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Toll Plazza Management System Using Text Detection and Text Recognization Techniques

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ABSTRACT

In our day to day life, we pay certain amount of tax through toll plaza to the government. The toll gates are mostly found on national highways and bridges etc., and we pay standing over a queue in the form of cash, although, the mobility of vehicles gets interrupted by this method which takes longer travel time, more consumption of fuel and also pollution level get increased in that region, instead of that the method commonly used by industries and in advanced countries is the Electronic Toll Collection System. Electronic toll collection system is the technology that enables the automatic electronic toll collection from the prepaid account registered on the name of vehicle owner, determining whether the vehicle is registered or not and informs the toll authorities avoiding toll violations. Over last decades, electronic toll collection system has been implemented in real time. Toll Tax Management System is a web based application that can provide all the information related to toll plazas and the passenger checks in either online and pays the amount, then he/she will be provided by a receipt. With this receipt he/she can leave the toll booth without waiting for any verification call. The aim of our project is to design a system, which automatically identifies an approaching vehicles and record vehicles number and time. If the vehicle belongs to the authorized person, it automatically opens the toll gate and a predetermined amount is automatically deducted from its account. This translates to reduced Traffic congestion at toll plazas and helps in lower fuel consumption. This is very important advantage of this system. In this paper, we can design system to extract the license numbers from vehicle plate automatically using image processing techniques. And match with database automatically and generate the bill without any delay.

Keywords : Electronic toll collection, Text detection, Text Recognition, Image Processing techniques, Number plate recognition

I. INTRODUCTION

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly. Machine

learning algorithms are often categorized as supervised or unsupervised. Supervised algorithms require a data scientist or data analyst with machine learning skills to provide both input and desired output, in addition to furnishing feedback about the accuracy of predictions during algorithm training. Data scientists determine which variables, or features, the model should analyze and use to develop predictions. Once training is complete, the algorithm will apply what was learned to new data. Unsupervised algorithms do not need to be trained with desired outcome data. Instead, they use an iterative approach called deep learning to review data and arrive at conclusions. Unsupervised learning algorithms -- also called neural networks -- are used for more complex processing tasks than supervised learning systems, including image recognition, speech-to-text and natural language generation. These neural networks work by combing through millions of examples of training data and automatically identifying often subtle correlations between many variables. Once trained, the algorithm can use its bank of associations to interpret new data. These algorithms have only become feasible in the age of big data, as they require massive amounts of training data. AI (artificial intelligence) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Particular applications of AI include expert systems, speech recognition and machine vision. AI can be categorized in any number of ways, but here are two examples. The first classifies AI systems as either weak AI or strong AI. Weak AI, also known as narrow AI, is an AI system that is designed and trained for a particular task. The Turing Test, developed by mathematician Alan Turing in 1950, is a method used to determine if a computer can actually think like a human, although the method is controversial. Automatic Number Plate Recognition (ANPR) system is a technology solution that takes photographs of vehicles and by extracting the number plate from whole image it segments the characters present on the number plate and then by using the template matching scheme, it translates the license number of pixel value into numerical or string. The main aim of the system is to properly identify and locate the vehicle number plate information and replace the manual systems with an automated system. ANPR system is an image processing technology that is used to identify the vehicles by tracking their number plate without direct human intervention. ANPR is the extraction of vehicle number plate information from an image or a sequence of images. The quality of the acquired images is a major factor in the success of the ANPR. ANPR as a real life application has to quickly and successfully process number plates under different environmental conditions, such day or night time. It should also be generalized to process license plates from different nations or states. The basic layout of number plate recognition can be shown in fig 1.

