ROADSIGN DETECTION AND RECOGNITION (RSDR)

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ABSTRACT

Road-sign Detection and Recognition via Video (RSDR) is a system that able to detect and recognize a road-sign on a motion video. This is due to the rapid changes of the technologies, more and more technologies recognize are able to provide high performance for people to carry their daily task. In RSDR, it is a system help the driver to recognize the shape of road-sign while the driving task is carried. Before this, most of the processing in digital image is based on still image. The limitation on still images is unable to perform effectively then motion video. Motion video can be processed directly in real-time by capturing the data to be examine, while for the still image the captured data is not in real-time thus the information cannot be delivered in short time. This RSDR will be developed according to methodology of waterfall models and it weakness is overcome by applied the incremental and iterative development process. Because with the well defined of the requirement on RSDR, the waterfall model is chooses to produce a high quality system. In case, there is some of the uncountable event occur required changes on development process the support of incremental and iterative development process can be help to overcome this problem arise. The method of template matching is used to recognize the road-sign. Before the recognition process, the detection of the road-sign on motion video is being done in Matlab by applied the Video and Image Processing techniques control by simulation process to detect an object from motion video. Only the successful of the object extracted from video frame will proceed to template matching on recognition process based on the template in the database. In conclusion, RSDR is potentially being a smart system in future for user to gather information from real-time process such as the driving task.

ABSTRAK

Road-sign Detection and Recognition via Video (RSDR) adalah satu sistem yang akan dapat mengesan dan mengenal simbol-simbol di jalan raya. Dengan teknologi yang sering berubah semakin banyak technology diperkenalkan untuk memberi kemudahan kepada manusia menjalankan tugas harian mereka. Sebelum ini, kebanyakan aplikasi dijalankan ke atas gambar digital yang statik, dengan ini ia tidak dapat beroperasi dengan lebih pantas daripada video. Video dapat menangkap gambar dalam masa nyata. Oleh itu, maklumat yang diminta dapat sampai dalam masa yang laju dalam keadaan masa nyata. Metodologi yang digunakan ialah "Waterfall" tetapi dengan kelemahanya, satu cara yang dinamakan perkembangan dan perulangan ("incremental and iterative development process") digunakan untuk mengatasi kelemahan ini. "Waterfall" dipilih adalah disebabkan dari segi maklumat, permintaan dan pencapaian bagi sistem telah jelas disenaraikan, ia tidak terlibat dalam sebarang perubahan yang mermelukan aplikasi rekaan ini balik semula ke awal aplikasi rekaan. Dalam aplikasi ini, teknik "template Matching" digunakan untuk mencari kesamaan dan keunikan bagi dua (2) gambar untuk memperkenalkan simbol-simbol di jalan raya. Sebelum melalukan aplikasi "template matching", simbol yang digunakan mestilah dapat di dalam frame yang beroperasi dengan mengunakan Matlab untuk jalankan aplikasi dalaman. Aplikasi dalaman Matlab terlibat "Video and Image Processing" dan simbol yang dapat adalah berdasarkan simulasi yang dijalankan ke setiap frame yang ditangkap. Hanya simbol yang diperkenalkan diguna dalam aplikasi "template matching". RSDR boleh katakan sebagai satu aplikasi yang dibawa kepada masa depan manusia dengan mendapatkan maklumat dalam masa nyata.

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LIST OF ABBREVIATION

RSDR	-	Road-Sign Detection and Recognition Via Video
JPJ	-	Jabatan Pengangkutan Jalan
SIFT	-	Scale Invariant Feature Transform
RGB	-	Red, Green and Blue
CPU	-	Central Processing Unit
3D	-	Three- dimensional
GUI	-	Graphic User Interface
RAM	-	Random Access Memory

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CHAPTER 1

INTRODUCTION

1.1 Introduction

A Road Sign Recognition System is a computerized system that detects and recognizes road sign from video. The road sign on the roadside is the source of information. It gives information such as right way, direction and warning of some roads which might have risky factors so that a driver can drive in more effectively. All road signs are created according to the international standard which helps prevent barrier between the different languages and symbol. For outsiders or unfamiliar drivers who depend much on the road sign, it acts as a driving assistance. Besides, it also reduces accident cases that probably occur and confusion that arises among new drivers.

Most recognition systems apply image processing technique to detect and recognize road-sign. Image processing uses any form of signal processing for which the input is an image, such as photographs or frames of video. The output of image processing can be either an image or a set of characteristics or parameters related to the image. With the image-processing techniques involve, it treating the image as a two-

dimensional signal and applying standard signal-processing techniques. Image processing usually refers to digital image processing, but optical and analog image processing are also possible to be implement.

