March - April 2020
ISSN: 0193-4120 Page No. 8850 - 8857

A Novel Approach for Vehicle Theft Detection using Image Processing

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Abstract

The aim of the project is to identify the stolen vehicles by comparing the images taken by the CCTV cameras in a given location using image processing and neural networks. As video analytic technologies are developing, object detection and classification of video data can be performed by machines like CCTV cameras and computers. The automatic object detection and classification can be applied to identify same vehicle from multiple video clips taken at different time or by different cameras. The accuracy of video object classification can be enhanced by using other information. The proposed project involves technologies such as image processing and neural networks to integrate the independently working cameras and to make them work together so that the identification of a stolen vehicle is possible automatically. The concerned authorities are alerted on the identification of the stolen vehicle automatically.

Keywords; *Background subtraction, Region of interest, Real world object detection, Conversion of video to frame, Optical character recognition, mobile application*

I. INTRODUCTION

Image processing deals with identification of images and processing them based on certain algorithms so that a desired output can be produced .This project deals with the use of image processing to identify a stolen vehicle by identifying the number plate so that the vehicle can be identified and reported to the nearby police station. The above process can be extensively used in CCTV cameras so that the process can be done automatically without human intervention.

In the digital era there is a demand for the inclusion of technology in everyday life. The presences of CCTV in various areas are aimed to reduce crime and to identify a particular individual or an object in a given area. CCTV is limited in its use because there is no dynamic tracking of an object and it requires consistent and continuous monitoring of the recorded video to identify a given object.

It is not possible to monitor all the videos sequentially which leads to a considerable waste of time. The aim of the project is to reduce the time involved in identifying a given object and to keep track of the static location of the object. By connecting the available CCTVs in a given area, the work can be done efficiently and the identification process becomes simple and efficient thereby reducing manual labor.

Figure 1: Single frame of a typical CCTV feed.

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March - April 2020
ISSN: 0193-4120 Page No. 8850 - 8857

The above picture is captured in a normal CCTV camera without analyzing any parameters automatically. More than 50 % of the theft occurs by breaking the car and by other hot wiring techniques. The vehicle can also be stolen by towing the car .the glass of the car is broken and hotwired to start the engine.

Opportunistic theft: The car is stolen when the car is Idle without the owner's presence but has the key. Sometimes the car is stolen during the test drive and also the thief knows the place for the key storage so that he can return to the particular place to steal the car.

Carjacking is the most serious form of vehicle theft; the car is taken from the owner by force which is a form of robbery. Sometimes the driver is made to compliance with the demands of the assailant. The use of force makes it a serious crime.

Fraudulent theft: The stolen vehicles are sold to a foreign customer by the use of illegal money or by taking loans from a bank using fraudulent means, which is used to buy a car. The recovery of the entire vehicle is not possible since there will be modifications done to the vehicle. The recovery rates are based on the jurisdiction of the involved police and the methods used to recover the vehicle.

II. LITERATURE SURVEY

Lots of work and various researches have been conducted to identify the stolen vehicles on 2014, Arnold WM Smeulders[2] focused on improving the camera quality by adjusting the lens present in the camera. We solve the problem by including spatiotemporally local motion features which help us in solving the above issue. Our approach is used to solve the problem by involving a large number of static cameras and by deploying a robust algorithm strong enough to capture the vehicle even in poor optical conditions. As in [3] many urban areas the parallel lines such as corridors which have the same vanishing point can be used to get a perspective of the image even if it is moving in high speeds.

According to a study there are various cameras which are efficient enough to identify static objects but they cannot be deployed here because the object we are trying to identify is not static as in[7].Thus advanced cameras must be used to calculate the various parameters involved in the image capture.

Research has also been done on identifying a vehicle using light weight processing .IT involves hashing the value into an inverted hash so that the necessary value can be identified by the camera as in [9].The disadvantage is that continuous hashing of values becomes a heavy workload on the system thus reducing the efficiency with time. As in [11] the image can be identified using dynamic programming so that a partial match can be converted into a full match leading to the identification of the vehicle. Air borne image tracking was implemented using Track lets generation algorithm While Horn and schunck algorithm was used to detect the motion estimates for the CCTV video.