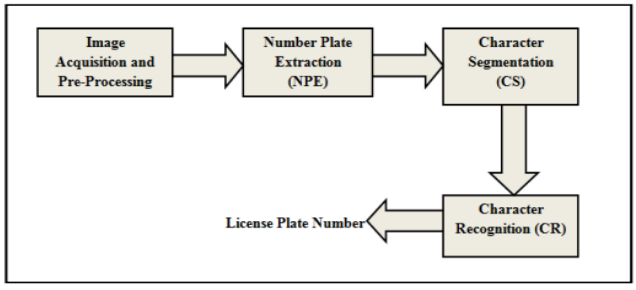

Fig 1 : Number Plate Recognition

II. RELATED WORK

Neumann, Lukas, and Jiri Matas, et.al,…[1] proposed Text localization and recognition in images of real-world scenes has received significant attention in the last decade. In contrast to text recognition in documents, which is satisfactorily addressed by state-of-the-art OCR systems, scene text localization and recognition is still an open problem. Factors contributing to the complexity of the problem

include: non-uniform background, the need for compensation of perspective effects (for documents, rotation or rotation and scaling is sufficient); real-world texts are often short snippets written in different fonts and languages; text alignment does not follow strict rules of printed documents; many words are proper names which prevents an effective use of a dictionary. Most published methods for text localization and recognition are based on sequential pipeline processing consisting of three steps - text localization, text segmentation and processing by an OCR for printed documents. In such approaches, the overall success rate of the method is a product of success rates of each stage as there is no possibility to refine decisions made by previous stages. In this paper, we propose an end-to-end method for text localization and recognition. The technical contributions of the paper are the following. First, in the recognition part, no real-world training data are used.

Neumann, Lukáš, et.al,…[2] implementedtext localization and recognition in real-world (scene) images is an open problem which has been receiving significant attention since it is a critical component in a number of computer vision applications like searching images by their textual content, reading labels on businesses in map applications. An end-to-end real-time scene text localization andrecognition method is presented. The real-time performance is achieved by posing the character detection problem as an efficient sequential selection from the set of Extremal Regions (ERs). The ER detector is robust to blur,illumination, color and texture variation and handles low-contrast text.In the first classification stage, the probability of eachER being a character is estimated using novel features calculated with O(1) complexity per region tested. Only ERswith locally maximal probability are selected for the second stage, where the classification is improved using morecomputationally expensive features. A highly efficient exhaustive search with feedback loops is then applied to group ERs into words and to select the most probable charactersegmentation. Finally, text is recognized in an OCR stagetrained using synthetic fonts.The method was evaluated on two public datasets. The robustness of the proposed method against noise and low contrast of characters is demonstrated by “false positives” caused by detected watermark text in the dataset. Methods in the second group find individual characters by grouping pixels into regions using connected component analysis assuming that pixels belonging to the same character have similar properties. Connected component methods differ in the properties used (color, stroke-width, etc.).

Wang, Kai, Boris Babenko, et.al,…[3] proposed framework forreading words in unconstrained images which is a challenging problem of considerable practical interest. While text from scanned documents has served as the principal focus of Optical Character Recognition (OCR) applications in the past, text acquired in general settings (referred to as scene text) is becoming more prevalent with the proliferation of mobile imaging devices. Since text is a pervasive element in many environments, solving this problem has potential for significant impact. For example, reading scene text can play an important role in navigation for automobiles equipped with street-facing cameras in outdoor environments, and in assisting a blind person to navigate in certain indoor environments. This paper focuses on the problem of word detection andrecognition in natural images. The problem is significantlymore challenging than reading text in scanned documents,and has only recently gained attention from the computervision community. Sub-components of the problem, such astext detection and cropped image word recognition, havebeen studied in isolation. However, what is unclearis how these recent approaches contribute to solvingthe end-to-end problem of word recognition.We fill this gap by constructing and evaluating two systems. The first, representing the de

