, by precisely addressing these aspects and extremities, the process for scanning the QR codes and overseeing concurrent number plate scans during the dark and gloomy time when the vehicle exits, can be a secure, sturdy and aptly carried out in compliance to other necessary protocols [15]. Residents gain clearance upon their vehicle's recognition and by scanning protected QR code , while non-residents generate a QR code provided by the vehicle owner. This QR code is presented to security for scanning and verification, allowing exit upon authentication.

The fusion of Python for development, Yolo V8 for real-time object detection, Easy OCR for precise character recognition and protected QR code elevates this system to an unprecedented level of performance and reliability [5].This system can revolutionize security and management at various entry points, ensuring smoother operations and increased security measures at all times.

II. Literature Review

2.1 Standard Vehicle Detection

The increase in vehicular presence in modern cities has led to a need for a change in how societies handle and secure their territories. Traditional manual record-keeping, once crucial for security, now struggles with a large number of vehicles. The need for a constant human presence, recording license plates throughout the day, is both labour-intensive and logistically challenging. Also, concerns arise about the long-term viability of manually stored data due to its vulnerability to eventual illegibility.

To address these limitations, a slice-edge system has surfaced, using advanced technologies, Python, YOLO V8 (You Only Look formerly), and Easy OCR. The objectification of these technologies aims to overcome the failings associated with homemade record-keeping and introduce a more effective and sustainable result. This section delves into the current state of exploration and development in the areas of automated number plate discovery, real-time object recognition, and character recognition to give a comprehensive understanding of the system's technological foundation.

2.1.1 Automated Number Plate Discovery:

Automated Number Plate Recognition (ANPR) systems have gained elevation in recent times as a robust result for efficiently managing vehicular entry and exit in colourful settings, including domestic societies. The integration of Python, a protean and extensively used programming language, contributes to the rigidity and inflexibility of the system. Python's expansive libraries and community support make it an ideal choice for developing complex yet effective operations.

The use of YOLO V8, an advanced object discovery algorithm, is a crucial technological element in the system's capability to autonomously describe and fete number plates. YOLO V8 employs a single neural

network to reuse the entire image, furnishing real-time object discovery with high delicacy. This ensures that the system can fleetly and directly prisoner vehicle number plates, laying the foundation for flawless entry and exit procedures within reopened communities.[2]

2.1.1.1 Real-Time Object Discovery with YOLO V8

You Only Look formerly (YOLO) algorithms have evolved as state-of-the-art results for real-time object discovery. YOLO V8, being the eighth replication of this algorithm, refines and enhances the effectiveness of object recognition. Its capability to reuse images in real-time, coupled with high delicacy, makes it a necessary element for the proposed system.

The YOLO V8 algorithm, with its unified armature, addresses the failings of traditional object discovery styles by furnishing a comprehensive understanding of the entire image in a single pass. This not only improves the speed of discovery but also ensures that the system remains responsive to dynamic scripts, similar to vehicles entering and exiting a domestic society. The integration of YOLO V8 elevates the system's performance to unknown situations, enhancing the overall security and operation capabilities.

2.1.2 Precise Character Recognition with Easy OCR:

Character recognition, a critical aspect of number plate discovery, is seamlessly handled by Easy OCR in the proposed system. Easy OCR is famed for its delicacy in rooting textbooks from images, making it an ideal choice for feting alphanumeric characters on vehicle number plates. The community between YOLO V8 for object discovery and Easy OCR for character recognition ensures that the system not only identifies number plates but also directly interprets the alphanumeric information bedded on them.

The operation of Easy OCR introduces a subcaste of perfection to the system, mollifying the pitfalls associated with misapprehension and ensuring that the stored data remains dependable for future reference. This perfection is particularly pivotal in scripts where the system needs to separate between occupant and non-resident vehicles, contributing to enhanced security measures within the domestic society.[10]

2.1.3 Integration of Technologies for Performance:

Our comprehensive and high-performance system integrates Python for development, YOLO V8 for real-time object discovery, and Easy OCR for precise character recognition. This approach not only overcomes the limitations of homemade recordkeeping but also sets new norms for effectiveness, trust ability, and rigidity in managing vehicular conditioning within domestic societies.