Features were extracted from the video and using Light weight index the LSH index was created which was put into a inverted index lookup .The user also generated commands in the form of queries which can combined with the inverted index and by using dynamic programming the image can be located as in [3].

The challenge arose in the identification of objects which were not useful for the process since surveillance videos are different from conventional videos as in [1]. In conventional videos only the object of importance is given focus and the rest are omitted but in surveillance videos every aspect must be taken into consideration so that the necessary parameters are not omitted.

Scene understanding methods were not used since there was a need to have a training step in order to make the system robust, rather temporal order techniques were used, which focus on the orbital values and maintain low false rates as in [5].

The limitations of existing system are unable to

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March - April 2020
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detect the accurate location of vehicle, since only single frame is used for vehicle classification. Our proposed system involves multiple frames without focusing on a single frame.

III. PROPOSED METHODOLOGY

The project is aimed at developing CCTV software which automatically identifies the stolen vehicle based on a given set of parameters such as size, model, etc. The algorithm is developed using MATLAB software which compares the image of the stolen vehicle to any similar images in nearby localities. If the images match then the static location of the vehicle is alerted to the involved authorities and the CCTV cameras in nearby areas get activated to keep track of the vehicle if it is taken to another place.

This is possible by the use of neural networks and image processing, which are the building blocks for implementing this software. The alert message can be in the form of a text or an alarm which can be indicated by the use of an application which can be installed at the nearby police station. The objective is to reduce manual workload by identifying the stolen vehicle automatically and to keep track of the current location of the vehicle.

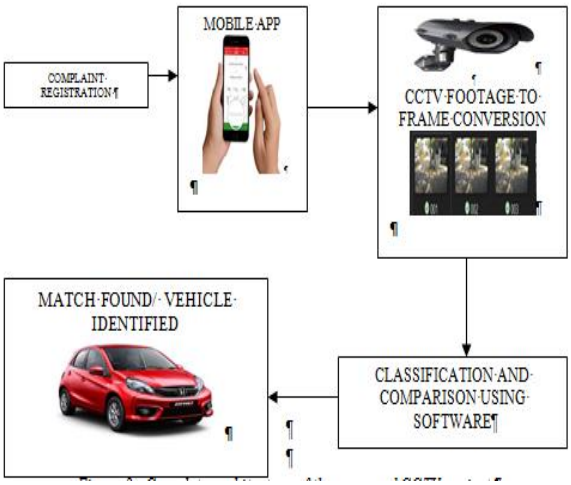

Figure 2 - Complete architecture of the proposed CCTV project.

A.Preprocessing and Component Extraction:

In this module we convert the video into frames so that it can be used for comparison in the later stages of the project .The converted frame is then subjected to a conversion process so that the necessary image gets highlighted(Grey to Binary) .The method is implemented using MATLAB software.

B.Model development:

Our model consists of the following parts: Background Subtraction, Region of Interest, Number plate extraction, Extraction using OCR Method and Extracted Object Reorganization. The overall framework of the model has.

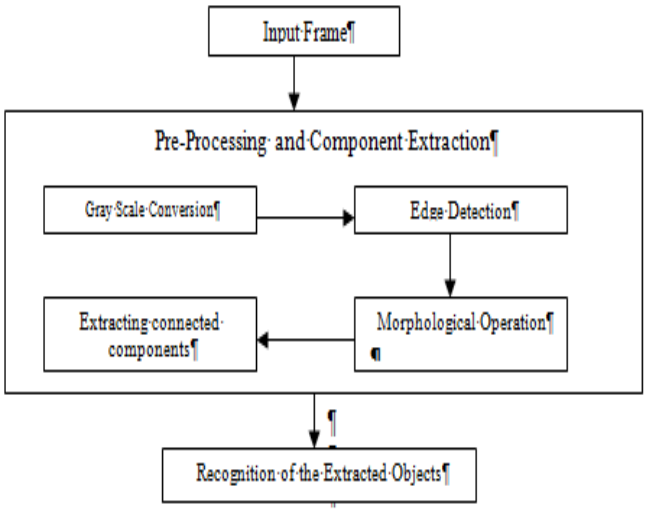

Figure 3 – Overall process flowchart fort color extraction from a video frame.

