

1.INTRODUCTION

In a multicultural setting where people from various nations meet, answers to the never-ending issues facing men are developed. Python is a standout contribution to the scientific community in the open-source community. The Open Computer Vision (Open CV) fruit, which can aid in the development of computer vision, is the result of computer vision research at Intel. In the country right now, more people are using cars. As its primary means of identification, each of these vehicles has a special vehicle identification number. The ID is actually found in the license number, which is a reference to a valid license to take part in the public movement. There must be a unique number plate on the body of every vehicle in the world (at least on the back). They must determine which cars are growing in number with other cars. Safety, automatic switching, highway speed detection, light detection, stolen vehicle detection, and loss collection systems for both human and non-human losses are all made easier by this identifying system. The computer's manual method of manually entering the license plate number is replaced with the automatic license plate recognition system.



Fig.1: Image consisting of ANPR software processing

The license plate identification approach comprises of three primary subjects that must be covered in order to acquire an adequate personal recognition. Find the panel of digital photographs, segment characters from the panel's pictures, and recognize visual characters are three of them. Identifying the precise location of the number plate in the obtained image is the first and most fundamental step. The structural analysis method and the color analysis method have both been used to determine the localization of a license plate.

By processing the connected component, undesirable traces are eliminated from the License panel area. A collective control system called ANPR is used to photograph vehicles and identify their license plates. Automatic traffic control and tracking systems and highway toll collection are two examples of ANPR system applications. Automated parking systems, gas station automation, and flight time tracking. The identification of a vehicle license number is now quick and inexpensive because to these technologies automation.

Due of the enormous variety and assortment of license plate styles found in different states and nations, ANPR is typically regarded as a very difficult subfield in computer vision. The following factors make license plate recognition systems more challenging:

1. dynamic lighting conditions with reflections, shadows, and blur
2. automobiles that travel quickly
3. Obstructions

2. COMPONENTS OF ANPR

There are different components of ANPR. They are camera, database, illumination, software, hardware and database. ANPR camera is a crucial component in ANPR system. Camera's capture the image of either the frontend or rare side of a vehicle. High resolution cameras are used to capture the images of speed moving vehicles. Illumination with respect to ANPR is lightning on the license plate. IR rays are used for lightning on the number plate. Due to its invisibility to the human eye and lack of distraction to drivers, infrared light is also perfect for this use. As a result of the fact that license plates vary from one geographic area to another, the customer requested the product in a variety of wavelengths. Different software tools are used for image processing. Frame grabbers, Personal Computer are used as hardware. PC is acts as interface used to interact with user interface and database respectively. Database consists of the number plates along with details of the respective number plates.

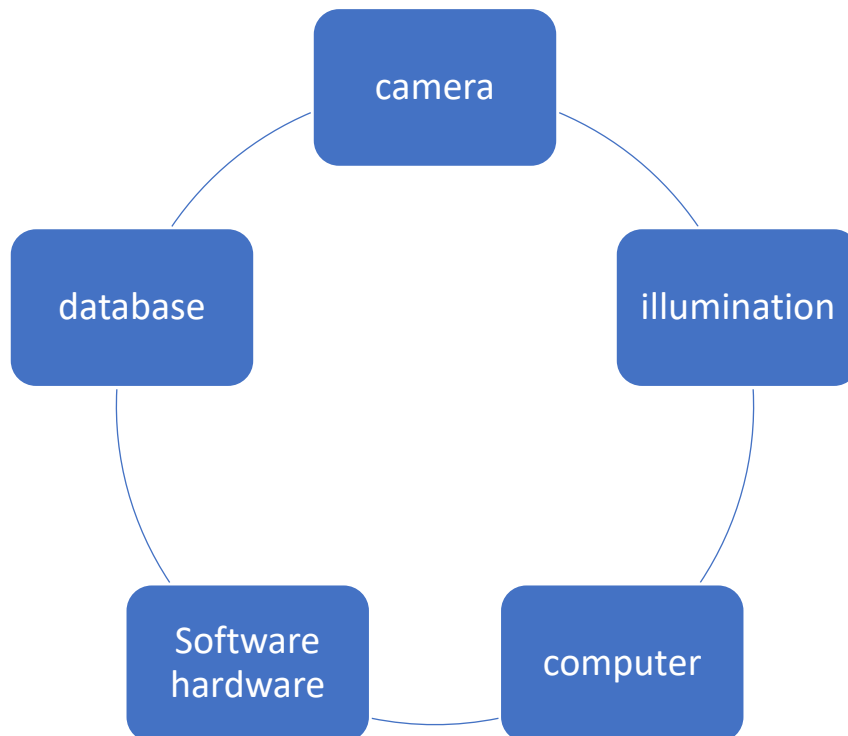


Fig.2: Image consisting of components of ANPR

3. ANPR METHODOLOGIES

3.1– LPR Algorithm:

