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Design of IoT based Automatic Number Plate Recognition

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Abstract:

New opportunities for several applications in the fields of security and transportation have emerged because of developments in computer vision and image processing techniques. One of these well-known uses is automatic number plate detection (ANPD), which is essential for traffic control, toll collection, parking management, and law enforcement. This paper focuses on creating and implementing a productive ANPD system using the Internet of Things based Raspberry Pi platform.

This paper includes the summary of the methods currently in use and the difficulties involved in number plate recognition. We have also highlighted the benefits of the Internet of Things based approaches like Raspberry Pi as the hardware platform for our system, including its cost, adaptability, and computational power. The need of using computer vision methods, such as edge detection, contour analysis, and morphological operations to preprocess the video frames and extract pertinent characteristics is also highlighted. Traditional computer vision methods and deep learning models are combined to accomplish accurate number plate identification.

Keywords— Raspberry Pi, Image processing (IP),Internet of Things (IoT), Computer Vision, Open CV.

I. INTRODUCTION

Because the number of vehicles on the road is increasing so quickly, efficient traffic management is a major concern for cities all over the world. The time-consuming, prone to error, and frequently ineffective nature of conventional manual traffic monitoring and law enforcement approaches has come to light. Because of this, there is a rising need for automated systems that can precisely gather and interpret pertinent data, such as vehicle identification through number plate recognition. The use of Automatic Number Plate Detection (ANPD) systems, which provide useful data for a variety of applications including toll collection, parking management, traffic infraction detection, and vehicle tracking, is essential for effective traffic management. For identification or decision-making purposes, these systems often include taking pictures or videos of moving vehicles, collecting the licence plate information, and then further analysing the data. With the Raspberry Pi serving as the central processing unit of this study, our goal is to create an accurate and effective ANPD system. The system will include a camera module built on a Raspberry Pi for picture acquisition, sophisticated computer vision algorithms for number plate recognition, and real-time processing capabilities for quick results. Using sophisticated computer vision methods, such as image pre-processing, edge detection, and feature extraction, number plates will be precisely identified and segmented from the recorded images. The algorithms will be enhanced to work with varying plate sizes, typefaces, and backgrounds, ensuring dependable performance in a variety of settings. We will create algorithms that enable real-time analysis of collected photos using the computing capabilities of the Raspberry Pi. Optical character recognition (OCR) techniques will be used to extract the characters from the detected number plates and interpret them, enabling quick identification and further processing. We want to solve the drawbacks of conventional ANPD systems, such as expensive costs, difficult installations, and constrained scalability, by utilising the power of Raspberry Pi. The findings of this study will aid in the creation of scalable, affordable ANPD systems that will enable effective traffic control, better law enforcement, and increased road safety. This research intends to provide a realistic and affordable way for implementing ANPD systems, opening up prospects for broad adoption in various traffic management applications. It does this by using Raspberry Pi as the central processing unit.

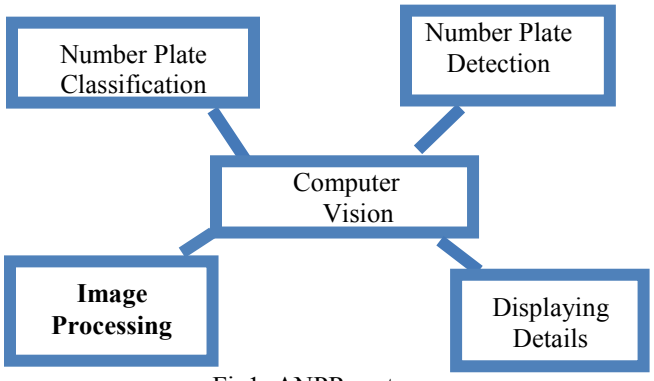

Fig1: ANPR system

II. LITERATURE SURVEY

In [1] tells us that, Automobiles are not permitted in many employment environments in Unknown. Because

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security is critical, this research will help security officers identify the number plate numbers of vehicles as they approach the gate by providing seamless plate number verification for vehicles coming in and out.