With the capability to autonomously detect and record number plates, our proposed system effectively overcomes traditional challenges associated with homemade record-keeping. The real-time processing capabilities of YOLO V8 enhance the system's responsiveness, making it well-suited for dynamic surroundings such as reopened communities. Easy OCR's contribution to accurate character recognition further solidifies the system's trust ability, providing a foundation for secure entry and exit procedures.

2.2 Standard Vehicle Authentication

The drawbacks associated with employing RFID (Radio-Frequency Identification) for vehicle authentication stem from its exclusive linkage to the vehicle rather than the individual. This intrinsic limitation poses a significant challenge as RFID lacks the implicit capability to verify the user's identity, thereby leaving the system susceptible to unauthorized access. Moreover, RFID technology does not provide a means to validate or substantiate the permissions granted by the vehicle owner. This deficiency raises additional concerns regarding the overall security of the authentication process, making it crucial to explore alternative technologies, such as QR (Quick Response) scanners, to address these identified limitations and enhance the precision and security of vehicle access control.

2.2.1 RFID Contrary to QR Scanner

The above-mentioned observation highlights a significant drawback inherent in RFID (Radio-Frequency Identification) technology, where its exclusive association is with the vehicle rather than the individual. Consequently, RFID lacks the inherent capability to address the risk of unauthorized individuals gaining access to a vehicle. Specifically, the technology does not enable the verification of the user's identity or validate the permissions granted by the vehicle owner.

To address this identified inadequacy, a strategic decision has been taken to phase out the use of RFID technology. Instead, there is a proposal to adopt QR (Quick Response) scanner technology, with the expectation that it will establish a more robust and secure operational framework for the application. The envisioned QR scanner technology is distinguished by its ability to create a direct and verifiable link between

the individual and their entitlement to use the vehicle. This transition is motivated by a commitment to strengthen the security architecture of the application, specifically aiming to overcome the acknowledged shortcomings associated with RFID technology in preventing unauthorized access or potential theft.

## 2.3 Challenges and Future Directions:

While the proposed system showcases promising advancements in the realm of automated number plate discovery, it's essential to admit being challenged and consider implicit avenues for unborn exploration. One notable challenge is the need for robustness in varying environmental conditions, similar as low light or adverse rainfall. unborn exploration could explore advancements in image processing ways or the objectification of fresh detectors to address these challenges.also, the scalability of the system to accommodate the growing number of vehicles in domestic societies or civic areas is a material consideration. probing strategies for optimizing the system's performance as the scale increases could lead to wider relinquishment and impact.

The seamless incorporation of AI and machine learning algorithms presents boundless possibilities for ongoing enhancement through iterative learning. Further studies could concentrate on enhancing the algorithms based on feedback from real-world data, enabling flexibility to changing situations and emerging obstacles.As technology advances, the intersection of ethical concerns becomes more and more critical. Ensuring responsible and ethical use of automated surveillance systems, particularly in residential settings, is paramount. Future research could delve into creating ethical AI deployment frameworks that include privacy protections, data transparency, and community involvement.

III.Proposed Work

Detection utilizing YOLO v8 involves employing a progressive object detection technique. This approach enables the identification and localization of various objects within an image or video. By leveraging this model's capabilities, it becomes feasible to accurately pinpoint and outline specific objects, such as vehicles or license plates, in a given visual dataset. Now, there are a series of steps that enable the functionality of the model. They are: -

1. Preparation of the dataset: This involves gathering multiple sets of images containing vehicles with visible license plates. Each image needs to be labelled, marking the bounding boxes around the license plates that denote the coordinates they are in. It is important required to have a well-annotated dataset for effective training.

2. Training the model: To train YOLOv8 for license plate detection, use the labelled dataset that was created earlier. During training, the model learns to identify license plates by optimizing its parameters based on labelled data. The final value received in this step will be the model itself along with the needed information of its number plate.