The LPR algorithm is traditional way of implementing ANPR. Most of the countries use this technique. It has a long procedure of steps. Grayscale thresholding, binarization, and input data vehicle image preprocessing Filtering Feature Extraction Segmentation Character Recognition Output which gives output as Alphanumeric Texture the steps involved in this procedure. By reducing background noise, adjusting the intensity of individual picture particles, deblurring the image, and removing image reflections, preprocessing removes extraneous data and improves the image. Three main subprocesses are used in preprocessing for automobile license plate numbers: geometric operation, grayscaling, and binarization.

3.2–Using YOLOv5 And CNN:

The YOLOv5 is used to detect the vehicles and convolutional neural networks in used for image processing of the captured image. The cutting-edge YOLOv5 object detection model for number plate recognition. Using image processing and contouring techniques, the output from detection is then processed and separated into distinct characters. These distinct characters are then given to a CNN model, which outputs the associated label. The final output of the automobile license plate number is created by combining these character designations.

3.3–Using OpenCV And OCR:

OpenCV is a python library which is used for image processing of the image of license plate. OCR is Optical Character Recognition is used to recognize the characters which are fetched in the OpenCV. Using python library the vehicle image which is of RGB color is converted to gray scale then the license plate is localized, then the characters are fetched. After the characters are fetched the characters are recognized with the help of OCR.

4. WORKING OF ANPR

The ANPR working is categorized into 3 categories:

1. Capture image of Vehicle
2. Detect and process the image(using OpenCV)
3. Character Recognition(using OCR)

4.1 –Capture Image Of Vehicle:

TheANPR camera captures the image of rear or frontend of the vehicle. High resolution cameras are used at the roadside for capturing speed moving cars. It is important step in ANPR working. The MAV IQ range raises the bar for intelligent ANPR cameras by combining HD image quality, high speed ANPR detection, zoom capability, and long range pulsed IR lighting into one effective equipment. The MAV IQ collection of strong all-in-one ANPR cameras is made possible by the superior intelligent ANPR cameras from MAV, which combine the heritage of our HD and Analogue ranges with a potent yet environmentally friendly ANPR processor. These cameras establish new standards for ease of installation, longevity, low maintenance, great quality, and exceptional ANPR identification.

Smart cities are very much a part of our present, not simply our future. In order to help governments throughout the world, MAV offers top-of-the-line Intelligent ANPR cameras, which are revolutionizing traffic management. The idea behind smart cities is to give commuters and transportation agencies access to real-time information, which helps to cut down on traffic jams and the risks that thousands of people face every day when using the roads and other modes of transportation. The success of these traffic control systems depends heavily on the use of ANPR cameras, and as with everything else, the best camera is required to produce the best results. As a result, numerous nations have chosen MAV's line of Intelligent ANPR Cameras over the market leaders; quality is everything.

4.2– Detect And Process The Image (using OpenCV):

The image captured by the ANPR camera is taken as input and in contrast to the rest of the image of the car's back end,

1. OpenCV's blackhat morphological operator emphasizes the license plate numbers. The white writing on the black background makes the license plate numbers "pop," and the majority of the background noise is wiped out.
2. demonstrates the results of combining the closing operation with the inverse binary thresholding proposed by Otsu. Take note of how the areas where the license plate is positioned resemble a single, broad white surface.
3. emphasizes the borders of the characters on the license plate.
4. the characters on the license plate are shown as a continuous white zone.
5. threshold image is cleaned up using erosions and dilations in Python and OpenCV, which makes it simpler for our ANPR system to locate the characters on a license plate.
6. We can clearly see the region with the license plate letters is one of the largest contours after a number of image processing pipeline steps for ANPR/ALPR carried out with OpenCV and Python.
7. The outcomes of our Python and OpenCV-based ANPR localization workflow. This sample is excellent for sending to Tesseract for OCR.

