M.KUMARASAMY
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AI BASED REMOTE ACCESS VEHICLE

A MINOR PROJECT - III REPORT

Submitted by

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in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this **18ECP105/106L - Minor Project III** report "**AI BASED REMOTE ACCESS VEHICLE"** is the bonafide work of **Bharath B**(927621BEC026), **Chandru J**(927621BEC028), **Dhiyanesh S**(927621BEC048), **Hari Haran M**(927621BEC059) who carried out the project work under my supervision in the academic year **2023-2024 - ODD**.

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This report has been submitted for the **18ECP105/106L – Minor Project-III** final review held at M. Kumarasamy College of Engineering, Karur on _____

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: **Core Competence:** Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: **Professionalism:** Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: **Lifelong Learning:** Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	**Matching with POs, PSOs**
OpenCv , GPU, Camera	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2**

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We would like to thank our **Minor Project Co-ordinator**, **Dr.K.Karthikeyan, B.E., M.Tech., Ph.D., Associate Professor**, Department of Electronics and Communication Engineering for his kind cooperation and culminating in the successful completion of this project work. We are glad to thank all the Faculty Members of the Department of Electronics and Communication Engineering for extending a warm helping hand and valuable suggestions throughout the project. Words are boundless to thank our Parents and Friends for their motivation to complete this project successfully.

ABSTRACT

There are various means of monitoring traffic situations on roads. Due to the rise of artificial intelligence (AI) based image processing technology, there is a growing interest in developing traffic monitoring systems using camera vision data. This study provides a method for deriving traffic information using a camera installed at an intersection to improve the monitoring system for roads. The method uses a deep-learning-based approach (YOLOv4) for image processing for vehicle detection and vehicle type classification. Lane-by-lane vehicle trajectories are estimated by matching the detected vehicle locations with the high-definition map (HD map). Based on the estimated vehicle trajectories, the traffic volumes of each lane-by-lane traveling direction and queue lengths of each lane are estimated. The performance of the proposed method was tested with thousands of samples according to five different evaluation criteria: vehicle detection rate, vehicle type classification, estimation, and queue length estimation. The results show a 99% vehicle detection performance with less than 20% errors in classifying vehicle types and estimating the lane-by-lane travel volume, which is reasonable. Hence, the method proposed in this study shows the feasibility of collecting detailed traffic information using a camera installed at an intersection. The approach of combining AI and HD map techniques is the main contribution of this study, which shows a high chance of improving current traffic monitoring systems.

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LIST OF ABBREVIATIONS

ACRONYM		ABBREVIATION
ALPR	-	Automated license plate readers
GPIO	-	General purpose input and output

CHAPTER 1

INTRODUCTION

The traditional ALPR system usually requires a higher solution camera and a computer or notebook to process the complex ALPR algorithm. With the advances in the mobile technology, many mobile devices are now equipped with a strong CPU and high-resolution camera which meet the requirement of a good license plate recognition system. The quality of cameras in high-end smartphones is comparable to those highly expensive digital cameras. As hardware result, many complex applications for daily activities have been transferred from PC into the mobile platform. Thus, it is now possible to implement license plate recognition algorithm in the mobile platform. Conventional ALPR system is usually bulky as it needs to communicate with a fixed-point camera, which is not portable. A portable ALPR will be highly beneficial to law enforcement officers as they can carry around the device and perform traffic monitoring anywhere and anytime. It includes identifying for stolen vehicles and retrieving information of vehicles that violated traffic rules. Conventional ALPR system is usually very expensive to install and costly to program and maintain. In contrast, the implementation of ALPR in a mobile device is cheaper. However, there are still very limited researches that have been conducted thus far for ALPR on a mobile platform. View metadata, citation and similar papers at core.ac.uk brought to you by CORE provided by University Teknikal Malaysia Melaka: UTeM Open Journal System Journal of Telecommunication In this paper, we reviewed several researches and approaches that have implemented ALPR in the mobile-based platform. We discuss the techniques used in three main stages of ALPR namely localisation, segmentation and recognition. The remainder of this paper is organised as follows. Section II segmentation is discussed in Section III. Section IV discusses the license plate recognition, and finally, Section V summarises and concludes the findings. The first stage in ALPR is the license plate detection or extraction. The input for this stage is an image or a video frame. The image or the video frame is usually captured from a smartphone device. The output for this stage is then used for license plate location. This stage is very important as the result of the license plate recognition success rate is highly dependent on the image or the video frame. license plate recognition (LPR) plays an important role in numerous applications such as unattended parking lots [31], [35], security control of restricted

areas [8], traffic law enforcement [7], [33], congestion pricing [5], and automatic toll collection [20]. Due to different working environments, LPR techniques vary from application to application. Most previous works have in some way restricted their working conditions [9], such as limiting them to indoor scenes, stationary backgrounds [30], fixed illumination [7], prescribed driveways [22], [26], limited vehicle speeds [1], or designated ranges of the distance between camera and vehicle [23]. The aim of this study is to lessen many of these restrictions. Of the various working conditions, outdoor scenes and nonstationary backgrounds may be the two factors that most influManuscript received December 11, 2002; revised December 8, 2003. This work was supported by the National Science Council, Republic of China, under Contract NSC-89-2218-E-003-002. The Associate Editor for this paper was A. Broggi. S.-L. Chang, L.-S. Chen, and Y.-C. Chung are with the Department of Information and Computer Education, National Taiwan Normal University, Taipei, Taiwan, R.O.C. S.-W. Chen is with the Graduate Institute of Computer Science and Information Engineering, National Taiwan Normal University, Taipei, Taiwan, R.O.C. (e-mail: schen@csie.ntnu.edu.tw). Digital Object Identifier 10.1109/TITS.2004.825086 ence the quality of scene images acquired and in turn the complexity of the techniques needed. In an outdoor environment, illumination not only changes slowly as daytime progresses, but may change rapidly due to changing weather conditions and passing objects (e.g., cars, airplanes, clouds, and overpasses). In addition, pointable cameras create dynamic scenes when they move, pan or zoom. A dynamic scene image may contain multiple license plates or no license plate at all. Moreover, when they do appear in an image, license plates may have arbitrary sizes, orientations and positions. And, if complex backgrounds are involved, detecting license plates can become quite a challenge. Typically, an LPR process consists of two main stages: 1) locating license plates and 2) identifying license numbers. In the first stage, license plate candidates are determined based on the features of license plates. Features commonly employed have been derived from the license plate format and the alphanumeric characters constituting license numbers. The features regarding license plate format include shape, symmetry [15], height-towidth ratio [23], [25], color [17], [25], texture of grayness [2], [25], spatial frequency [26], and variance of intensity values [8], [10]. Character features include line [34], blob [13], the sign transition of gradient magnitudes, the aspect ratio of characters [12], the distribution of intervals between characters [28], and the alignment of characters [32]. In reality, a small set of robust, reliable, and easy-to-detect object features would be adequate. The license plate candidates determined in the locating stage are examined in the license number identification stage. There are

two major tasks involved in the identification stage, character separation and character recognition. Character separation has in the past been accomplished by such techniques as projection [11], [30], morphology [2], [10], [28] relaxation labeling, connected components [25], and blob coloring. Every technique has its own advantages and disadvantages. Since the projection method assumes the orientation of a license plate is known and the morphology method requires knowing the sizes of characters, these two approaches are not appropriate for our application because of their required assumptions. Relaxation labeling is by nature iterative and often time consuming. In this study, a hybrid of connected components and blob coloring techniques is considered for character separation. There have been a large number of character recognition techniques reported. They include genetic algorithms [17], artificial neural networks [2], [16], [26], fuzzy c-means [25], support vector machine [16], Markov processes [6], and finite automata [1]. These methods can be broadly classified into iterative and noniterative approaches. There is a tradeoff between these two groups of approaches; iterative methods achieve better accuracy, but at the cost of increased time complexity. In this study, we pay more attention to accuracy than time complexity whenever a choice has to be made between them. For this, we developed our own character recognition technique, which is based on the disciplines of both artificial neural networks and mechanics. The rest of this paper is organized as follows. In Section II, the types of license plates to be considered are described, followed by the fundamental idea of the proposed LPR technique. The two primary stages of the proposed technique, license plate location and license number identification, are discussed in detail in Sections III and IV, respectively. Experimental results are presented in Section V. Concluding remarks and ideas for future work are given in Section VI. Thus, it is now possible to implement license plate recognition algorithm in the mobile platform. Conventional ALPR system is usually bulky as it needs to communicate with a fixed-point camera, which is not portable. A portable ALPR will be highly beneficial to law enforcement officers as they can carry around the device and perform traffic monitoring anywhere and anytime. It includes identifying for stolen vehicles and retrieving information of vehicles that violated traffic rules. Conventional ALPR system is usually very expensive to install and costly to program and maintain. In contrast, the implementation of ALPR in a mobile device is cheaper. However, there are still very limited researches that have been conducted thus far for ALPR on a mobile platform.