1. Background Subtraction:

Background subtraction is performed on the binary image so that the object can be identified accurately. (I.e. it's a car).Algorithm such as Canny Edge detector is used to identify the object.

Background subtraction (BS) is used to highlight a particular image by removing all the parameters in a video. The video is converted to frames and the technique is applied so that only the necessary factors are taken into consideration. In our case the number plate is highlighted so that the characters can be identified. Background modeling consists of two main steps: Background Initialization; Background Update.

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March - April 2020
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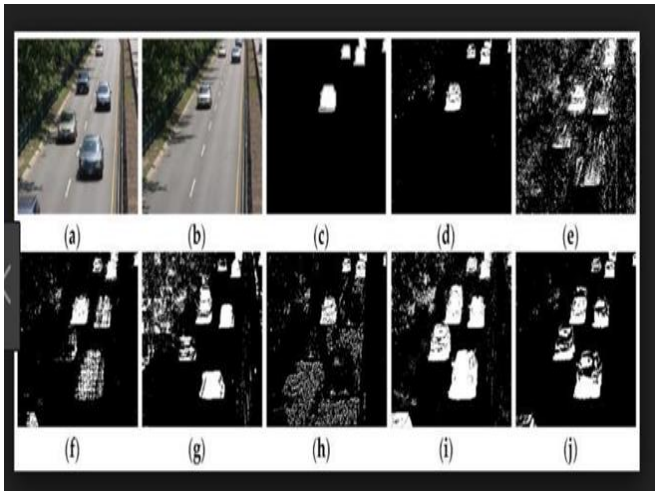

Figure 4 - Image extracted from background subtraction method.

2. Region of Interest:

A region of interest is used to identify a particular data from a whole set of parameters. In vehicle number detection the number plate is highlighted from the car so that the characters can be extracted and identified. ROI is also used in various applications.

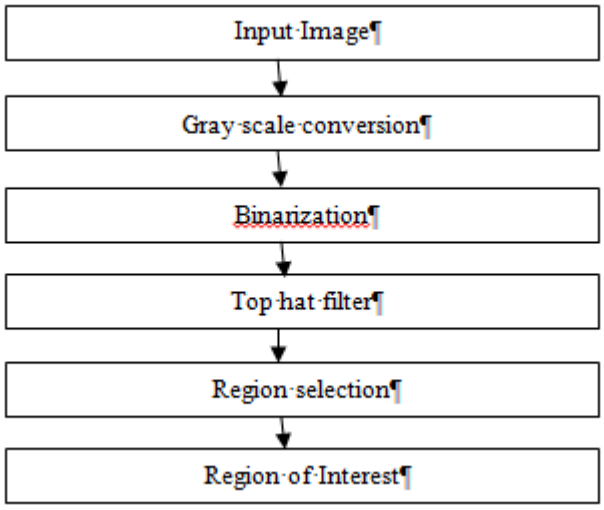

Figure 5 – Region of Interest flow diagram.

Examples of regions of interest:

1D dataset is used to identify the time and frequency Parameters which are involved in 2D dataset is used to identify the boundaries of an image 3D dataset is used to outline the image or a character. A ROI is a form of annotation, often associated with categorical or quantitative information (e.g., measurements like Volume or mean intensity), expressed as text or structured form.

3. Number Plate Extraction:

The captured image from the CCTV footage is in capital RBG format. It is converted into gray scale image and to binary image.

Character Segmentation:

Character segmentation part segments the character individually from the extracted number plate. Here the first process is crop out the number plate characters from start to end point by leaving all extra wide spaces.

4. Extraction using OCR Method:

Optical Character Recognition is the automated recognition of characters from the scanned documents to process for future applications. OCR is applied to recognize text form any multimedia such as image, audio, video.