These are the steps involved in Processing the image of the license plate. The image processing is done based on the steps mentioned above. Image processing is done in an efficient manner using python library of OpenCV.



Fig.3: Imageconsistingof OpenCV's blackhat morphological operator highlights the license plate



Fig.4: Image consisting of OpenCV is used to perform a closing and threshold operation

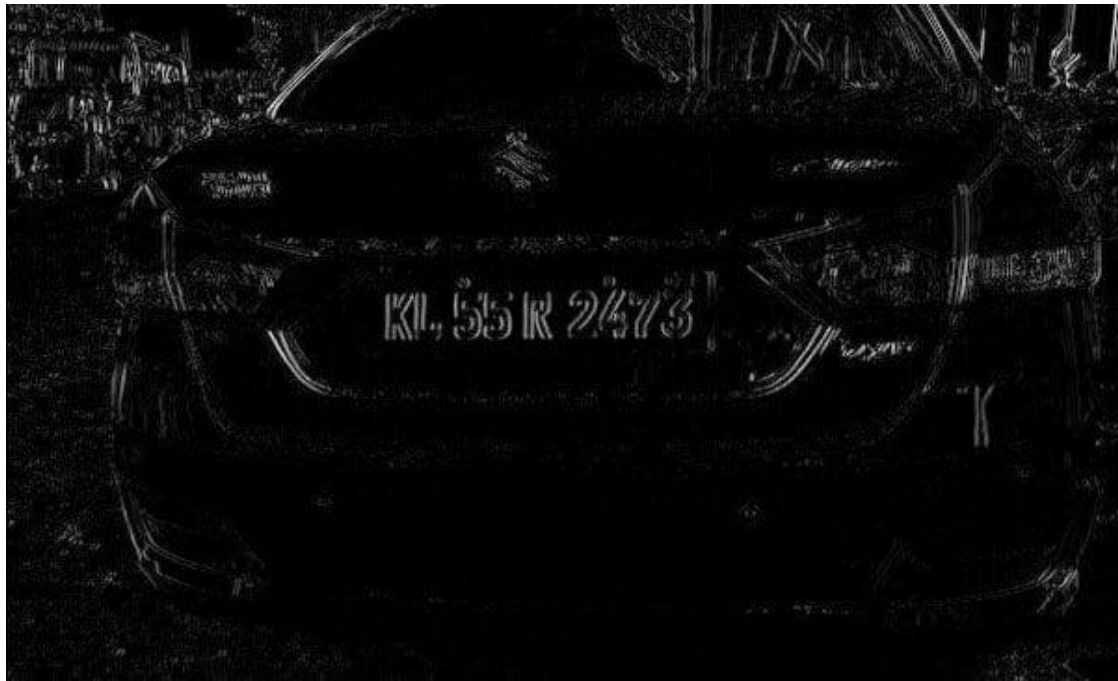


Fig.5: Image consisting of Scharr's algorithm which emphasizes the edges in our blackhat image



Fig.6: Image consisting of Blurring, closing, and thresholding operations using OpenCV



Fig.7: Image consisting of Erosions and dilations with OpenCV and Python clean up our threshold



Fig.8: Image consisting of large contour is the license plate of the vehicle using processing.



Fig.9: Image consisting of results of our Python and OpenCV-based ANPR localization pipeline.

4.2– Character Recognition (using OCR):

The Character Recognition is used to recognize the characters fetched. The character fetched is compared with the patterns of sequence of characters. If there is match the same process is continued till all the characters are recognized in the number plate.