facto state-of-the-art,is a two stage pipeline consisting of text detection followedby a leading OCR engine. The second is a system rooted in generic object recognition, an extension of our previouswork. Bissacco, Alessandro, et al,…[4] implementedextraction of text from uncontrolled images is a challenging problem with many practical applications. Reliable text recognition would provide a useful input modality for smartphones, particularly in applications such as translation where the text may be difficult for a user to input by other means. Text extraction is also useful in robotics, as a search signal in large image collections, in wearable devices and numerous other areas. Commercially available OCR systems are designed primarily for document images such as those from a flatbed scanner, and perform poorly on general imagery. They typically rely on brittle techniques such as binarization, where the first stage of processing is a simple thresholding operation used to divide an image into text and non-text pixels. Challenging input for existing commercial systems include both scene text and also more document-like text that suffers from blur, low resolution or other degradations that are common in smartphone imagery To address these problems, this paper describes the design of a complete OCR system built using modern computer vision techniques. In particular we take advantage of substantial recent progress in machine learning and large scale language modeling. Our system outperforms previous approaches by a wide margin, more than halving the error rate on the main public benchmarks. We scale the individual components of our system to regime orders of magnitude larger than explored in prior work. In particular, our deep neural network character classifier is trained on up to 2 million manually labeled examples, and our language model is learned on a corpus of more than a trillion tokens. We maintain sub-second recognition latency primarily through careful engineering.

Jaderberg, Max, et.al,…[5]well studied and there are many available systems, the automatic detection and recognition of text within images is far less developed. However, text contained within images can be of great semantic value, and so is an important step towards both information retrieval and autonomous systems. For example, text spotting of numbers in street view data allows the automatic localization of houses numbers in maps, reading street and shop signs gives robotic vehicles scene context, and indexing large volumes of video data with text obtained by text spotting enables fast and accurate retrieval of video data from a text search. Text spotting in natural images is usually divided into two tasks: text detection, and word recognition. Text detection involves generating candidate bounding boxes that are likely to contain lines of text, while word recognition takes each candidate bounding box, and attempts to recognize the text depicted within it, or potentially reject the bounding box as a false positive detection. The goal of this work is text spotting in natural images. This is divided into two sequential tasks: detecting words regions in the image, and recognizing the words within these regions. We make the following contributions: first, we develop a Convolutional Neural Network (CNN) classifier that can be used for both tasks. The CNN has a novel architecture that enables efficient feature sharing (by using a number of layers in common) for text detection, character case-sensitive and insensitive classification, and bigram classification.

III. EXISTING METHODOLOGIES

Nowadays, increasing traffic volume causes congestions commonly around the toll gate of highway. Therefore, the new technique is urgently required to reform the problem of congestions. Automated toll collection system is one of the methods to solve the above conditions. The automated system is composed of several subsystems. The RFID technology, computer database, power supply, microcontroller, motor and inferred device are included. Automated system can bring the several

sectors for toll gates as saving time and reducing the human workers. Develop the prototype model, which reproduces the operation states of various toll gate systems: passing time and waiting time. There are two ways of collecting toll tax being in practice at present. First is the traditional manual method where one person collects the money and issues a receipt. The other one is Smart Card system where the person needs to show the smart card to the system installed at the toll tax depot to open the barrier. The existing system consists of a microcontroller, RFID reader, RFID Tag and bill printer. The reader retrieves the information about the ID number and identifies the vehicle. Then for the tax to be collected the bill is printed at the time of exit. The motor here is used to open and close the gate automatically. The existing system includes automated system using RFID technology can be classified into two modules. They are vehicle module and base module. The vehicle module consists of passive RFID tag. The RFID reader, host computer system and gate control system are composed as the base module.