1.1 OVERVIEW

The first stage in ALPR is the license plate detection or extraction. The input for this stage is an image or a video frame. The image or the video frame is usually captured from a smartphone device. The output for this stage is then used for license plate location. This stage is very important as the result of the license plate recognition success rate is highly dependent on the image or the video frame. Note that license plate can exist anywhere in the image. The license plate can be distinguished by its feature in an image, such as edge boundary, size, colour and existence of character feature. With the knowledge of these features, the processing time for detecting a license plate can be reduced by only processing the pixels that contain these features.The process begins with the capture of an image or a video stream that contains vehicles and their license plates. High-resolution cameras are commonly used for this purpose, and they may have special features like infrared illumination for nighttime operation. The captured images or video frames often undergo preprocessing to enhance the quality of the images and improve the visibility of the license plates. Preprocessing techniques may include resizing, noise reduction, and contrast adjustment. License plate recognition systems need to locate the region within the image or frame where the license plate is situated. This process is called license plate localization. Techniques like edge detection, color filtering, and template matching may be used to identify the plate's location. The system presented is designed to recognize license plates from vehicle. Input to the system is an image acquired by a camera that consists of a license plate and its output is the recognition of characters on the license plate in a separate notepad window. The system consists of the standard six main modules in an LPR system, viz. Estimation of vehicle speed, Image acquisition, License plate extraction, License plate segmentation and Licence plate recognition. The first task acquires the image. The second task extracts the region that contains the license plate. The third task isolates the characters, letters and numerals (total of 10 digits), as in the case of Indian License Plates. The last task identifies or recognizes the segmented characters. Background subtraction is a useful and effective method for detecting moving objects in video images. Since this method assumes that image variations are caused only by moving objects (i.e., the background scene is assumed to be stationary), however, its applicability is limited. The rationale in the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often

called "background image", or" background model". Background subtraction is mostly done if the image in question is a part of a video stream. There are many challenges in developing a good background subtraction algorithm. First, it must be robust against changes in illumination. Second, it should avoid detecting nonstationary background objects such as moving leaves, rain, snow, and shadow cast by moving objects. Finally, its internal background model should react quickly to changes in background such as starting and stopping of vehicles. Optical flow is the pattern of apparent motion of objects, surfaces, and edges in a visual scene caused by the relative motion between an observer (an eye or a camera) and the scene. Optical flow is used for the perception of movement by the observer in the world; perception of the shape, distance and movement of objects in the world and the control of locomotion. Sequences of ordered images allow the estimation of motion as either instantaneous image velocities or discrete image displacements i.e, it corresponds to the movement of pixels in an image. The optical flow methods try to calculate the motion between two image frames which are taken at times t and t+at at every vowel position. However, the methods used in optical flow are very slow and have unsharp boundaries with many errors. Adaptive change detection improves change detection by combining both the temporal difference method and the background subtraction method into one algorithm with the advantages of one of the algorithms compensating for the disadvantages of the other. Since, temporal difference method detects only the continuously moving objects and fails when an object stops, and due to the in efficiency of background detection method because of changing backgrounds and changing light conditions, the above method is useful to some extent. However, this method can be used only for static background cases This is the first phase in an LPR system. This phase deals with acquiring an image by an acquisition method. In our proposed system, we used a digital camera to acquire the input image. License Plate Extraction is a key step in an LPR system, which influences the accuracy of the system significantly. This phase extracts the region of interest, i.e, the license plate, from the acquired image. The proposed approach involves histogram based analysis for detecting the location of the license plate in the image acquired Alter splinting the extracted License plate into individual character images, the character in each image can be identified. There are many methods used to recognize isolated characters. In this system we use Template matching was performed by using two sets of templates. One set was made up of perfect characters. Other set includes the segmented license plate characters.

1.2 OBJECTIVE

ANPR systems are often used by law enforcement agencies to automatically identify and record the license plates of vehicles to enforce traffic laws. This can include detecting speeding vehicles, vehicles running red lights, or identifying vehicles without valid registration or insurance. In security and surveillance applications, the objective is to monitor and track vehicles entering or exiting a location. ANPR can help identify vehicles of interest, such as those on watchlists, stolen vehicles, or unauthorized vehicles in restricted areas. ANPR is commonly used in parking facilities to automate access control and payment processes. The objective is to streamline parking operations, improve security, and provide a convenient experience for parking customers. ANPR technology is used for collecting tolls on highways and bridges. The objective is to automate toll collection, reduce congestion, and improve the efficiency of toll booths. In commercial and residential settings, ANPR can be used to control access to parking lots, gated communities, and secure facilities. The objective is to allow authorized vehicles to enter while preventing unauthorized access. Some applications involve tracking the movement of vehicles for logistics, fleet management, or security purposes. The objective is to monitor vehicle routes, arrivals, and departures. Law enforcement agencies use ANPR to identify and locate vehicles involved in criminal activities, such as amber alerts, stolen vehicle recovery, and monitoring vehicles of interest to investigations.

Figure 1.1: Shown License plate recognition

Image Acquisition: The first stage of any vision system is the image acquisition stage. After the image has obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement, Image Acquisition enables you to acquire images and video from camera frame grabbers directly into MATLAB and Simulink . You can detect hardware automatically and configure hardware properties. Advanced workflows let you trigger acquisition while processing in-the-loop, perform background acquisition, and synchronize sampling across several multimodal devices. With support for multiple hardware vendors and industry standards, you can use imaging devices ranging from inexpensive. Web cameras to high-end scientific and industrial devices that meet low-light, high-speed, and other challenging requirements. Image acquired by camera will be indicated in MATLAB as a matrix of 0's and 1's i.e, binary. purpose we can use following types of cameras.

CCD Cameras: A Charge-Coupled Device (CCD) is a device for the movement of electrical charge, usually from within the device to an area where the charge can be manipulated, for example conversion into a digital value. This is achieved by "shifting" the signals between stages within the device one at a time. CCDs move charge between capacitive bins in the device, with the shift allowing for the transfer of charge between bins. The CCD is a major piece of technology in digital imaging. In a CCD image sensor, pixels are represented by p-doped MOS capacitors. These capacitors are biased above the threshold for inversion when image acquisition begins, allowing the conversion of incoming photons into electron charges at the semiconductor-oxide interface; the CCD is then used to read out these charges. Although CCDs are not the only technology to allow for light detection, CCD Image sensors are widely used in professional, medical, and scientific applications where high-quality image data is required. In applications with less exacting quality demands, such as consumer and professional digital cameras, active pixel sensors (CMOS) are generally used; the large quality advantage CCDs enjoyed early on has narrowed over time.