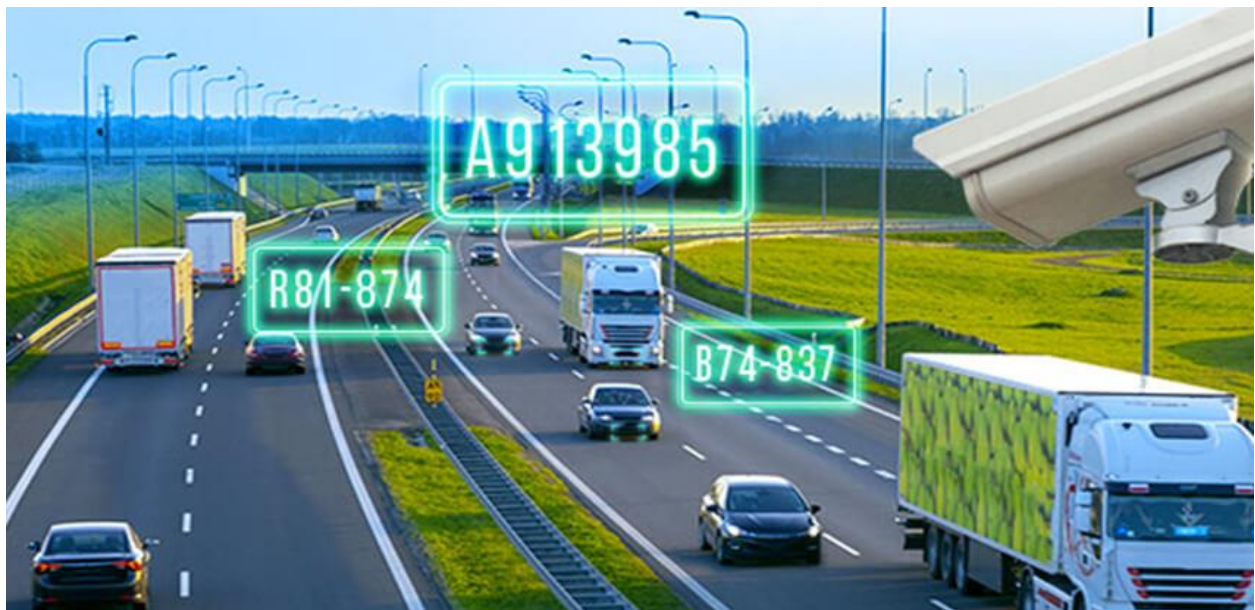


Fig.10: Image consisting of character recognition technique (OCR)

5.APPLICATIONS OF ANPR

1. Determine Speed of the Vehicle

The ANPR cameras capture the image of either front or rear side of the vehicle when the vehicle goes in its range. ANPR camera captures the image and stores the time at which the vehicle has passed through the camera. The same is captured by other cameras. Then cameras pass the image of the vehicle along with the times to the computer. Computer computes the average speed, and using different image processing techniques to recognize the license plate. It compares with the database license plates if there is a match then it checks whether the speed limit exceeded or not. If exceeded then the computer interacts with the interface and issues fine accordingly.

2. Smart Vehicle Parking System

A smart vehicle parking monitoring and management system in which all operations are carried out entirely through image processing and sensor-free. In an ANPR system, a camera is used to take pictures of the vehicle's license plate, which are then processed by a computer using a variety of image processing algorithms to identify the information on the plate. The system is also made to direct the cars to the closest parking space that is open. The suggested system seeks to address every issue that existed in earlier systems that made use of unreliable sensors.

3. Tolling

Autonomous number plate recognition (ANPR) systems and radio transponders are used in conjunction by Highway to toll cars entering and leaving the route. At every intersection, radio antennas pick up the transponders and record each vehicle's unique identification just like the system does. Without ANPR systems (Automatic Number Plate Recognition) as a backup system, it would be impossible to keep track of all the traffic, with vehicles having a gross weight of more than 5,000 kg being forced to use one. Highway users are advised of the usage fees by post using either system.

6.ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES:

1. Increased security

Deterrence is ANPR's main function. Usually, criminal behavior can be stopped before it starts if people are aware that their license plate is being captured and reviewed. The police can search the data gathered by ANPR and look for vehicles that are suspect or that have been associated with crimes, which is another benefit of ANPR. ANPR data might offer both defense information and damning information because it must be kept for a brief period of time. Additionally, ANPR offers security on a more basic level by managing permit parking for staff vehicles in open workplace parking or identifying a vehicle that has previously been prohibited from entering your property. For both commercial and residential use, ANPR provides an additional layer of security.

2. Automated service

An effective and economical way to monitor parking solutions is with ANPR cameras. They eliminate the need for parking wardens in parking lots. They are more effective than most people and consequently offer a more dependable service because of their high-accuracy readings and 24/7 functioning. Additionally, they provide a no-confrontation parking option, which some people have found useful when issuing tickets to motorists. In traffic and parking enforcement, where staff can rely on ANPR to give the essential information, parking management teams frequently find that both traffic people and ANPR cameras operate effectively together. This reduces the amount of time that employees must spend on the streets.