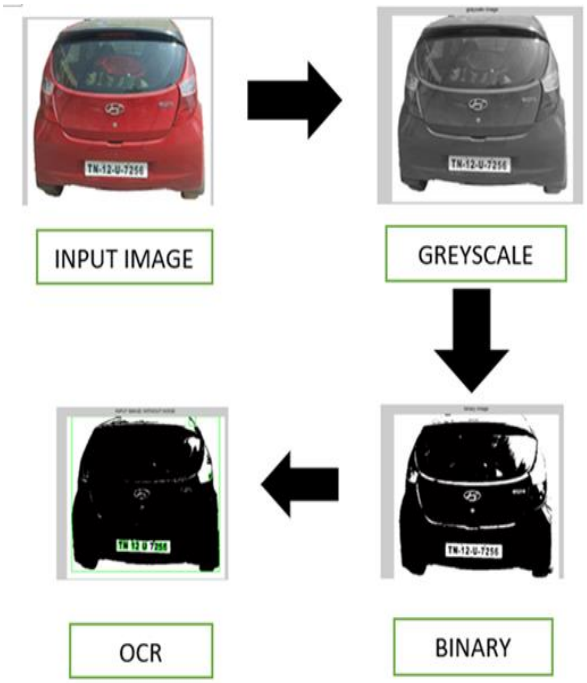

Figure 6 – Extraction of characters using OCR.

Algorithm for identifying a number plate using OCR:

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March - April 2020
ISSN: 0193-4120 Page No. 8850 - 8857

STEP 1: Plate localization is used to recognize and separate the number plate from the rest of the vehicle.

Figure 7a– Plate localization.

STEP 2: Plate orientation and sizing changes the size so that information can be processed easily.

Figure 7b– Orientation and Normalization.

STEP 3: Normalization changes the brightness of Image.

STEP4: Character segmentation is done to identify each character on the plate.

STEP 5: Optical character recognition and Syntactical Geometrical analysis is done to check if each number plate is in compliance with those specific countries regulations.

STEP 6: Edge detection method is used in normalization to identify the difference between a character and a number. Median filter is also used to reduce the noise in the image used for processing.

Figure 7c– Character recognition using Edge detection method.

STEP 7: Template matching includes the following steps shown in figure 7.

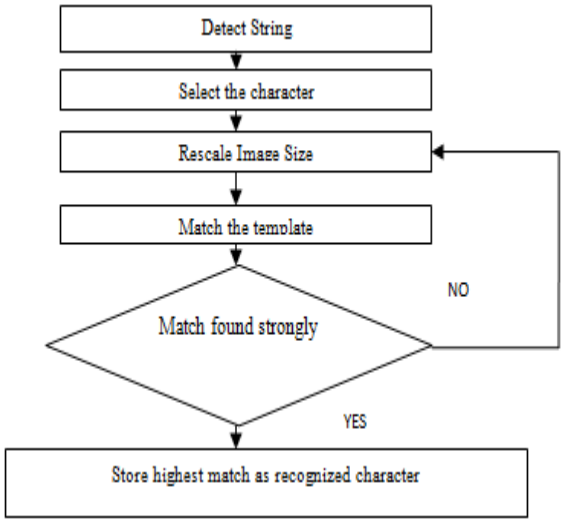

Figure 8 – Flow chart for Template Matching.

IV. EXPERIMENT AND RESULTS

In our proposed model the processes we have going through are: Capturing the real time video from CCTV footage, conversion of video into multiple frames, cropping the number plate from the image, character recognition using OCR.

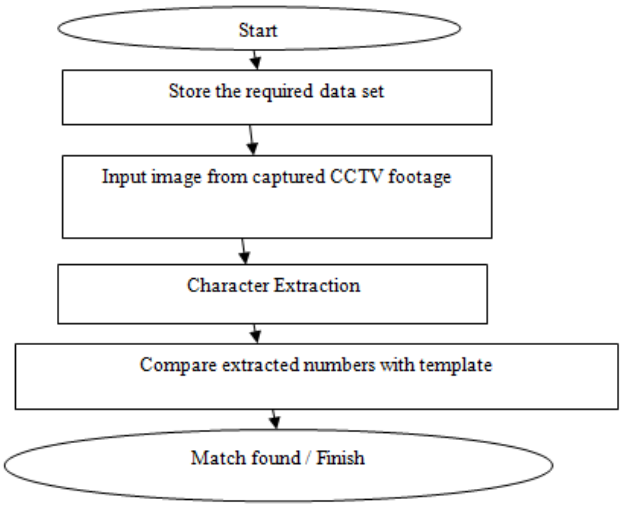

Figure 9 – Flow chart for proposed system.

