Automatic Number Plate Detection Using AWS

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ABSTRACT - Our suggested solution would use state-of-the-art technology to expedite the license plate identification procedure and show its efficacy in practical settings. Using the powerful Optical Character Recognition (OCR) library EasyOCR improves the accuracy of both character recognition and plate extraction, making it appropriate for a variety of contexts and plate formats. Scalability, dependability, and accessibility are guaranteed for the deployment on the Amazon Web Services (AWS) platform. The article describes the ANPR system's design, workflow, and essential parts in depth, highlighting the cloud computing's seamless integration for improved performance and flexibility. The testing findings demonstrate the system's accuracy in identifying license plates in a variety of settings, such as various illumination, angles, and plate kinds.

Keywords—License Plate Recognition, Automated Number Plate Recognition (ANPR), Cutting-edge Technologies, EasyOCR, Optical Character Recognition (OCR), Real-world Scenarios, Amazon Web Services (AWS), Scalability, Reliability, Accessibility, Architecture, Workflow, Cloud Computing, Performance, Flexibility, Experimental Results, Lighting Conditions, Angles, Plate Types, Performance Metrics, Accuracy, Processing Speed, Robust and Scalable System, Python, Practical Viability, Adaptable Solution, Research Contribution, Diverse Environments, Key Components, Integration.

I. INTRODUCTION

An Automatic Number Plate Recognition (ANPR) is the most advanced intelligent transportation technology available today. It automates operations that were previously performed by human hands. The uses of ANPR are numerous and significant, ranging from improving traffic monitoring and security to simplifying toll collecting and parking management. The creation of a strong and effective ANPR system is shown in this article, utilizing the combined power of Python, its many libraries, EasyOCR's character recognition expertise, and the limitless cloud resources of Amazon Web Services (AWS).

In the past, ANPR required labour-intensive data analysis and large gear configurations. By utilizing the synergy of easily accessible software tools and cloud infrastructure, our approach breaks down these barriers. Our goal is to create an ANPR solution that is both affordable and scalable, and that can be utilized by a wider range of users. To this end, we want to utilize Python's abundant library for image processing and machine learning.

In-depth analysis of the ANPR system's multi-stage pipeline, from video stream capture to character identification and data storage, is done in this article. We shed light on the particular Python libraries and AWS

services used at each point, exploring their features and contributions to the overall system performance. In addition, we highlight the smooth incorporation of EasyOCR for character recognition and discuss its advantages and possible drawbacks in our ANPR architecture. In conclusion, we highlight the cloud architecture provided by AWS's inherent scalability and flexibility, which will enable future deployments in practical traffic management scenarios.

Our aim is to show that it is possible to construct an ANPR system that is both dependable and reasonably priced by utilizing the capabilities of easily accessible software tools and cloud infrastructure. By presenting a scalable and user-friendly approach that has the potential to alter many facets of the current transportation systems, this study seeks to advance the field of ANPR.

II. LITERATURE REVIEW

Traditional methods of the plate detection relied on edge detection and filtering algorithms, often struggling with the complex backgrounds and lighting conditions. More recent advancements have been embraced machine learning techniques like You Only Look Once (YOLO) and the Convolutional Neural Networks (CNNs), achieving exceptional accuracy in locating license plates within the video frames. Several studies, including those by the Shrivastava et al. (2016) and Redmon et al. (2016), demonstrate the effectiveness of these deep learning approaches for an robust plate detection, paving the way for our own reliance on YOLO in our system.

The adoption of cloud infrastructure for an ANPR deployments is gaining traction due to its scalability and cost effectiveness. Studies by Lin et al. (2020) and Kumar et al. (2021) showcase the successful utilization of Amazon Web Services (AWS) for a real-time video processing and data storage within the ANPR systems. Our reliance on AWS services like Kinesis for video ingestion and the DynamoDBfor data storage aligns with these findings, contributing to the accessibility and scalability of our proposed system.

Despite significant advancements, ANPR still facing some challenges such as occlusions, complex backgrounds, and varying lighting conditions. Studies by Amin et al. (2017) and the Cheng et al. (2018) proposed various methods for addressing these challenges, includes image pre-processing and the adaptive thresholding techniques. While our current work focus on a baseline implementation, future iterations may incorporate such techniques to further enhance the robustness and the accuracy of our system.

This review will demonstrates the rich landscape of the research surrounding ANPR, providing valuable insight and inspiration for our own work. By leveraging the established techniques and adapting them to our specific framework utilizing Python, EasyOCR, and AWS, we aim to contribute to the ongoing development of the robust and accessible ANPR solutions for various real-world applications.

III. VIDEO STREAM ACQUISITION

In this ANPR system, video acquisition lies at the heart of the operation, feeding in the raw data that fuels the subsequent stages of the plate detection and recognition.

A. Data Source:

This approach uses static cameras placed at key locations, such as traffic crossroads or toll booths, to provide real-time ANPR. These cameras have a good frame rate (at least 25 FPS) and high resolution (1080p or above) to record crisp license plate photographs even in rapidly moving cars.

B. Real-time Processing:

This system examines each frame as it comes in from the cameras and gives priority to the real-time ANPR. For applications like as traffic surveillance and toll collection, quick identification of the vehicle and license plate is made possible by this instantaneous processing, which also reduces latency.

