

REAL TIME MOTORCYCLE IMAGE DETECTIONS AND ANALYSIS

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ABSTRACT

This research investigated image tracking and edge detection for motorcycle in various lighting and weather conditions. The capability in different resolution and threshold level also evaluated. Comparison between hardware and software implementation of edge detection also been made. Develop framework showed great accuracy is segmentation of plate number from motorcycle image in daylight condition compared to rainy daylight and night condition. The aim of this project is to develop framework for motorcycle image detection and recognize for traffic offender. Analysis with histogram level and contrast stretching method showed performance in hardware is improved rather than software.

Keywords: detection system; object recognition; bounding box; motorcycle; edge detection

INTRODUCTION

Detection process can be defined as classifying an object whether it is presence or absence in an image. Object that is present in an image can be verified based on position provided and edge boundary [1]. In object detection, object can also be recognized by identifying its shape. Recognition process can be defined as identifying a specific particular object such as a person, or a road sign [2]. This project focuses on the detection and recognition of motorcycles. Motorcycle image is selected in this study because many cases of fatal accidents involving motorcycles are caused by the failure of driver to detect the presence and position them in a safe distance [3]. This project

also contributed to enforcement officer to identify traffic offender via motorcycle plate number recognition.

LITERATURE REVIEW

Researchers [4] in their study found that the vehicle headlights during the daylight can determine the safe distance for motorcycles and other vehicle. The safe distance for vehicle moving at a same speed of 150 km/hr with headlights is 5 meters to 18 meters for motorcycles and cars [4][5]. However, motorcycle detection is a very challenging task due to its size, color and shape. The surrounding environment scenario such as illumination changes, random interaction between traffic participant and crowded urban traffic system also contribute complexity during detection.

The motorcycle detection location can be classified into three categories according to the relative position from the enforcement officer car driver. The three categories are close by regions, overtaking regions and mid- range / distant region [6]. In the close by regions methods edge/shadow cannot be used because the space to capture image is limited. In the overtaking region, a driver only can detect motorcycle on sides view position in short time. Detecting motorcycle in the mid-range / distant region is easy since the full view of a motorcycle is available and its appearance is more stable.

Image detection and recognition process of motorcycle has been applied on existing system namely AES for traffic enforcement. Automatic Enforcement System (AES) can be categorized as fixed speed camera, red light camera and mobile camera [7]. In this case, traffic offenders are refers to motorcyclist which is violating the rule of road system. Enforcement officer try to solve this issue by using old method such as roadblock manually. This method is not relevance because implemented manually and many enforcement officers needed. Other method, they used AES to prevent traffic offender violate road rules. However the AES has a drawback and limitation. This system will function and placed at black spot or main targeted area only. Even though AES can be mobilized but it's heavy to carry. Due to this reason, AES mounted across the road or highway for traffic enforcement.

MATERIALS

Real time motorcycle image discriminate from other object through applying Sobel Edge Filter in this project. The design system for hardware and software implementation is shown as Figure 1 and Figure 2. The edges appear as outline of object within the image which can be used in subsequent image analysis operations for object recognition. Edge enhancement process can reduce an image to show only its edge details. In this case edge information contains motorcycle, motorcyclist and plate number currently used.