In [2], Using the data that the system has recorded, this confirms the owner's identification as well as the specifications of the car. Recognising a licence plate consists of four steps. The first phase is image acquisition, which is followed by licence plate extraction, segmentation of the licence plate, and character identification.

In [3], The pre-processing stage is utilised to improve the candidate region's appearance. Pre-processing techniques such as picture smoothing are used to reduce impulsive noise such as shadow disruption, and they considerably increase an image's reliability. A rain streak in an image may be tough to erase. To decompose an image, the Morphological Component Analysis (MCA) method is utilised.

Paper [5], After the camera takes a picture, the Raspberry Pi does image de saturation and character recognition before displaying the extracted number plate on the LCD. The created system was prototyped in Python and on the Raspberry Pi, and real-time results are exhibited. When a car approaches the camera, it takes a sequence of photos and saves them in a file. Then the collected data from the licence plate will be put into a cloud platform. The related database contains car information, and the user will be presented with it.

In paper[6],The extraction or detection of licence plate data is the first stage.Existing methods that combine object identification with deep learning and traditional computer vision techniques can be used to find the licence plate in a photograph. In the second stage, the license plate is divided into segments, and the characters are extracted using well-established techniques like connected components, relaxation labeling, vertical and horizontal projection, and mathematical morphology. It's worth noting that character segmentation may not be necessary in every multi-stage process. The final step involves character recognition, which utilizes pattern matching algorithms or classifiers such as neural networks and fuzzy classifiers.

The paper[9] discusses how the cascade structure was used in the construction of a rapid algorithm for real-time vehicle number plate recognition. This system employs a basic frame detection module for license plate segmentation. This module comprises three key stages: The first stage involves generating potential plate areas and employing gradient features to eliminate areas that are not license plates. The second phase involves extracting challenging plate regions and incorporates three processes to differentiate between plate and non-plate regions. The third step is plate verification, which ensures that no non-plate areas are mistakenly identified in the earlier phases.

III. Design and Methodology

Designing an automatic number plate recognition (ANPR) project requires a clear methodology as well as a number of essential components. Here is a high-level summary of the ANPR project's design and methodology:

>Specifying the goals, including things like vehicle identification, access control, traffic monitoring, or law enforcement.

>The Raspberry Pi 3 is around 50% more powerful than the Pi 2 because to its quad-core 64-bit Broadcom BCM2837 ARM Cortex-A53 SoC CPU, which operates at 1.2 GHz. Consequently, the new Raspberry Pi 3 can run business software and browse the internet. Choosing pi cameras with the right features, such as adjustable focus, low-light performance, and high resolution pictures.

> While the software specification relies on OpenCV, computer vision serves as a technique that allows us to comprehend images and videos, encompassing aspects such as their storage, manipulation, and data extraction. In the realm of artificial intelligence, computer vision stands as the fundamental and predominant tool.

>To testing and training the ANPR system, gather a broad dataset of number plate photos. To ensure resilience, consider various angles, distances, lighting situations, and varieties of license plates.

>To improve image quality and eliminate noise, use image preprocessing techniques. Adapt the sharpness, contrast, and brightness.

It's crucial to keep in mind that ANPR projects can vary greatly depending on the particular requirements and limitations. The aforementioned methodology offers a broad framework to direct the design process, however depending on the particulars of the project, extra considerations and optimizations can be required.