Infrared Cameras: Infrared (IR) light is electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 500 nanometres (nm) to1 mm. This range of wavelengths corresponds to a frequency range of approximately530 THz down to 300 GHz. Most

of the thermal radiation emitted by objects near room temperature is infrared. Infrared light is emitted or absorbed by molecules when they change their rotationalvibrational movements. Infrared energy elicits vibrational modes in a molecule through a change in the dipole moment, making it a useful frequency range for study of these energy states for molecules of the proper symmetry. Infrared spectroscopy examines absorption and transmission of photons in the infrared energy range. Infrared light is used in industrial, scientific, and medical applications. Night-vision devices using active near-infrared illumination allow people or animals to be observed without the observer being detected. Infrared astronomy uses sensor-equipped telescopes to penetrate dusty regions of space, such as molecular clouds; detect objects such as planets, and to view highly red-shifted objects from the early days of the universe. Infrared thermal-imaging cameras are used to detect heat loss in insulated systems, to observe changing blood flow in the skin, and to detect overheating of electrical apparatus. Based on our application any of the above camera can be used. Here in this project we use images taken by a CMOS camera. Below figures shows the one of the images we use for the project and how the MATLAB reads the image. Web cameras to high-end scientific and industrial devices that meet low-light, high-speed, and other challenging requirements. Image acquired by camera will be indicated in MATLAB as a matrix of 0's and 1's i.e, binary. For this purpose we can use following types of cameras. Infrared energy elicits vibrational modes in a molecule through a change in the dipole moment, making it a useful frequency range for study of these energy states for molecules of the proper symmetry. Infrared spectroscopy examines absorption and transmission of photons in the infrared energy range. Infrared light is used in industrial, scientific, and medical applications. Night-vision devices using active near-infrared illumination allow people or animals to be observed without the observer being detected. Infrared astronomy uses sensor-equipped telescopes to penetrate dusty regions of space, such as molecular clouds; detect objects such as planets, and to view highly red-shifted objects from the early days of the universe. Infrared thermal-imaging cameras are used to detect heat loss in insulated systems, to observe changing blood flow in the skin, and to detect overheating of electrical apparatus. Based on our application any of the above camera can be used. Here in this project we use images taken by a CMOS camera. Below figures shows the one of the images we use for the project and how the MATLAB reads the image. . Night-vision devices using active near-infrared illumination allow people or animals to be observed without the observer being detected.

CHAPTER 2

LITERATURE SURVEY

This paper represents that-In first step, camera captures the video of vehicles number plate. To read this video MATLAB software is used. The video used for operations has timing of 10 to 15 seconds. The 10 second video contains 240 frames/images. In second step, video gets converted into frames at frame rate 24 fps. In third step, frames are converted into Images which is very important step. Then Opening and closing operations are done. To extract vehicle number plate, Image processing like segmentation, recognition, localisation has been done. First canny edge detection algorithm detects the edges of image. Then morphological operator are used. And in this way number plate gets detected[1].India has a general format of number plate like first two letters are state code then district code followed by four unique code for that particular vehicle number plate. If the color of number plate is identical to background then there can be errors while detecting and locating the number plate. The operations like opening and closing, erosion and dilation are performed on image. The work is divided into several parts like First input colored image is taken from camera. Next the colored image is converted into grey scale conversion. To remove noise from image various filtering methods are used, in this median filtering is used which removes salt and pepper noise. The contrast of image can be cleared using histogram equalization. After that localization of plate is done using Sobel Edge detector where regions and edges of image is done. Then the numbers of plate is segmented using segmentation method[2].Number plate recognition uses image processing and character segmentation technology. The highly resolution camera can be used to capture the images or video so after taking it as input the output should be clear. This system is has four basic steps-In first step as a input a video is captured from the camera. Next the video is converted into frames and from that a clear frame or image is selected. Then the region of plate is extracted using two features like aspect ratio and edge density. The Segmentation is done on the number plate to segment each number from the plate and to recognition is done on number plate to recognize the numbers properly and correctly[3]. This paper represents the following methods-In first method the preprocessing is done. In this the colored input image is converted to the grey scale image which divides the image into number of pixels. Next the Detection of egdes is done using canny edge detector where the edges of image is detected to reduce the discontinuities. Then the input image is dilated using

morphological operator to increase the thickness of the number so that the number can be detected easily. Segmentation is done on the dilated image. It performs like the numbers of the plate is obtained separately. The segmentation uses template matching algorithm like OCR. Lastly the numbers are enhance to get better desired image at output. The camera should be of very high resolution so that the output can be of very high quality[4]. A problem arises while processing image is that color can appear differently in different lightning conditions. To overcome this we reduce the number of colors around 50. Following can be reasons for color reduction: Images with more than 256 colors will need to be dithered or mapped and, therefore, might not display well. Image has more than 256 colors, MATLAB cannot store the image data in a uint8 array but generally uses an array of class double instead, and making the storage size of the image much larger (each pixel uses 64 bits). In this work, we have extracted the edges created by the characters within the license plate. It is seen that when the characters of the license number are written horizontally the vertical edges of each character appear at regular interval and they have a specific height. The pattern and concentration of the vertical edges also remains in conformity with the pattern of the license number. This appearance of vertical edge pattern is statistically seen to occur within the license plate, nowhere else within the natural scene of the image. The area of the region should not be less than specified threshold values. Length and Breadth or aspect ratio should lie within 10:1. Image segmentation is the process of partitioning an image into parts or regions. This division into parts is often based on the characteristics of the pixels in the image. For example, one way to find regions in an image is to look for abrupt discontinuities in pixel values, which typically indicate edges. These edges can define regions. Another method is to divide the image into regions based on color values. Segmentation is done using blob analysis which involves following commands. 'Bwlabel' command labels and gives you the number of pixels connected together in a sequence to form a group of connected objects. “regionprops” measures a set of properties for each connected component. Regionprops computes only the 'Area', 'Centroid', and „Bounding Box“ measurements. Usage of both of these commands to label objects is used in rectangle as Bounding Box around the objects. Boundaries of each labelled objects and using these boundary coordinates cropped the characters from the license plate. At this stage, cropped character may also contain garbage objects as well as useful LP characters and numbers; few of the extracted objects. Contrast of each image is enhanced through histogram equalization technique, Total 256 numbers of gray levels (from 0 to 255) are used for stretching the contrast. Let total number of pixels in the image be N and the number of pixels having gray level

k be nk. Then the probability of occurrence of gray level k is, Pk= nk/N. The stretched gray level Sk is calculated using the cumulative frequency of occurrence of the gray level k. Median filter is a non-linear filter, which replaces the gray value of a pixel by the median of the gray values of its neighbours. We have used 3x3 masks to get eight neighbours of a pixel and their corresponding gray values. This operation removes salt-and-pepper noise from the image Image has more than 256 colors, MATLAB cannot store the image data in a uint8 array but generally uses an array of class double instead, and making the storage size of the image much larger (each pixel uses 64 bits). In this work, we have extracted the edges created by the characters within the license plate. It is seen that when the characters of the license number are written horizontally the vertical edges of each character appear at regular interval and they have a specific height. . To extract vehicle number plate, Image processing like segmentation, recognition, localisation has been done. First canny edge detection algorithm detects the edges of image. Then morphological operator are used. And in this way number plate gets detected[1].India has a general format of number plate like first two letters are state code then district code followed by four unique code for that particular vehicle number plate. If the color of number plate is identical to background then there can be errors while detecting and locating the number plate. The operations like opening and closing, erosion and dilation are performed on image. The work is divided into several parts like First input colored image is taken from camera. Next the colored image is converted into grey scale conversion. To remove noise from image various filtering methods are used, in this median filtering is used which removes salt and pepper noise. The contrast of image can be cleared using histogram equalization. After that localization of plate is done using Sobel Edge detector where regions and edges of image is done. Then the numbers of plate is segmented using segmentation method[2].Number plate recognition uses image processing and character segmentation technology. The highly resolution camera can be used to capture the images or video so after taking it as input the output should be clear. This system is has four basic steps-In first step as a input a video is captured from the camera. Next the video is converted into frames and from that a clear frame or image is selected. Then the region of plate is extracted using two features like aspect ratio and edge density. The Segmentation is done on the number plate to segment each number from the plate and to recognition is done on number plate to recognize the numbers properly and correctly[3]. This paper represents the following methods-In first method the preprocessing is done. In this the colored input image is converted to the grey scale image .