A. Experimental Setup and Results:

In our proposed system, the first step is to store the required character and vehicle image data set to find the vehicles. Secondly the input image is fetched from the CCTV footage by converting the video sequence into multiple image frames. The converted video to frames sample image is given in figure 9.

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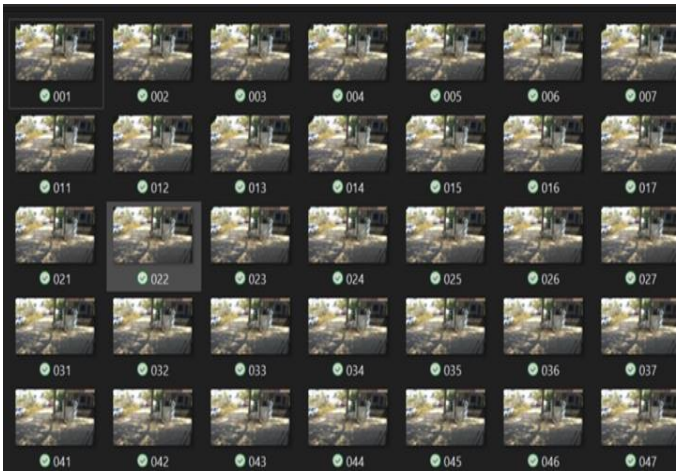

Figure 10 – CCTV video footage to multiple frame conversion.

Then background subtraction is used to highlight a particular image by removing all parameters in a video. The video is converted into frames and the technique is applied so that only the necessary factors are taken into consideration. In our project the number plate is highlighted so that the characters can be identified effectively.

Figure 11– Background Subtraction.

After background subtraction region of interest will be applied to extract or identify the particular number plate from the whole parameters.

Figure 12 – Application of Region of Interest.

Once the number plate is extracted using ROI, optical character recognition is used to fetch the characters from the number plate. With the help of the predefined character data set comparison can be made for the extracted characters from number plate. Once the characters match found then the vehicle is identified successfully. The overall working of our system is specified in figure 13,14 and 15.

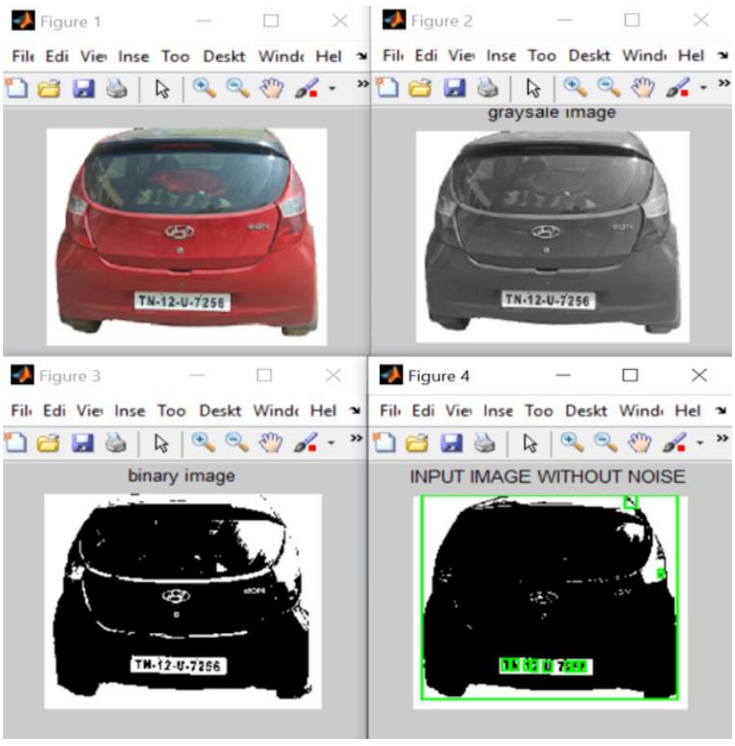

Figure 13 – Extraction of number plate from input image.