DESIGN SCHEME FOR IMAGE DETECTION AND ANALYSIS

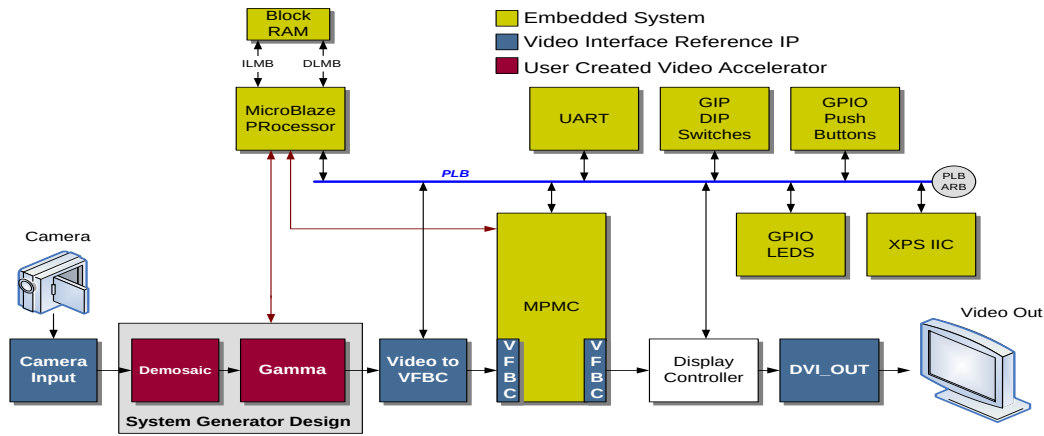


Figure 1: Design application system with fpga

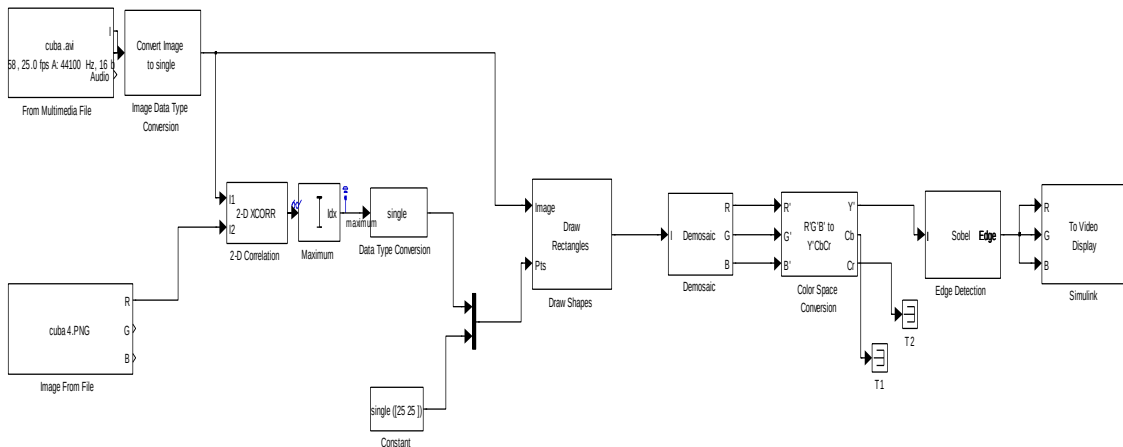


Figure 2: Design application system with matlabsimulink

EXPERIMENTAL

Motorcycle Image Detection Process

The Sobel Edge detection algorithm used to process motorcycle image in gray scale format. Motorcycle image process can be divided in three major steps as image scale size, motorcycle candidate localization and motorcycle recognition. All the process is explained in details;

Image Scale Size

During image scale size process, image of motorcycle is selected based on resolution applied and distances chosen. In this context a video is captured based on distances of motorcycle moving from camera itself. The image of motorcycle is selected based on region of interest and crop to identify it as a target object. All the motorcycle image size

is different and depends on the distances selected. Thus the size of motorcycle image is decrease while the distances increase. This process is applied with MATLAB Simulink software.

Motorcycle Candidate Localization

Motorcycle localization process contains Gaussian smoothing, binarization, candidate search and store. Two phases involved in this process such as location search based on motorcycle candidate localization and motorcycle detection. This process justifies candidate location or motorcycle image position in a video.

Motorcycle Recognition

Motorcycle recognition process occurred in hardware platform such FPGA. It contains normalization scale size of candidate image block, Gaussian smoothing, binarization and sobel edge detection. Motorcycle image candidate has different size based on respective distance located. This scenario is helpful for motorcycle identification process having a unique normalized scale size benchmark. FPGA memory has a limitation depends on the scale size of image storing inside it. Image normalization scales an image to a certain size. Normalization scale size 126 x 158 adopted for the whole image size as shown in Table I. The resolution involved for this normalization process are 640 x 480 pixel, 720 x 480 pixels, 800 x 600 pixels and 1024 x 768 pixels.