CHAPTER 3

EXISTING SYSTEM`

3.1 IMAGE ACQUISITION:

The analog or digital camera can be used to capture different types of images and this images are used as input to the system. For license plate region extraction, the character region is first recognized by identifying the character width and difference between the background region and the region. The license plate region is then extracted by finding the inter-character distance in the plate region. In addition, the license plate type is identified by the difference in the gray-level value between the background region and character region. The completed segmentation of characters the last parameter in the license plate process is character recognition. In the character recognition different types of techniques are available like statistical, syntactic and neural Raspberry pi is an credit card sized single board computer Raspberry pi has total 40 pins in which 27 pins is of GPIO (General purpose input and output) and remaining 13 pins are used for VCC and GND. Video Core IV GPU and 1GB RAM. The camera capture the image automatically of the number plate and is passed to the Raspberry Pi with the help of USB cable. The image is verified by using Raspberry Pi . After the recognition if the user is authorized then it will be display the name user otherwise it will display user is unauthorized. Schematic block diagram shows above

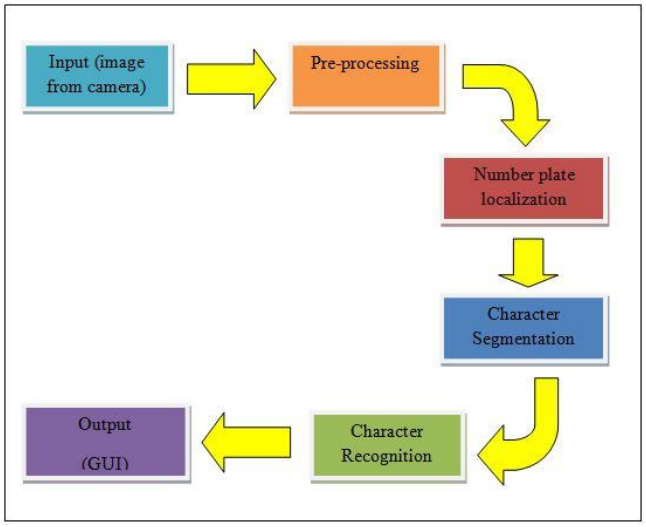

Figure 3.1.1: Block Diagram of license plate recognition

Online ANPR framework:

In an online ALPR framework, the limitation and elucidation of tags occur promptly from the approaching video outlines, enabling Real-time tracking through the surveill ance camera. Example : OpenALPR CloudWatch

Offline ANPR framework:

A logged off ALPR framework, interestingly, catches the shovel, dumper number plate pictures and stores them in a concentrated information server for further preparation, i.e. for translation of vehicle number plate

Example : OpenALPR Library Looking at the works of other countries pushes and inspire us to try to solve the challenges that we face in our country and also motivates us to use ANPR in all facets. United States Mobile ANPR use is widespread among US law enforcement agencies at the city, county, state and federal level. According to a 2012 report by the Police Executive Research Forum, approximately 71% of all US police departments use some form of ANPR. Mobile ANPR is becoming a significant component of municipal predictive policing strategies and intelligence gathering, as well as for recovery of stolen vehicles, identification of wanted felons, and revenue collection from individuals who are delinquent on city or state taxes or fines, or monitoring for "Amber Alerts". United Kingdom The Home Office states the purpose of automatic number-plate recognition in the United Kingdom is to help detect, deter and disrupt criminality including tackling organised crime groups and terrorists. Vehicle movements are recorded by a network of nearly 8000 cameras capturing between 25 and 30 million ANPR ‘read’ records daily. These records are stored for up to two years in the National ANPR Data Centre, which can be accessed, analysed and used as evidence as part of investigations by UK law enforcement agencies. Automatic Number Plate Recognition Dept of CSE, CMRIT 2018-19 Page 4 Saudi Arabia Vehicle registration plates in Saudi Arabia use white background, but several vehicle types may have a different background. United States diplomatic plates have the letters 'USD', which in Arabic reads 'DSU' when read from right to left in the direction of Arabic script. There are only 17 Arabic letters used on the registration plates.A Challenge for plates recognition in Saudi Arabia is the size of the digits. Some plates use both Eastern Arabic numerals and the 'Western Arabic' equivalents. A research with source code is available for APNR Arabic digits. Turkey The system has been used with two cameras per lane, one for plate recognition, one for speed detection. Now the system has been widened to network all the registration number cameras together, and enforcing average speed over preset distances. Some arteries have 70 km/h (43 mph) limit, and some 50 km/h (31 mph), and photo evidence with date-time details are posted to registration address if

speed violation is detected. As of 2012, the fine for exceeding the speed limit for more than 30% is approximately US$175. Canada The police service in Ontario uses automatic licence-plate recognition software[21] to nab drivers behind the wheels of vehicles with Ontario number plates.

CHALLENGES IN THE EXISTING SYSTEM:

In the created nations the qualities of the vehicle number plate are entirely kept up. For instance, the measure of the plate, shade of the plate, text style face/size/shade of every character, dispersing between ensuing characters ,the quantity of lines in the vehicle number plate, script and so on are kept up particularly. A portion of the pictures of the standard tags utilized as a part of created nations. In most academic institutions and car parks, the ongoing car park entry registration process for visitors, staff or students entering the institution involves a security guard having to confirm membership details by checking for membership sticker on the windscreen of the vehicle or by checking the driver's identification card. This process of writing is tedious and time consuming and is prone to inaccurate recordings, furthermore the backup and sharing of this vehicle information is difficult because the data is hard copy. United Kingdom The Home Office states the purpose of automatic number-plate recognition in the United Kingdom is to help detect, deter and disrupt criminality including tackling organised crime groups and terrorists. Vehicle movements are recorded by a network of nearly 8000 cameras capturing between 25 and 30 million ANPR 'read' records daily. These records are stored for up to two years in the National ANPR Data Centre, which can be accessed, analysed and used as evidence as part of investigations by UK law enforcement agencies. Automatic Number Plate Recognition Dept of CSE, CMRIT 2018-19 Page 4 Saudi Arabia Vehicle registration plates in Saudi Arabia use white background, but several vehicle types may have a different background. United States diplomatic plates have the letters 'USD', which in Arabic reads 'DSU' when read from right to left in the direction of Arabic script. , the ongoing car park entry registration process for visitors, staff or students entering the institution involves a security guard having to confirm membership details by checking for membership sticker on the windscreen of the vehicle or by checking the driver's identification card. This process of writing is tedious and time consuming and is prone to inaccurate recordings, furthermore the backup and sharing of this vehicle information is difficult because the data is hard copy. A city like Bangalore has multiple apartment complexes and societies, most of them also verify by checking for membership sticker on the windscreen of the vehicle. If a stranger or unknown vehicle enters, they are required to register which

is time consuming. Most complexes even consider it unsafe as once a vehicle enters it is hard to track the movement of the members of the vehicle. Security issues are the main drawback with many cars being stolen, especially when they are left at parking lots even if for a few hours, it is hard to keep a record of all the vehicles entering/exiting at peak usage times. Thus keeping in mind these drawbacks of the traditional system we aim to get a step ahead and address each of them individually when building our solution. Automatic license plate recognition has two major technological requirements: 1. The quality of the license plate recognition algorithms. 2. The quality of the image acquisition (camera and the illumination conditions) The better algorithms are: 2.1. Higher is the recognition accuracy. 2.2 Faster is the processing speed. 2.3. Wider is the range of picture quality it can be used on. 3. Varying Indian Number Plate Formats By and large, one LPR program can read plates from one specific nation just .This is on the grounds that the geometrical structure of the plate and introduction, text styles, and grammar were imperative parts of the LPR system. Without the earlier information of the plate geometry (character distribution, character spacing, plate color, dimension ratios etc.), the algorithm may not even find the plate in the captured image. The Home Office states the purpose of automatic number-plate recognition in the United Kingdom is to help detect, deter and disrupt criminality including tackling organised crime groups and terrorists. Vehicle movements are recorded by a network of nearly 8000 cameras capturing between 25 and 30 million ANPR ‘read’ records daily. These records are stored for up to two years in the National ANPR Data Centre, which can be accessed, analysed and used as evidence as part of investigations by UK law enforcement agencies. Automatic Number Plate Recognition Dept of CSE, CMRIT 2018-19 Page 4 Saudi Arabia Vehicle registration plates in Saudi Arabia use white background, but several vehicle types may have a different background. United States diplomatic plates have the letters 'USD', which in Arabic reads 'DSU' when read from right to left in the direction of Arabic script. , the ongoing car park entry registration process for visitors, staff or students entering the institution involves a security guard having to confirm membership details by checking for membership sticker on the windscreen of the vehicle or by checking the driver’s identification card. This process of writing is tedious and time consuming and is prone to inaccurate recordings, furthermore the backup and sharing of this vehicle information is difficult because the data is hard copy.