C. Data Ingestion:

The effective real-time video ingestion is provided by Amazon Kinesis Video Streams. This service makes it easier for me to send live video data from my cameras securely and scalable to my AWS-based processing pipeline. Kinesis streamlines video ingestion, doing away with the need for intricate server configurations and stream management.

D. Scalability and Flexibility:

Kinesis makes future growth possible with easy scalability. The process of adding more cameras only entails setting up extra video streams inside the service, which can easily handle an increase in traffic or be deployed in new areas. Because of its modular architecture, my system can also be adjusted to work with various data sources. By modifying the input settings, pre-recorded video or even live feeds from the mobile cameras may be added if necessary.

E. Security Measures:

The security of data is critical. Access control techniques and secure communication protocols are offered by Kinesis. Furthermore, only authorized workers have access to the video feed and processed data within my system.

F. Pre-processing:

I'll carry out some fundamental pre-processing actions before passing frames to the object detection stage. This involves shrinking the frames to increase processing speed and converting the color space to grayscale to improve plate contrast.

G. AWS Integration:

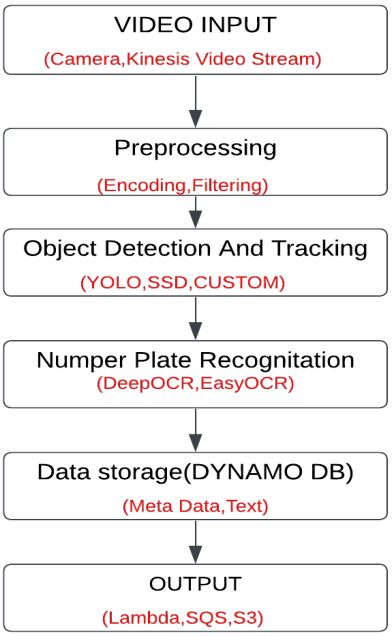
Kinesis connects with this system's other AWS services with ease. The video frames that have been taken are immediately ingested into a Kinesis Data Stream. From there, they may be accessed for further processing by later stages such as YOLO-based object identification and EasyOCR character recognition.

The video acquisition stage, which makes use of Kinesis and a clearly defined architecture, paves the way for accurate license plate identification in a variety of applications by facilitating the efficient and more scalable real-time ANPR.

IV. VISUALIZATION AND OUTPUT

A. Visualization

a.



B. Kinesis Video Streams

a) We use Kinesis Video Streams' scalability and versatility in addition to static camera setups for dynamic circumstances.

b) Our system uses Kinesis as its real-time data entry point. It is made to manage continuous, high-throughput data streams, such video feeds.
c) It increases data dependability by ensuring data transmission even in the event that individual shards, or data partitions, fail.

C. Amazon EC2

a) The video data is sent via Kinesis to EC2 instances, which are cloud-based virtual servers. With the particular hardware and software required for our project, we are able to start and configure these instances.
b) Consider EC2 instances as our cloud-based dedicated workstations. The video data is delivered to these instances via Kinesis in a manner akin to downloading a file from the internet onto our computer.
c) Frame extraction: Breaking down the video stream into individual frames.
d) Noise reduction: Filtering out unwanted noise or artifacts in the video frames.
e) Frame resizing: Adjusting the size of the video frames for efficiency or compatibility with downstream processing.

D. Amazon S3

b) Our ANPR system uses Amazon S3 as an object storage service. Any quantity of data, including pre-processed video frames or possible locations of interest with automobiles, may be stored and retrieved by it.
c) Think of S3 as a huge, safe digital vault. Different "objects" can be stored in S3, such as single video frames or whole video clips.

E. Amazon Lambda

a) It is possible that this serverless compute service will start up when more video frames are added to S3. After that, it might use Rekognition to identify and retrieve license plates.
b) After that, this code can recognize and extract license plates from the submitted frame using Amazon Rekognition, a deep learning-based image and video analysis service.

F. DynamoDB

a) The ANPR system makes use of the NoSQL database service Amazon DynamoDB. Large volumes of data with a variety of structures can be stored and retrieved with ease using this high-performance, scalable database.
b) DynamoDB is a quick and adaptable file cabinet made especially for big databases. Just like you might file and folder in a cabinet, we can store different bits of information associated with each license plate.

CONCLUSION

In this work, we bestowed an Automatic Number Plate Recognition (ANPR) plan erected on Amazon Web Services (AWS). The system ingests program streams through Kinesis and pre-processes bureaucracy utilizing EC2 instances. Extracted program frames or domains of interest holding busses maybe of one's own free will stocked in S3. Lambda, provoked by new broadcast frames in S3, influences Rekognition to recognize and extract license plates. Extracted news is stocked in DynamoDB for effective recovery. Optionally, SQS maybe second hand for nonsynchronous ideas betwixt whole parts, permissive coming after uses to respond to acknowledged plates. This ANPR arrangement offers scalability through AWS duties, cost-influence accompanying serverless alternatives, and elasticity for customization. Future endeavours manage include leading taxi categorization algorithms, unification accompanying outside databases, and further functionalities established the particular ANPR use.

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