Detection of Vehicle License Plates Using Background Subtraction Method

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Abstract

The detection of a vehicle license plate can be considered as a primary task of a License Plate Recognition System (LPRS). Detecting a vehicle, locating the license plate and the non-uniformity of license plates are few of the challenges when it comes to detection of a license plate. This paper proposes a work to ensure the detection of license plates which are being used in Sri Lanka. The work here, consists of a prototype which was developed using the Matlab's predefined functions. The license plate detection process consists of two major phases. They are, detection of a vehicle from a video footage or from a real time video stream and license plate area isolation from the detected vehicle. By sending the isolated license plate image to an Optical Character Recognition (OCR) System, its contents can be recognized. The proposed detection process may depend on facts such as, the lighting and weather conditions, speed of the vehicle, efficiency in real time detection, non-uniformity effects of number plates, the video source device specifications and fitted angle of the camera.

In the license plate detection process, the first phase, that is; the detection of a vehicle from a video source is accomplished by separating the input video source into frames and analysing these frames individually. A monitoring mask is applied at the beginning of the processing in order to define the road area and it helps the algorithm to look for vehicles in that selected area only.

To identify the background, a foreground detection model is used, which is based on an adaptive Gaussian mixture model. Learning rate, threshold value to determine the background model and the number of Gaussian modes are the key parameters of the foreground detection model and they have to be configured according to the environment of the video.

The background subtraction approach is used to determine the moving vehicles. In this approach, a reference frame is identified as the background from the previous step.By subtracting the current frame from that reference frame, the blobs which are considered to be vehicles are detected. A blob means a collection of pixels and the blob size should have to be configured according to facts such as the angle of the camera to the road and distance between camera and the monitoring area.

Even though a vehicle is identified in the above steps, it needs a way to identify a vehicle uniquely to eliminate duplicates being processed in next layer. As the final step of the first layer, it will

generate distinct numbers using the Kalman filter, for each and every vehicle which are detected from the previous steps. This distinct number will be an identifier for a particular vehicle, until it lefts the global window.

In, the second phase of the license plate detection will initiate in order to isolate the license plate from the detected vehicle image. First, the input image is converted into grayscale to reduce the luminance of the colour image and then it will be dilated. Dilation is used to reduce the noise of an image, to fill any unnecessary holes in the image and to improve the boundaries of the objects by filling any broken lines in the image.

Next, horizontal and vertical edge processing is carried out and histograms are drawn for both of these processing criteria. The histograms are used to detect the probable candidates where the license plate is located. The histogram values of edge processing can change drastically between consecutive columns and rows. These drastic changes are smoothed and then the unwanted regions are detected using the low histogram values. By removing these unwanted regions, the candidate regions which may consists of the license plate are identified. Since the license plate region is considered to be having few letters closely on a plain coloured background, the region with the maximum histogram value is considered as the most probable candidate for the license plate.

In order to demonstrate the algorithm, a prototype was developed using MATLAB R2014a. Additional hardware plugins such as Image Acquisition Toolbox Support Package for OS Generic Video Interface, Computer vision system toolbox and Image Acquisition Toolbox were used for the development. When the prototype is being used for a certain video stream/file, first and foremost, the parameters of the foreground detector and the blob size has to be configured according to the environment. Then, the monitoring window and the hardware configurations can be done.

The prototype which was developed using the algorithm discussed in this paper was tested using both video footages and static vehicle images. These data were first grouped considering facts such as non-uniformity of number plates, the fitted angle of the camera. Vehicle detection showed an efficiency around 85% and license plate locating efficiency was around 60%. Therefore, the algorithm showed an overall efficiency around 60%.

The objective of this work is to develop an algorithm, which can detect vehicle license plates from a video source file/stream. Since the problem of detecting a vehicle license plates is crucial for some complex systems, the proposed algorithm would fill the gap.

Keywords*: License Plates, Matlab R2014a*