3.2 LICENSE PLATE SEGMENTATION

After the extraction/detection of the license plate area, the next process is the segmentation of the license plate. During this process, the number plate image character is split repeatedly until every character is separated into individual sub-images. This phase is important in any ALPR system as each segmented characters will determine the rate of character recognition accuracy. If the segmentation of a license plate fails, the result will cause a character to be divided improperly, or two characters are mistakenly merged as one segmented character. There are some cases where the license plate extracted from the localisation step have some problems such as dots, tilting, stains on plates and different illumination condition across the license plate. For example, unwanted stains that are present on the license plate might cause the system to mistakenly recognise it as characters which lead to recognition error. However, these problems can be easily solved by applying preprocessing processes such as mathematical morphology and vertical edge projection histogram used in [7], which will be discussed further in the next section. In [5] and [6], both researches used a projection profile method for their license plate character segmentation process which is horizontal projection and vertical projection respectively. In [5], the segmentation process was done by using a method known as a horizontal projection of the license plate. Basically, it is a process of finding the maximum peak or also known as the space between characters by the vertical projection of the graph iteratively. When the algorithm meets a certain condition such as the height of the peak, it will zeroizes the peak iteratively until no spaces are found. A vertical projection method was also used in [6] for a license plate character segmentation process in a mobile phone. In this method, the vertical axis is scanned for a black point in the images in order to detect the character.

Figure 3.1.2: Shown license plate segmentation

Ref	**Image size**	**Success Rate (in %)**	**Ref**	**Image Size**	**Success Rate (in %)**
[5]	1024 X 768	96,5	[43]	40 X 280	Not reported
[33]	640 X 480	Not reported	**[**44]	**640 X 480**	**Not reported**
[17]	720 X 576 1920 X 1280	90,1	[45]	Not reported	81,20
[34]	Not reported	87	[49]	640 X 480 768 X 512	97,9
[15]	640 X 480	97,3	[47]	692 X 512	97,14(Four Characters)
[13]	**236 X 48**	**Not reported**	[50]	480 X 640	61,36(Pixel voting) 90,65 (Global Thresholding) 78,26 (Local Thresholding) 93,78 (Combination of global and local binarization)
[19]	640 X 480	97,16	[51]	1300 X 1030	92,31
[39]	360 X 288 to 1024 X 768	94	[52]	640 X 480	98,3
[6]	220x50	98,82	[21]	324 X 243	97,6
[14]	648 × 486	96,4	**[**23]	**720 X 576** **768 X 576**	**Not reported**
[8]	640 X 480	89	[53]	640 X 480	~75,17
[41]	**640 X 480**	**Not reported**	[11]	384 X 288	91
[42]	768 X 256	87,6	[28]	600 X 330 768 X 576	94,7
			[38]	**640 X 480**	**Not reported**

TABLE 1.1: Number plate detection rate and image size

COADING:

```
import cv2
import numpy as np

# Read input image
img = cv2.imread("audi.jpg")

# convert input image to grayscale
gray = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

# read haarcascade for number plate detection
cascade = cv2.CascadeClassifier('haarcascades\haarcascade_russian_plate_number.xml')

# Detect license number plates
plates = cascade.detectMultiScale(gray, 1.2, 5)
print('Number of detected license plates:', len(plates))

# loop over all plates
for (x,y,w,h) in plates:

  # draw bounding rectangle around the license number plate
  cv2.rectangle(img, (x,y), (x+w, y+h), (0,255,0), 2)
  gray_plates = gray[y:y+h, x:x+w]
  color_plates = img[y:y+h, x:x+w]

  # save number plate detected
  cv2.imwrite('Numberplate.jpg', gray_plates)
  cv2.imshow('Number Plate', gray_plates)
  cv2.imshow('Number Plate Image', img)
  cv2.waitKey(0)
```

CHAPTER 4

PROPOSED SYSTEM

High-resolution cameras with options for day and night vision capture images or video streams of vehicles with visible license plates. Captured images or video frames undergo preprocessing to enhance image quality. This may include resizing, noise reduction, and contrast adjustment. Utilize computer vision techniques to locate and extract the region containing the license plate. This step identifies the precise area where the license plate is located in the image. Employ image processing algorithms to segment individual characters or digits from the license plate region. Adaptive methods can be used to deal with variations in plate design. Implement an OCR system to recognize and interpret the segmented characters on the license plate. Modern ANPR systems often employ deep learning techniques to improve accuracy. Connect the system to a database that contains information about registered vehicles or vehicles of interest (e.g., stolen vehicles).

Workflow:

1. Image Capture: The system captures images or video frames of vehicles entering its field of view. This is typically achieved using one or more cameras strategically positioned.
2. Image Preprocessing: Preprocessing is applied to the captured images to improve quality and clarity. This can involve resizing, noise reduction, and enhancing contrast.

Figure 4.1:Shown Proposed System

Automatic Number Plate Recognition using an efficient OCR engine like Pytesseract along with major and vast libraries of OpenCV for image processing. As we have seen so far ANPR covers as a solution to most of the problems we have posed. We would like to dig a bit deeper now and highlight the scope of the project and the extent to which we can push the boundaries.The main issue that is usually recognized when it comes to number plate detection is the noise that is added to the image in the process of capturing the image or due to the environment around, taking that into consideration we can say that using our system, we can implement it in all environments, be it rain or even in the dark.Usually when any new system is proposed to possible clients, their main concern is the addition of new features into their existing system. Keeping this in mind we can say for sure that our system can be integrated to the pre-existing infrastructure of most clients. Using a web crawler, number plate recognized is parsed to the government website vahan.nic.in along with the solved captcha and the vehicle details can be accessed for further Inference and analysis. Also showcase the vulnerabilities in the security of the government websites and privacy issues in government website. Also provide analytics and solution on the extracted data. Advantages of the proposed system: To perform successful and efficient preprocessing on the raw RGB image To exploit the high performance and effectiveness of OpenCV and Pytesseract framework to detect and recognize LP of vehicles,to improve our system reliability. To correctly determine the number plate based on Indian Number plate Standards To Successfully extract the information from Government vehicle information database • To Show the security vulnerabilities on vahan.nic.in. we can say that using our system, we can implement it in all environments, be it rain or even in the dark.Usually when any new system is proposed to possible clients, their main concern is the addition of new features into their existing system.