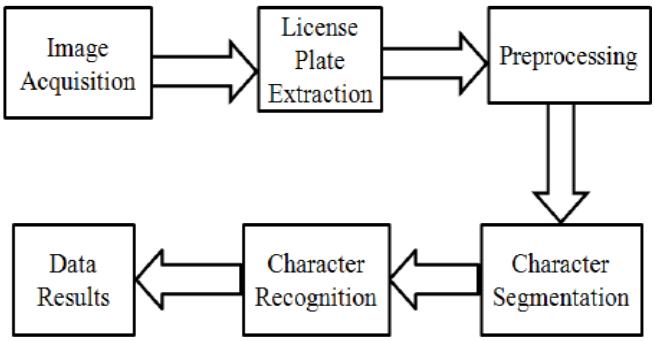

Fig 2: Existing framework

IV. PROPOSED WORK

Each vehicle will be provided by license plate number which containing a unique ID. This license plate is captured by an image. When the vehicle will reach at the toll booth web camera capture the license plate with number. This image is passed to the system. Now, with the help of PC interface unit the data collected is passed to PC through serial port. In the proposed system we can convert license plate number into text format. ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. License plate recognition technology tends to be region-specific, owing to plate variation from place to place. Software developed will show all the details about the vehicle on the screen. Details like date time and id will be stored in the access database. The system will check whether the user is valid or not, if valid the system generates the bill in online transaction. The vehicle details regarding the deducted amount and the main account balance are intimated to the user's mobile through GSM technology. License Plate Recognition is an image-processing technology that is used to identify vehicles by their license plates. A license plate reviewer mechanism works by extracting the characters from an image. This image processing technology is used for various applications such as toll plaza, parking lots, border control, and traffic law enforcement. As a result to the problem of observing the enormous number of vehicles for law enforcement and security, this work concentrates to design a license plate recognition system to make the work more practical. Our system is designed to detect and identify license plates without constant human intervention. This will provide benefit of saving the cost and time to the organization.

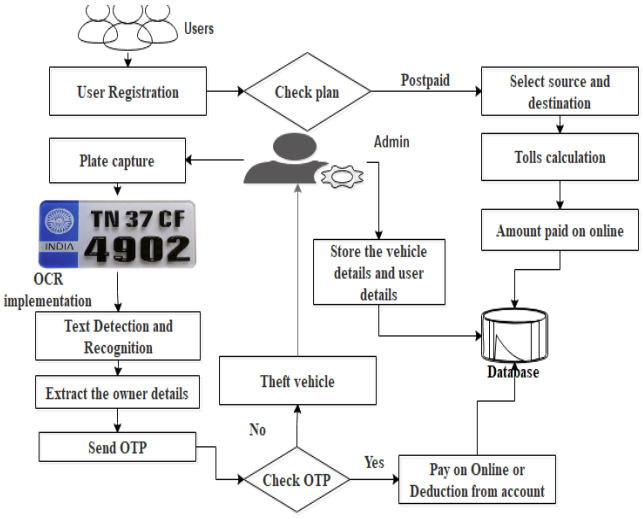

Fig 3: Proposed Framework

4.1 FRAMEWORK CONSTRUCTION

The Electronic Toll Collection (ETC) aims to eliminate the delay on toll roads by cashless tolling and it is rapidly becoming the most innovative technology for the commuters who pass through the toll plaza. In this module, user can register their details such as name, mobile number and other details. Number plate details extracted and stored in database. Admin can maintain all details in single database.

4.2 IMAGE ACQUISITION

In this module, admin can capture the web camera. Camera can be detect the image as 2D image. Implement binarization technique to detect the foreground pixels. Binarization is an important preprocessing step in several document image processing tasks. Image binarization is the separation of each pixel values into two collections, black as a foreground and white as a background. Thresholding technique is used for document image binarization.

4.3 TEXT DETECTION AND RECOGNITION

In this module, implement number detection approach based on text strokes values which is defined in the form of minimum and maximum values in order to obtain the license plate only and remove other very small or very large identified objects which were outside the threshold range. The objects passed successfully through predefined threshold criterion were forwarded to the training process. In this module, text strokes in number plate detected using Conditional Random field. Detected texts are drawn as bounding box. Text can be recognized using Optical Character Recognition algorithm. In this module implement Optical Character Recognition to recognize the detected text. Optical Character Recognition (OCR) is a piece of software that converts printed text and images into digitized form such that it can be manipulated by machine. OCR is a complex problem because of the variety of languages, fonts and styles in which text can be written, and the complex rules of languages etc.