Table 1: Normalization value

126 x 158 -> 126 x 158	640 x 480 -> 126 x 158	720 x 480 -> 126 x 158
800 x 600 -> 126 x 158	1024 x 768 -> 126 x 158	

The Sobel edge detector uses a simple convolution kernel to create a series of gradient magnitude [8]. The convolution kernel can be represented as equation (1) and (2)

$$N(x,y) = \sum_{k=-1}^1 \sum_{j=-1}^1 K(j,k) p(x-j, y-k) \quad (1)$$

The sobel edge detector uses two convolution kernel, one two detect in vertical contrast (hx) and horizontal contrast (hy) [9]

$$hx \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix}, \quad hy \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix} \quad (2)$$

METHODS

Motorcycle can be discriminate from other vehicle like bicycle because it has paddles for moving [10]. Leg movement by pedaling enable motorcycle and bicycle discriminate each other. Recognition of motorcycle process involved identified motorcycle plat number at the back side, back lamp and tyre size. The origin of the motorcycle image detected is inside a rectangle bounding box. Its location is defines by

four zones based on its relative position with a bounding box. Four zones which is surrounded a rectangle bounding box is defines as TOP, BOTTOM, RIGHT and LEFT. All zones can be seen in Figure 3.

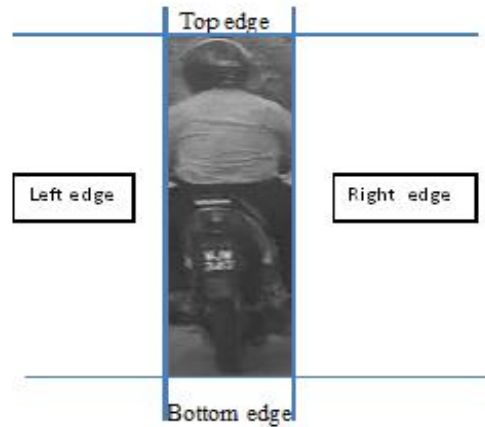


Figure 3: Four zones surrounding a rectangle bounding box

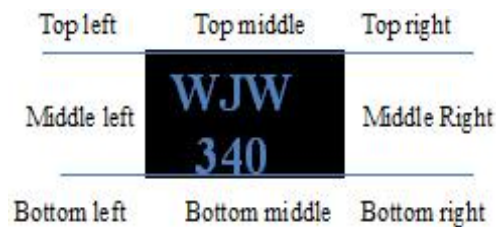


Figure4 : Motorcycle plate boundary

Enforcement officer need to recognize traffic offender base on unique identity. Due to this scenario we can locate plate number inside the bounding box for recognition process. The location of the plate number inside the square shape of bounding box defines by eight zones as shown as Figure 4.

Image Analysis

Image analysis can be divided into image tracking and image edge detection. In image tracking analysis the performances is evaluated based on bounding box pattern match with motorcycle image as shown as Figure 5. The visibility image output tracking performance is observed whether it's clear or blurring in edge format on software and hardware platform. The parameter involved during observing of visibility tracking image output quality performances are threshold level, resolution used, histogram level analysis, histogram equalization analysis, contrast stretching output image and histogram transformation analysis. Whilst in case of edge detection analysis, output display image is also observing and compared based on platform used whether software or hardware. Through the experiment a total of 84 output image is analyze. The output image is collected in different lighting condition, weather conditions and distances. Proper data selection is needed in comparing the data between hardware and software

platform used.

RESULT AND DISCUSSION



Figure 5 : Bounding box tracking image

Table 2: Tracking Performances At Low Resolutions And Different Threshold Level

Resolution	Threshold (t) Output image Performance	Software Output image Performance	Hardware
126 X 158	2	clear	blur
126 X 158	4	clear	blur
126 X 158	6	clear	clear
126 X 158	8	blur	clear
126 X 158	10	blur	clear

The histogram level in Figure 6 shows a number of pixels and tonal variations of an image. The higher number of pixel correspondence to image intensity. The image clear since the pixel peak value is high. Other method in enhance of image quality via adjustment of intensity value through histogram equalization process. Based on this technique, a contrast of image is improved via spread the intensity value over the full range of image. Contrast stretching in this case is an output image which is transformed from the real image which is track from the initial process. The pixel value is display along the histogram graph and enhancement process occurred. Through this image output with better accuracy can be produced. In this case, the image which has a value on 0.1-1.0 as shown as histogram transformation graph in Figure7 is own accurate edge detection. This is opposite situation since software platform image quality degraded while hardware platform image quality is improved. Intensity of image output pixel is display along histogram equalization graph as Figure 8. The pixel intensity is high since threshold level is increasing. Quality of image output is improving, clear and eliminated the noise which caused its blur at initial process. Histogram transformation shows original image has contrast stretching value 0.2 to 0.8. Meanwhile at threshold level 2 to threshold level 4 the graph shows noise and a contrast stretching value 0 to 0.95. Whilst threshold level 6 to threshold level 10 the graph also has noise and a contrast stretching value 0 to 0.85. The image quality drop while increasing a threshold value since blurring occurs.