MARKET VALUE OF THE ANPR SYSTEM

According to the new market research report "Automatic Number Plate Recognition (ANPR) System Market by Type (Fixed, Mobile, Portable), Component (ANPR Cameras, Software, Frame Grabbers, Triggers), Application (Traffic Management, Law Enforcement, Electronic Toll Automatic Number Plate Recognition Dept of CSE, CMRIT 2018-19 Page 7 Collection, Parking Management), and Geography - Global Forecast to 2023", the automatic number plate recognition (ANPR) system market in 2016 was valued at USD 1.78 Billion and is expected to reach USD 3.57 Billion by 2023, at a CAGR of 9.74% between 2017 and 2023. Factors that are driving this market include the infrastructure growth in emerging economies, increasing allocation of funds by various governments on intelligent transport

systems (ITS), deployment of camera technologies in security and surveillance, and traffic enforcement application, and the growing usage of video analytics technology for intelligent monitoring of vehicles. Europe was the largest market for ANPR systems in 2016. The large market in this region can be attributed to the high adoption of intelligent transportation systems for traffic management, tolling management, law/police enforcement, and other applications. The market in Europe has been segmented into Germany, the UK, France and the Rest of Europe. Some major companies offering ANPR systems in Europe include ARH Inc. (Hungary), Digital Recognition Systems Ltd. (UK), NDI Recognition Systems Ltd. (UK), and Q-Free ASA (Norway). The key players in the market include Kapsch Traffic Com AG (Austria), Conduent, Inc. (US), QFree ASA (Norway), Siemens AG (Germany), Genetec Inc. (Canada) Neology, Inc. (US), Bosch Security Systems GmbH (Germany), Tattile srl (Italy), TagMaster North America, Inc. (US), NDI Recognition Systems Ltd. (UK), Euro Car Parks Limited (UK), Quercus Technologies, S.L. (Spain) Vigilant Solutions, Inc. (US), Elsag North America, LLC (US), ARH Inc. (Hungary), Digital Recognition System Ltd. (UK), Beltech BV (Netherlands), ANPR International Ltd. (UK), HTS (New York), FF Group (Cyprus), and so on. This report categorizes the global ANPR system market on the basis of type, component, application, and geography. The report describes the drivers, restraints, opportunities, and challenges for the growth of this market. . As we have seen so far ANPR covers as a solution to most of the problems we have posed. We would like to dig a bit deeper now and highlight the scope of the project and the extent to which we can push the boundaries.The main issue that is usually recognized when it comes to number plate detection is the noise that is added to the image in the process of capturing the image or due to the environment around, taking that into consideration we can say that using our system, we can implement it in all environments, be it rain or even in the dark.Usually when any new system is proposed to possible clients, their main concern is the addition of new features into their existing system. Keeping this in mind we can say for sure that our system can be integrated to the pre-existing infrastructure of most clients. Using a web crawler, number plate recognized is parsed to the government website vahan.nic.in along with the solved captcha and the vehicle details can be accessed for further Inference and analysis. Also showcase the vulnerabilities in the security of the government websites and privacy issues in government website. You should note that image enhancement is different from image preprocessing step. Image enhancement step highlights image features for interpreter whereas image preprocessing step reconstructs a relatively better image from an originally imperfect/degraded image.

Image Preprocessing: It is usually necessary to preprocess remote sensing data prior to its analysis because image data recorded by sensors contain errors which degrade quality of the image and cause the image to appear noise, blurred and distorted. The errors creep into during data acquisition process. Most common types of errors are geometric and radiometric errors. All these errors are corrected using suitable mathematical models at the time of preprocessing. • Image Enhancement: Image enhancement is carried out to improve the appearance of certain image features to assist in human interpretation and analysis. You should note that image enhancement is different from image preprocessing step. Image enhancement step highlights image features for interpreter whereas image preprocessing step reconstructs a relatively better image from an originally imperfect/degraded image.Image Transformations: Image transformations are operations similar in concept to those for image enhancement. However, unlike image enhancement operations which are normally applied only to a single channel of data at a time, image transformations usually involve algebric operations of multi-layer images. Algebric operations such as subtraction, addition, multiplication, division, alogarithms, exponentials and trigonometric functions are applied to transform the original images into new images which display better or highlight certain features in the image. We shall discuss about all the four digital image processing steps in the next block, i.e. Block 4 of MGY-002. 71 Ground Truth Data Collection. Thematic Information :Extraction It includes all the processes used for extracting thematic information from images. Image classification is one such process which categorises pixels in an image into some thematic classes such as land cover classes based on spectral signatures. Image classification procedures are further categorised into supervised, unsupervised and hybrid depending upon the level of human intervention in the process of classification The large market in this region can be attributed to the high adoption of intelligent transportation systems for traffic management, tolling management, law/police enforcement, and other applications. The market in Europe has been segmented into Germany, the UK, France and the Rest of Europe. Some major companies offering ANPR systems in Europe include ARH Inc. (Hungary), Digital Recognition Systems Ltd. (UK), NDI Recognition Systems Ltd. (UK), and Q-Free ASA (Norway).

CHAPTER 5

RESULT:

1. Recognized License Plate Number: The primary result is the alphanumeric or alphanumeric-numeric sequence on the license plate. This can be used for further processing, such as database queries or alert generation.
2. Verification and Authentication: The LPR system may verify the recognized plate number against a database of registered or authorized vehicles to check for compliance with rules or permissions.
3. Access Control: In access control systems (e.g., parking facilities, secure areas), the result may trigger the opening of gates, barriers, or doors to allow authorized vehicles to pass.
4. Alerts and Notifications: If the recognized plate number matches a vehicle of interest (e.g., stolen vehicle, unauthorized entry), the system may generate alerts or notifications for security or law enforcement personnel.
5. Database Query and Retrieval: The recognized plate number can be used to query a database for information associated with the vehicle, such as owner details, vehicle history, or permit status.
6. Traffic Violation Detection: In traffic enforcement applications, the result can be used to identify and document traffic violations, such as speeding or running red lights, which can lead to the issuance of citations.
7. Data Logging: The recognized plate numbers can be logged for historical records, analytics, and audit purposes.
8. Automatic Payment and Billing: In parking and toll collection systems, the recognized plate number can be used to automatically bill the vehicle owner for parking fees or toll charges.
9. Vehicle Tracking: The LPR result can be used to track the movement of vehicles for logistical and fleet management purposes.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

License Plate Recognition (LPR) or Automatic Number Plate Recognition (ANPR) technology has become an indispensable tool in various domains, including law enforcement, traffic management, parking facilities, and access control. It offers numerous benefits such as improved security, automation of access control, traffic enforcement, and data analytics. The technology has evolved significantly over the years, with advancements in image processing, optical character recognition (OCR), and machine learning techniques, leading to higher accuracy and efficiency in license plate recognition. The successful implementation of LPR systems has improved safety, security, and convenience in transportation and access control scenarios. It has streamlined processes, reduced human intervention, and provided valuable data for decision-making. However, it's important to acknowledge potential privacy concerns associated with the widespread use of LPR technology, and regulations and guidelines should be in place to ensure responsible and ethical use. Through this project it is possible to recognise Vehicle registration numbers through digital image processing. From this system we have effortlessly obtained the various results such as • Whether the vehicle which is registered is blacklisted or not. • This also enables one single user to effectively monitor the traffic, and can easily locate the traffic violated vehicle. The data can be easily stored and transferred which makes the system more efficient. The system has been designed using a modular approach which allows easy upgrading and/or substituting of various sub-modules thus making it potentially suitable for a large range of vision applications. The performances of the system makes it a valid choice among its competitors especially in those situations when the cost of the application has to be maintained at reasonable levels. Furthermore, the modular architecture makes it extremely flexible and versatile. The earlier methodologies which have been implemented have not been as accurate and efficient as the designed Recognition system , this is because of the implementation of digital Image Processing which gives an accuracy of 90% under normal conditions This Project is based on automatic vehicle license plate recognition, in which it is observed that the existing techniques don't pay much attention towards improving the system's efficiency in terms of its power consumption. As the objective in our proposed design is to reduce power consumption of the system, with the successful implementation of the same it will play a very important role in traffic management and security systems such as automobile theft prevention, parking lot management etc. implementations of the