3. Detecting the number plates: The parameters include a rectangular line that is visible around the detected number plate. Thus, any number plate that comes under the surveillance of the live camera, would be regarded to be as one and will be solely detected. The input will be the detected yet trained data followed by the output as the learned label [12].
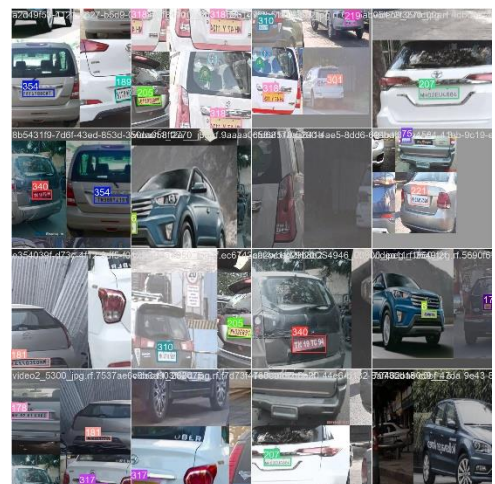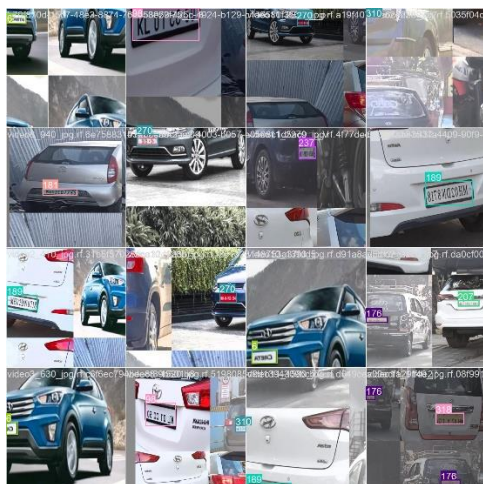
4. Text extraction using Easy OCR: Easy OCR provides a simulating method for extracting text from various file sources like images or videos, particularly useful for capturing and detecting 'alphanumeric' characters from license plates. Here, Easy OCR's functionality primarily comprehends utilizing its optical character recognition capabilities to accurately pinpoint and extract text, focussing on license plate numbers, from designed datasets using recursive approaches and instances and even setup processes [10][7].

5. Database storage and processing: The storing and processing of data after the detection and extraction using the steps above, involves managing the recognized details, fundamentally the license plate numbers, in a database system. This step includes organizing and storing the extracted data in a structured manner within a database, enabling easy retrieval, processing, and analysis to authorize future feasibility. Once this data is stored, it can undergo various processing tasks, such as validation, indexing, or further analysis, to derive meaningful insights or facilitate specific functionalities within a given application or system.

Authentication for security purposes: "To steal is, to just steal". This particular saying validates well enough with the current scenario around us. Even if it is a gated society with security personnel available 24/7, there are chances of heist or thieving. There is no defined time for an uncertainty or mishappening of such kind to take place. Individuals often find themselves caught to be victims of any such surprising activity. Though there are a lot of security measures being taken care of, the number of registered cases around the globe has not come to an end or reduced. Therefore, it has become a necessity to build a system or software that quickly responds to any prompts it observes.