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ISSN: 0193-4120 Page No. 8850 - 8857

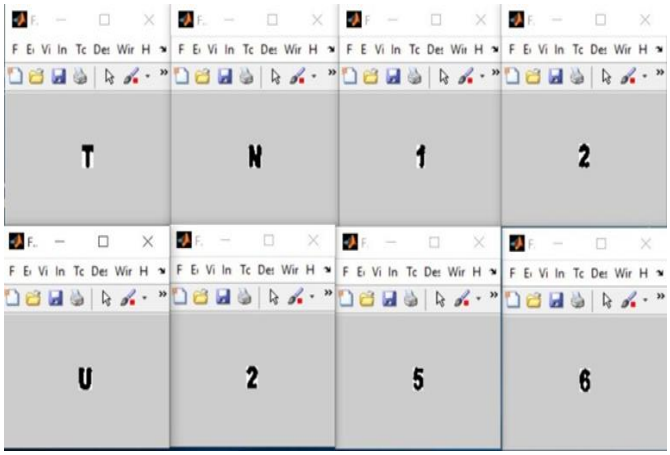

Figure 14 – Extraction of characters using OCR.

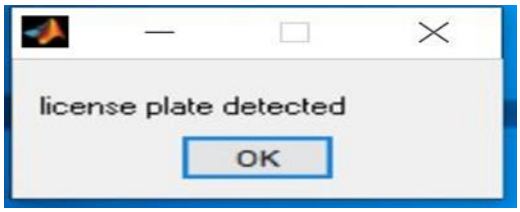

Figure 15 – License plate detected.

Experiments have been performed to test the accuracy of the proposed system, by recognizing sample images. The measurements of accuracy are given in table 1:

LPR Units	Accuracy Ratio	%
Number Plate region extraction	27/30	90%
Recognition of LP	22/25	88%

Table 1–Experimental results of LPR accuracy.

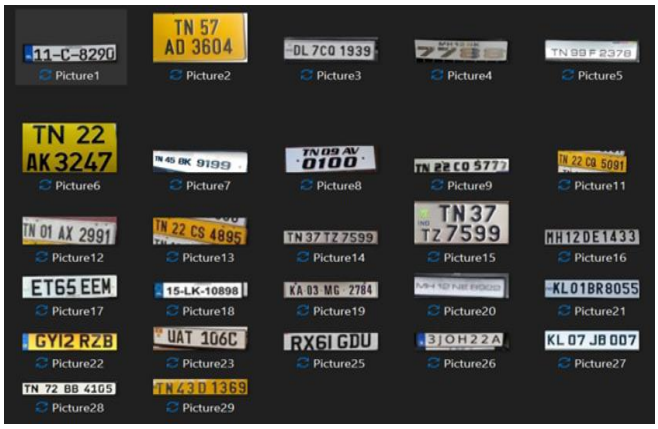

Figure 16– .Training License Plate (LP).

Nearly 30 training input images are taken from the database, in that only 10 license plates are extracted correctly. The remaining 20 training input images are not extracted properly because the image is not clear or there is an unwanted object in that frame that cause the crop of the license plate incorrect. The number plate accuracy results are specified in table 2:

Actual distance from the CCTV camera to number plate	30m
Width coverage at 30m	6.77m
Vertical camera angle to number plate (30 degrees - Max)	27.2 degrees
Horizontal camera angle to number plate (15 degrees - Max)	13.3 degrees

Table 2 – License plate recognition accuracy results.

V. CONCLUSION AND FUTURE WORKS

In this vehicle license plate detection project, we proposed a system which automatically detects the vehicle number plate using MATLAB and image processing. The algorithm used in this system is fully image dependent, that is the change in image will, affects the algorithm too will leads to inefficiency in case of adding other images. The experimental results shows that the license plates are extracted effectively based on and connected canny edge detection and connected methods gives the accuracy rate of 90%. Character recognition module using Region of interest and optical character recognition results with the success rate of 88%.

So the future scope of this project is to make the image fully independent in order to make the algorithm dynamic and more accurate.

VI. ACKNOWLEDGEMENT

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March - April 2020
ISSN: 0193-4120 Page No. 8850 - 8857

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