6.2 DISADVANTAGES:

1. privacy issues

Many people are concerned about their privacy when ANPR cameras are used, and many object to the idea of having their data retained for months. There is a worry that keeping information could result in data breaches, theft, or misuse of their personal information. People also object to the thought of having their whereabouts known at all times. The data is always

securely stored and should only be accessed for legitimate purposes by a senior official, therefore ANPR is not regarded as an invasion of personal privacy.

Law enforcement agencies will benefit from systems to recover seemingly destroyed data and steganalysis techniques in computer forensics and digital traffic analysis. Many data-hiding systems take advantage of human perceptual flaws while also having flaws of their own. For the time being, it appears that no data-hiding system is completely secure.

2. Extreme situations

ANPR is a fantastic addition to a parking lot, but it is not a foolproof solution. When it is raining or snowing heavily or when the number plate is hidden or deformed, ANPR cameras may have trouble operating. These cameras also depend on drivers of the vehicles to drive safely. For instance, if your number plate was covered when you were leaving the parking lot and you were too close to the car in front of you, the cameras might have missed your departure and may have overcharged you. Furthermore, some ANPR cameras lack the sophistication to detect number plates that deviate from the norm, such as vanity or foreign plates. Combining automated and human resources would be beneficial in these circumstances.

3. Human nature

The fact that ANPR parking systems hardly ever account for behavior and human error is a drawback. ANPR systems typically do not take into account granting a grace time when you enter a parking lot. As a result, cars who enter the parking lot in search of a space but are unsuccessful may be charged because the camera captured their entry and exit but did not capture a ticket to match. Similar to this, a ticket that is incorrectly written at a ticket machine—for instance, using the letter "O" instead of a zero—can result in a fine since the system is unable to match the ticket to the license plate that the cameras are reading

7.FUTURE SCOPE

In five years, The ANPR market will expand by about 25 to 30 percent. According to ErnoSzucs of ARH, Inc., enforcement solutions fusing, for instance, speed measurement, camera, and ANPR will fuel future growth.

"Over 90% of the projects from our partners are based on digital technologies and IP environments, showing a strong trend toward digitisation over the previous three to five years. Architectures are simpler, and connectivity and networking problems are simpler. The resolution problem with cameras has been resolved with digital technology, and even entry-level digital cameras can capture an entire highway lane. On the other side, digitalization has led to new problems. Large, high-resolution image processing is preferred over high picture compression rates because they improve OCR accuracy.

"Any discussion regarding new licence plates must take into account the requirement for photographic evidence for an offence like speeding. The image production infrastructure, which is predicted to be in place in the future, accounts for the majority of an enforcement system's cost. If the camera system needs to be installed, why add a parallel system when ANPR's contributory cost can be as little as 5%?

Automatic Number Plate Recognition (ANPR) systems were once complex, expensive, fixed-based applications that required a lot of setup work. Today, however, technical advancements have made them simple mobile apps that allow the use of the "point and shoot" technique. This is made possible by the development of software that operated on less expensive PC-based technology that does not require specialised hardware, as there is no requirement to specify the angle, speed, direction, or size of the plate as it passes the camera's field of vision. Law enforcement officers may now patrol every day with the benefit of real-time licence plate identification thanks to smaller cameras that can read licence plates quickly and processors that are more robust and fit in police cars.

8.CONCLUSION

ANPR technology usage is growing tremendously in the field of security. ANPR technique is used by the government officials especially police force and law enforcement for reducing the crimes related to vehicle's. ANPR camera, hardware and software can be embedded into a single device. This device is named as Ashva which is placed at the roof of the police patrolling cars for detecting the license plates of the cars around the device.

A lot of people today are becoming quite interested in ANPR solutions. It has benefited everyone, starting with enforcement and ending with smoother daily facilities. The good news is that technology is constantly developing, so soon you'll witness many improvements.

Four key tasks are accomplished by this project. The prototype computer's webcam will be used to assist in the first task, which is to input an image of the car. An improvement in quality occurs when the image is fed. In the resolution and thresholding, improvements are made. An established image frame size is imposed on the image. After augmentation, the image is processed in a way that separates the number plate from the entire scene using the rectangle's mathematical model. All of the characters in binary form are displayed on the segmented plate in a separate window. OCR, or optical character recognition, is used to process the improved segmented plate and segment all the characters in the image.

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