4.4 PLANNING INFORMATION

User may be book the travel previously to select source and destination. After that calculate the toll amount and pay on online. User also updates their neighbor numbers for future verification. In this module, user can update booking details in the system. The booking details are such as booking id, booking name, source, destination, toll plaza details, vehicle types, amount, date and vehicle image details etc. These details are stored in the system. So the admin can easily view user booking details in the system. And then user can get day by day toll plaza information in the system.

4.5 PAYMENT WITH ALERT SYSTEM

After verify the owner details, send OTP to owner mobile number. Payment may be online or cash on delivery. If OTP can't be submit within seconds means, automatically consider as theft vehicle. Send alert to police number. An OTP is more secure than a static password, especially a user-created password, which can be weak and/or reused across multiple accounts. OTPs may replace authentication login information or may be used in addition to it in order to add another layer of security.

4.6 ALGORITHM AND TECHNIQUES

4.6.1 CONDITIONAL RANDOM FIELD

Connected-component labeling (alternatively connected-component analysis, blob extraction, region labeling, blob discovery, or region extraction) is an algorithmic application of graph theory, where subsets of connected components are uniquely labeled based on a given heuristic. Connected-component labeling is not to be confused with segmentation. Connected component labeling is used in computer vision to detect connected regions in binary digital images, although color images and data with higher dimensionality can also be processed.

When integrated into an image recognition system or human-computer interaction interface, connected component labeling can operate on a variety of information. Blob extraction is generally performed on the resulting binary image from a thresholding step. Blobs may be counted, filtered, and tracked. Connectivity checks are carried out by checking neighbor pixels' labels (neighbor elements whose labels are not assigned yet are ignored), or say, the North-East, the North, the NorthWest and the West of the current pixel (assuming 8- connectivity). 4-connectivity uses only North and West neighbors of the current pixel. The following conditions are checked to determine the value of the label to be assigned to the current pixel (4-connectivity is assumed).

1. Iterate through each element of the data by column, then by row (Raster Scanning)
2. If the element is not the background
1) Get the neighboring elements of the current element
2) If there are no neighbors, uniquely label the current element and continue
3) Otherwise, find the neighbor with the smallest label and assign it to the current element
4) Store the equivalence between neighboring labels

On the second pass

1. Iterate through each element of the data by column, then by row
2. If the element is not the background
1) Relabeled the element with the lowest equivalent label

4.6.2 OPTICAL CHARACTER RECOGNITION:

Optical Character Recognition (OCR) has been a topic of interest for many years. It is defined as the process of digitizing a document image into its constituent characters. Despite decades of intense research, developing OCR with capabilities comparable to that of human still remains an open challenge. Due to this challenging nature, researchers from industry and academic circles have directed their attentions towards Optical Character Recognition. Over the last few years, the number of academic laboratories and companies involved in research on Character Recognition has increased dramatically. This research aims at summarizing the research so far done in the field of OCR. Optical Character Recognition (OCR) is a piece of software that converts printed text and images into digitized form such that it can be manipulated by machine. Unlike human brain which has the capability to very easily recognize the text/ characters from an image, machines are not intelligent enough to perceive the information available in image. Therefore, a large number of research efforts have been put forward that attempts to transform a document image to format understandable for machine. OCR is a complex problem because of the variety of languages, fonts and styles in which text can be written, and the complex rules of languages etc. Hence, techniques from different disciplines of computer science (i.e. image processing, pattern classification and natural language processing etc. are employed to address different challenges. An OCR is not an atomic process but comprises various phases such as acquisition, pre- processing, segmentation, feature extraction, classification and post-processing. Each of the steps is discussed in detail in this paper. Using a combination of these techniques, an efficient OCR system can be developed as a future work. The OCR system can also be used in different practical applications such as number-plate recognition, smart libraries and various other real-time applications.

V. EXPERIMENTAL RESULTS

This proposed approach for automatic number plate recognition system works well for low contrast, noisy and blurred as well as dark and light/bright input images. The proposed approach is tested on various real time images of different image categories as using

various performance metrics namely Peak Signal to Noise Ratio (PSNR) and Success Rate (%). In the proposed approach the success rate (%) in each phase of ANPR is higher and PSNR is also higher than that of existing ANPR method. This method is implemented in C#.NET.