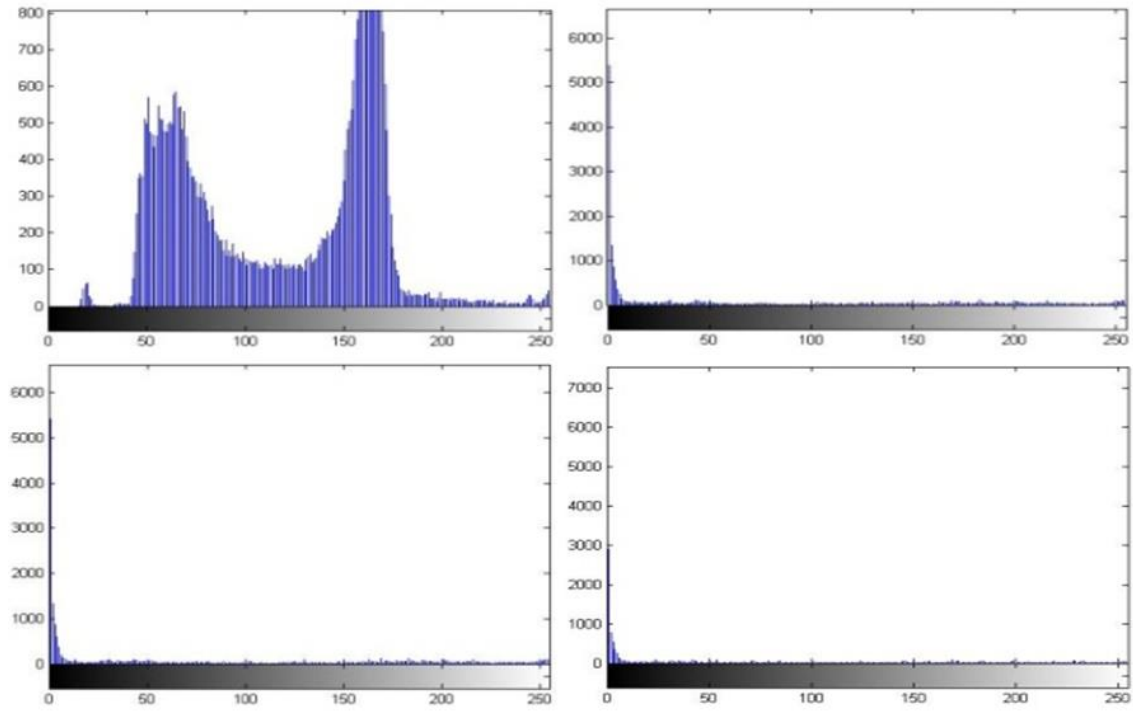


Figure 6 : Histogram Level Edge of image

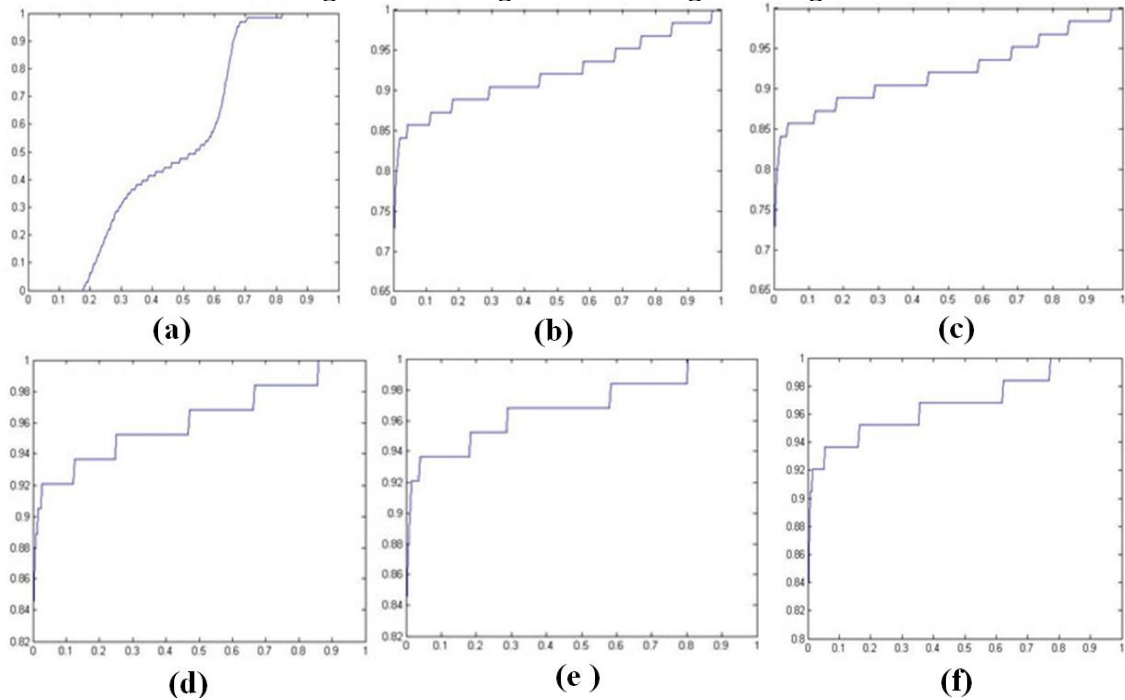


Figure 7 : Histogram transformation (a) Original image (b) Threshold level 2 (c) Threshold level 4 (d)Threshold level 6 (e) Threshold level 8 (f) Threshold level 10

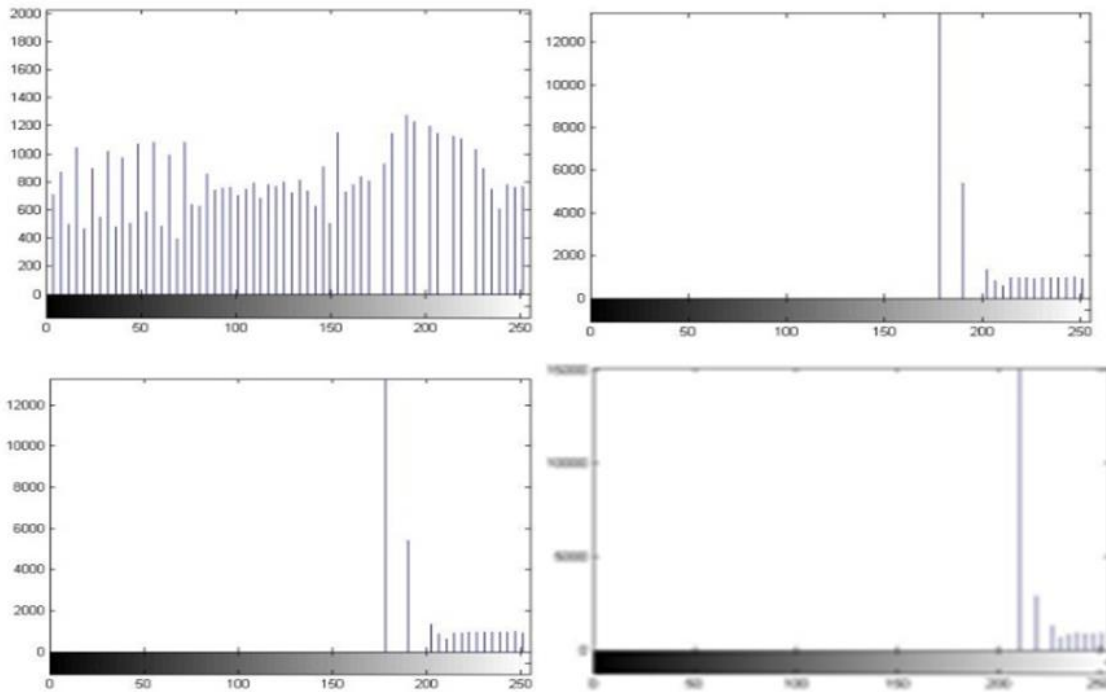


Figure 8: Histogram Equalization

CONCLUSION

A flexible visual driver support system integrated with MATLAB Simulink was successfully developed and used to track image every ten seconds for each resolution selected. The system can detect right, left, top and bottom bounding box boundary correctly with pixel of 640 x 480 in daylight and error for other resolutions. This situation occurs due to low capability of the system in processing the image at high resolutions. Threshold value and resolutions is a controlling parameter which is involves in this project to determine the edge quality of images produced.

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