Now, let's pay keen attention to our discovery or findings: - During the time of entry, the number plate recognition serves to be the finest of solutions. The user enters without any obstruction if found to be a resident, and if not, registers himself as one and moves ahead. At the time of exit, a protected QR code scanner is accomplished by the number plate recognition software. This QR code scanner works in a protected manner where the individual is sanctioned of their identity. It will be used to match the encrypted key using the designated software or application and when found to be illicit, is denied the exit from the premises. The QR code authentication method comes with two main benefits for both users and organizations. Firstly, it improves the user experience by eliminating the need to enter or type long passwords manually. [3] It only takes an easy and quick scan for users to authenticate themselves. Secondly, this method enhances security by preventing password-based bitter attacks. The use of a unique, encrypted QR code makes it challenging for threat actors to gain unauthorized access. Hence, a protected QR code scanner prioritizes user safety by inspecting content and employing encrypted measures to avoid risks and misleads [11][14].
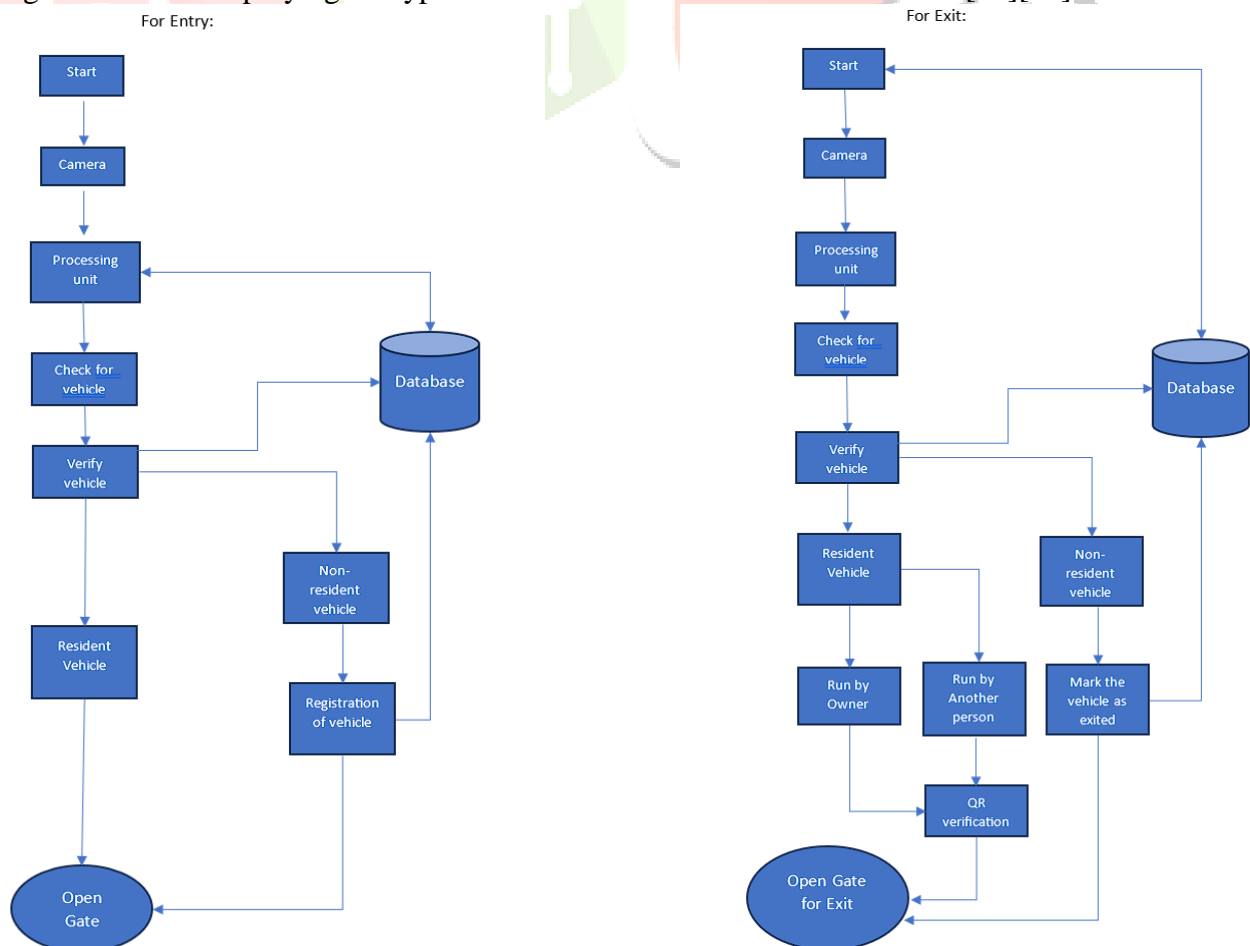
IV. Conclusion

Bringing together the capabilities of YOLOv8, EasyOCR, and a protected QR code scanner yields a comprehensive solution customized for precise and secure number plate recognition. Utilizing YOLOv8's sophisticated object detection, the system accurately pinpoints vehicles and isolates their number plates within images or video streams. EasyOCR seamlessly extracts 'alphanumeric' characters from these identified number plates, ensuring high accuracy in capturing license plate numbers even in varying and declining conditions. The incorporation of a protected QR code scanner adds an extra layer of security by validating the authenticity of QR codes associated with the number plates, which is specially taken care of during the time of exit. This not only ensures the safety of the scanning process but also mitigates potential security threats that might arise from QR code interactions and promotes refining the security layer. This proposed integration of YOLOv8, EasyOCR, and a protected QR code scanner establishes a powerful and secure framework for r number plate recognition. By combining these advanced detection technologies, precise text extraction, and stringent security measures, the system ensures both accuracy in recognition and the protection of user data which will cover all usual aspects.

V. References

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