A. Peak Signal to Noise Ratio (PSNR) : The peak signal to noise ratio (PSNR) is used as a quality measurement between original and reconstructed image. Higher the value of PSNR, better the quality of the reconstructed image. An improvement in the PSNR magnitude will increase the visual appearance of the image. The PSNR value is calculated in (dB) at each step of existing and proposed ANPR method for each category of image.

Table 1 : PSNR value

Methods	PSNR
Existing system	13.2
Proposed system	13.74

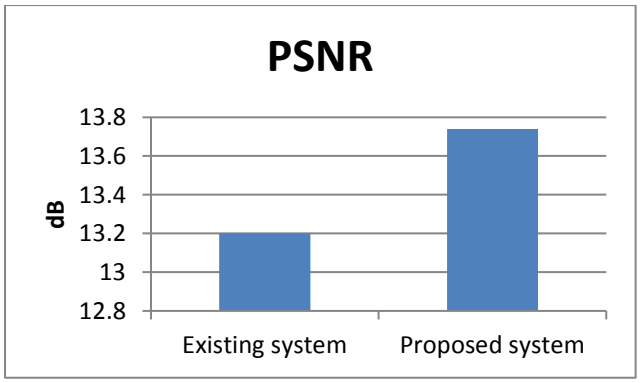

Fig 4 : PSNR Evaluation

Success Rate (%): The success rate (%) is calculated for 3 different phases of ANPR. The success rate for number plate extraction phase is equal to the ratio of successfully extracted plates and total no. of input vehicle images. The success rate for character segmentation phase is equal to the ratio of successfully segmented plates and total no. of input vehicle images. The success rate for character recognition phase is equal to the ratio of successfully recognized plates and total no. of input vehicle images. If the ANPR approach gives higher value of success rate (%) it means that approach has better result as compared to ANPR approach that has low value of success rate. The success rate (%) is calculated for each phase of ANPR using existing and proposed approach. The success rate (%) is higher in case of our proposed method as compared to existing method of ANPR.

Table 2 : Success Rate

Methods	Total no. of images	Success	Failure	Success (%)
Existing system	10	5	5	50
Proposed system	10	8	2	80

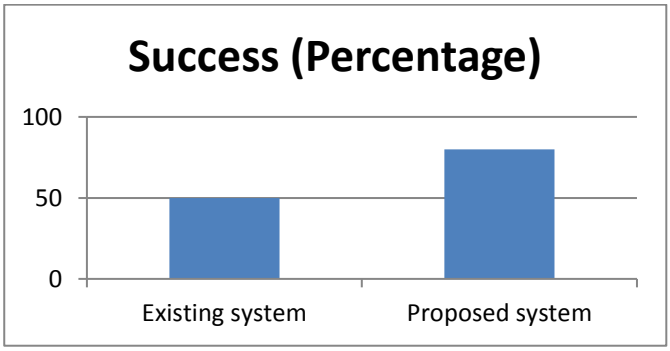

Fig 5 : Success Rate

VI. CONCLUSION

Toll Tax Management System is a web based application that can provide all the information related to toll plazas and the passenger checks in either online and pays the amount, then he/she will be provided by a receipt. It can be widely implemented on toll tax places .this system make saves time of driver and also of person on service for taking toll tax .This system automate the whole

system for toll tax. The proposed system uses less cost to implement and require fewer changes to the current system. It provides the tracking system for theft vehicle which is secured and highly reliable. E-toll system can help to achieve proper traffic management, appropriate toll collection and improves security. Thus a system used as an Automated Toll collection booth, based on image processing saves the time at toll booth, minimizes the fuel consumption during the ideal condition of the vehicle. Also it serves in providing the tracking system for theft vehicle which is secured and highly reliable can be obtained. It can be used to remove all drawbacks with the current system such as time and human effort and it also doesn't require any tag only required best quality camera and fixed font number plate on each vehicle

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