software algorithm have shown promising results. Automatic Number Plate Recognition Dept of CSE, CMRIT 2018-19 Page 58 The system can be made more robust if high precision cameras can be used to increase overall accuracy if this system is implemented in real time applications. Also a sensor can be designed to allow the camera to capture the image only when required to save power. The technology has evolved significantly over the years, with advancements in image processing, optical character recognition (OCR), and machine learning techniques, leading to higher accuracy and efficiency in license plate recognition. The successful implementation of LPR systems has improved safety, security, and convenience in transportation and access control scenarios. It has streamlined processes, reduced human intervention, and provided valuable data for decision-making. However, it's important to acknowledge potential privacy concerns associated with the widespread use of LPR technology, and regulations and guidelines should be in place to ensure responsible and ethical use. Through this project it is possible to recognise Vehicle registration numbers through digital image processing. From this system we have effortlessly obtained the various results such as • Whether the vehicle which is registered is blacklisted or not. • This also enables one single user to effectively monitor the traffic, and can easily locate the traffic violated vehicle. The successful implementation of LPR systems has improved safety, security, and convenience in transportation and access control scenarios. It has streamlined processes, reduced human intervention, and provided valuable data for decision-making. However, it's important to acknowledge potential privacy concerns associated with the widespread use of LPR technology, and regulations and guidelines should be in place to ensure responsible and ethical use. Through this project it is possible to recognise Vehicle registration numbers through digital image processing. From this system we have effortlessly obtained the various results such as • Whether the vehicle which is registered is blacklisted or not. • This also enables one single user to effectively monitor the traffic, and can easily locate the traffic violated vehicle. The data can be easily stored and transferred which makes the system more efficient. The system has been designed using a modular approach which allows easy upgrading and/or substituting of various sub-modules thus making it potentially suitable for a large range of vision applications. The performances of the system makes it a valid choice among its competitors especially in those situations when the cost of the application has to be maintained at reasonable levels. Furthermore, the modular architecture makes it extremely flexible and versatile. The earlier methodologies which have been implemented have not been as accurate and efficient as the designed Recognition system

FUTURE SCOPE:

1. Improved Accuracy: Advances in machine learning, deep learning, and neural networks will lead to even higher accuracy in license plate recognition, especially in challenging conditions like low light, bad weather, and non-standard license plate formats.
2. Real-time Processing: Real-time recognition capabilities will be further enhanced, allowing for immediate action, such as instant alerts for security threats or traffic violations.
3. Privacy and Ethical Considerations: As the use of LPR technology expands, there will be an increased focus on addressing privacy concerns and implementing regulations to protect individuals' data and rights.
4. Integration with IoT: LPR systems will integrate with the Internet of Things (IoT) to provide a more comprehensive view of traffic and access control, enabling smart cities and improved traffic management.
5. AI-Driven Analytics: License plate recognition data will be used for more extensive traffic analysis, urban planning, and environmental monitoring, contributing to sustainable and efficient urban development.
6. Cross-Border and International Integration: LPR systems will continue to evolve to work effectively across different countries and regions, allowing for the seamless monitoring and tracking of vehicles across borders.
7. Edge Computing: License plate recognition at the edge (on devices like cameras) will reduce the need for centralized processing, improving speed and efficiency.
8. Customization and Adaptability: Systems will become more adaptable and customizable, allowing users to define specific recognition criteria and actions based on their unique requirements.

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05th & 06th October 2023

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3 GOOD HEALTH AND WELL-BEING

The SDG Accord

DEPARTMENT OF BIOMEDICAL ENGINEERING

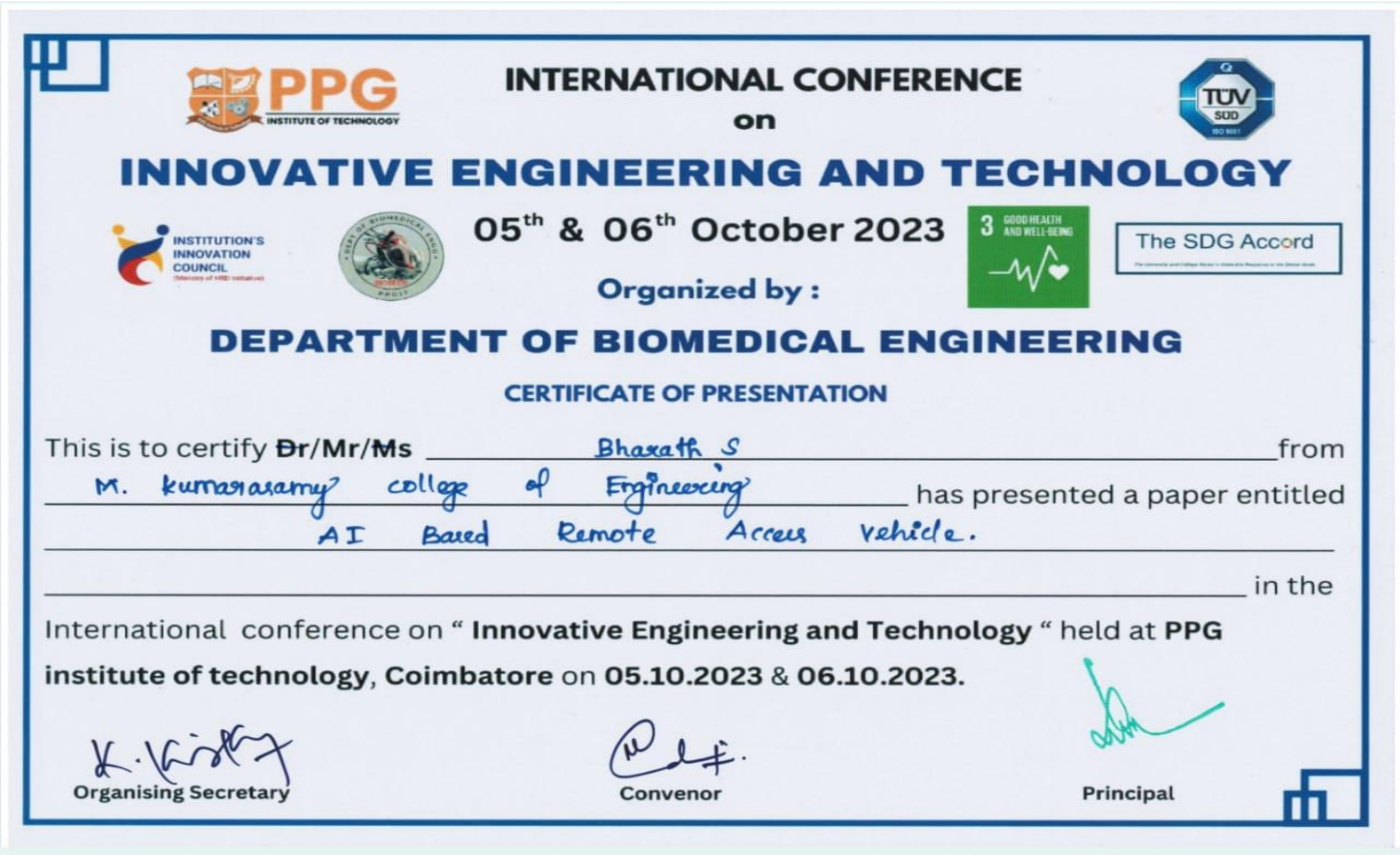
CERTIFICATE OF PRESENTATION

This is to certify ~~Dr~~/Mr/~~Ms~~ Hari Haran. M from M. Kumarasamy college of Engineering has presented a paper entitled AI Based Remote Access Vehicle in the International conference on " **Innovative Engineering and Technology** " held at **PPG institute of technology**, **Coimbatore** on **05.10.2023** & **06.10.2023.**