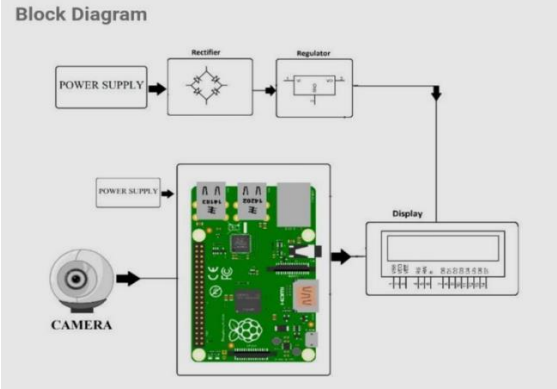

Fig 2: Block Diagram of Proposed System

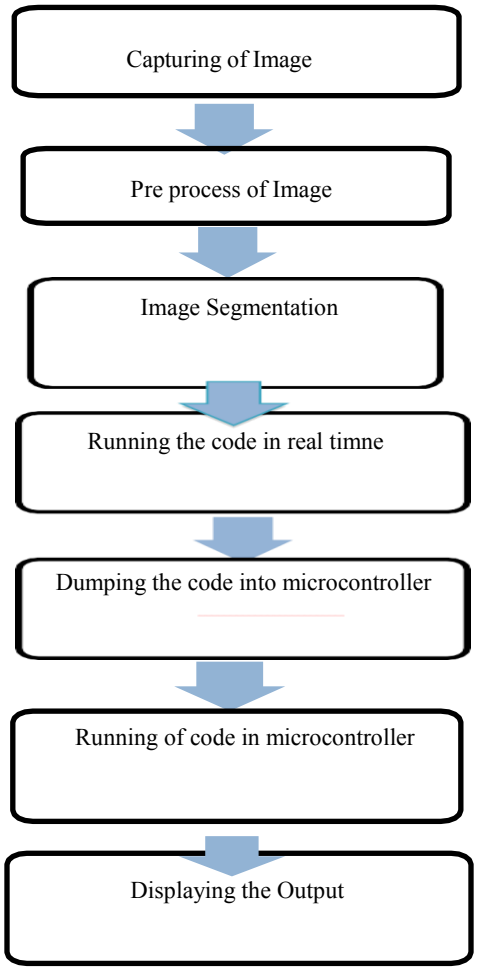

Fig3: Flowchart

IV. RESULTS

Fig 4a: Image of the Vehicle

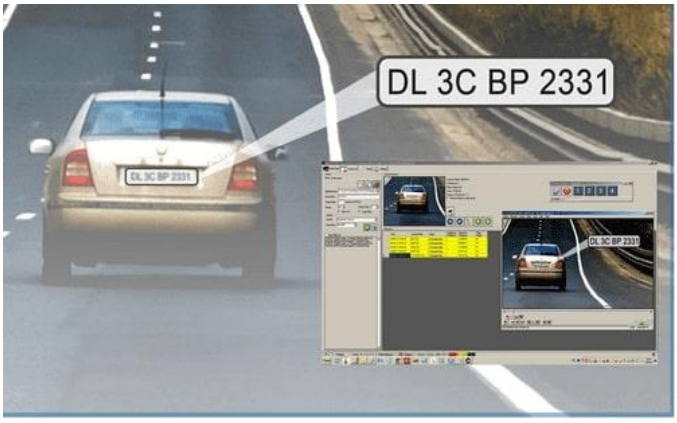

Fig 4b: Automatic detection of the vehicle number plate

Law enforcement, parking management, toll collecting, and traffic monitoring are just a few of the uses for which the ANPR system has shown to be efficient. It can increase security, improve traffic flow, and enable data-driven decision making across a variety of domains. The project has demonstrated the viability and usefulness of applying ANPR technology in real-world circumstances. You can connect the device to any IP camera with port capabilities for additional functionality. The device triggers an alarm when the number of people exceeds the maximum limit. You can also customize the device's operation schedule based on user preferences by setting time allocations for the algorithm. Figure 4a and 4b depict an example of input samples and the automatic recognition of vehicle number plates, respectively.

V. CONCLUSION and FUTURE WORK

To sum it up, the paper summarizes the automatic number plate recognition (ANPR) project which has displayed significant progress and promise in the field of vehicle identification and monitoring. Its execution has effectively accomplished accurate recognition of license plates from images or video feeds, thanks to the utilization of computer vision methods, machine learning algorithms, and image processing technologies. While the ANPR project has seen notable success, there are still various prospects for its future expansion and enhancement.

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