Organising Secretary

Convenor

Principal



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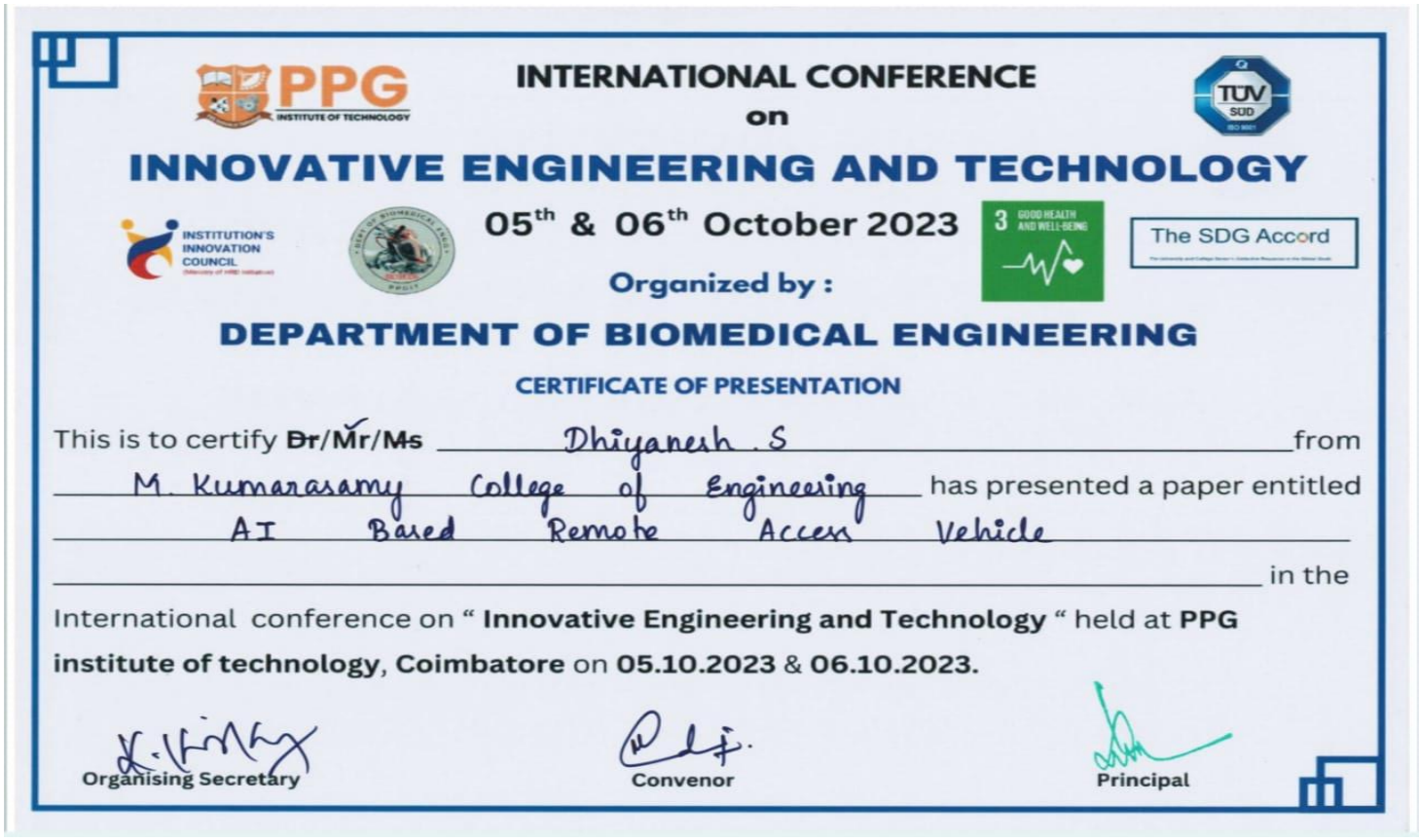

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This is to certify ~~Dr~~/Mr/~~Ms~~ Dhiyanesh .S from M. Kumarasamy College of Engineering has presented a paper entitled AI Based Remote Access Vehicle in the International conference on " **Innovative Engineering and Technology** " held at **PPG institute of technology**, **Coimbatore** on **05.10.2023** & **06.10.2023.**

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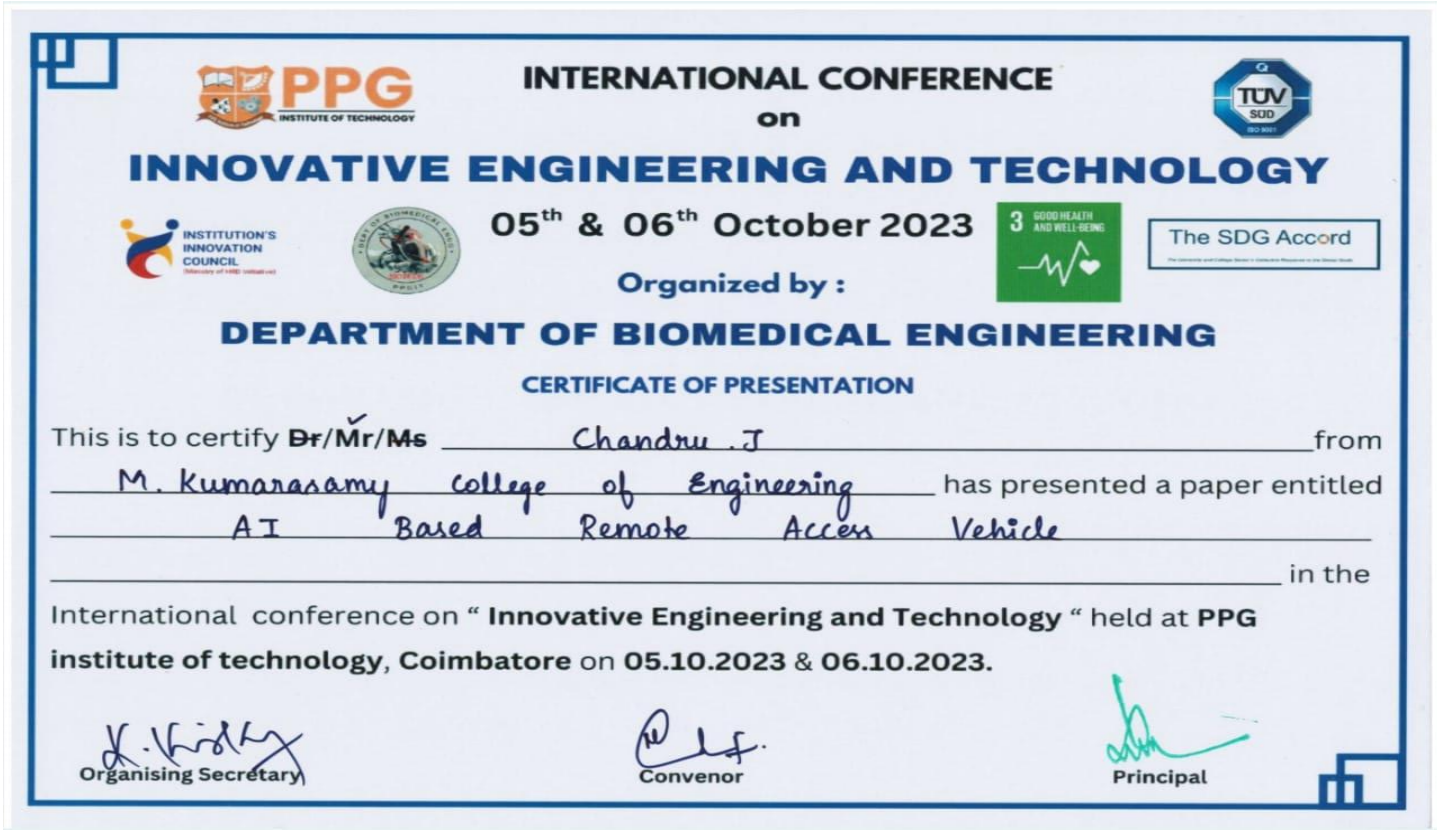

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This is to certify ~~Dr~~/Mr/~~Ms~~ Chandru .J from M. Kumarasamy college of Engineering has presented a paper entitled AI Based Remote Access Vehicle in the International conference on " **Innovative Engineering and Technology** " held at **PPG institute of technology**, **Coimbatore** on **05.10.2023** & **06.10.2023.**

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