Video is a technology that electronically captured, recorded, processed, stored, and transmitted scenes in motion. In this system the video is used for two (2) purposes; to improve the visual appearance of image to human viewer and prepare the images for measurement of the features and structures present. Human are generally better at recognize than computer, because they can detect the few critical factors that provide the identification of familiar objects. But human do not fare as well with unfamiliar object or even with unfamiliar views of common ones [1]. Hence there is a system needed to help human carry their dairy task in more efficient way.

1.2 Problems Statement

Real-time image is produce by capturing and recording on the movement of an object. Many recognition systems are applied by using the still image to identify more information. The usage of the still image is not flexible for system to detect the changes of the object in real-time. Still image is static image; it cannot be controlled by user to change the requirement or features to gain. All the information is determined by the captured image. Thus, it is difficult to extract the different information on still image due to changes on real-time environment.

The cost on the implementation for real-time system is high. This is due to the technology applied. With high mega pixels of digital camera, higher transmit rate on video frame and high processing power on system, all required a higher performance on hardware to be implement. In order to makes human life easier to carry out their dairy
task and lower cost of implementation, a universal use and good quality of product should take concern on costly implementation effect.

1.3 Objective

The objective of this Road-sign Recognition System:

i)   To identify road-sign frame on motion video.

ii) To recognize road-sign from motion video.

1.4 Scope

Scope is very important in developing process, because it is a determination on the function and specification of a system. The scope of RSDR is able to obtain salient information about surrounding when the video is running real-time.

i)   Using a clear real-time image taken from video in driving speeds below 60 km/h.

ii) Detect the difference by using shape and color between the road-sign.

iii) Apply the template matching method.

iv) A standard size (48x48 pixels) of video frame and is compared with stored sign of the same size.

v)   Runs at five (5) frames per second to interact with the control system in real time.

vi) Only recognize the video frames that's has been recorded in good weather and lighting condition in day time.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter describes on the related information regarding to the Road-Sign Recognition System via Video (RSDR). This system is divided into two (2) modules which are identify the road-sign area in the video frame taken and recognize the road-sign in motion video.

Road-signs carry much information necessary for successful driving which is describe current traffic situation, define right-to-way, prohibit or permit certain direction and warn about risky factor. Up to nowadays many algorithm for the road signs detection and classification have been introduced. Road sign is often used as convenient real-world object suitable for algorithm testing purpose. Hence review on the previous system; it would help to define a better solution on producing a more powerful of detecting and recognition system in road-sign with the more suitable of the techniques and algorithm use.

2.2 Road Sign

From the purpose on this study is the different road-sign in Malaysia and international. Road-sign contain it own standard which is based on the rule & regulation stated by different countries. Different countries has different classification rule on road-sign. To prevent from confusing and argument, there is a set of rule stated for all countries around the world to follow. The international road-sign is defined which is widely applied into most country in the world. While for Malaysia road-sign also contains some of the different, but all is based on the classification rule. Following is detail studied on the international and Malaysia road-sign.

2.2.1 International Road-Sign

Road traffic sign in different county has own type of expression. However, to overcome the barriers on the road sign all the country are express the sign based on the international signs with symbols have been developed in Europe and adopted in most parts of the world. Most countries use symbolic signs widely, but Australia and the United States are used the sign with the words expression (letters) which may cause the foreign driver confuse and unable to read the road-signs. Even if a native driver understands worded signs, simple symbols are easier and faster to recognize than words. Road signs are better with symbols to facilitate international traffic. Those not knowing common symbols should not be licensed to drive because without the knowledge on road sign it may cause the accident occurred.

The Annex 1 of the Convention on Road Signs and Signals of 8 November 1968 have divided the road sign in eight (8) categories [25]:

i)   Prohibitory or restrictive signs

ii)   Mandatory signs

iii)   Special regulation signs

iv)   Information, facilities or service signs

v)   Direction, position or indication signs

vi)   Additional panels

vii)   Priority signs

viii)   Danger warning sign

From the categories shown in above, each category is determined by own specification. Such as the danger warning signs, the shape and colors is the most unique design for people to gather the warning sign while driving. Road sign is carry much of the information assist driver to get the current traffic situation, define right way, direction and warn about the risky factors.

2.2.2 Road Sign Standard Used in Malaysia

Road signs in Malaysia are standardized road signs similar to those used in other nations but with certain distinctions. Until the early 1980s, Malaysia followed closely the Australia-Japan-Switzerland standard of road signs with diamond warning signs and circular signs as restrictive signs to maintain traffic.

Malaysia has used road signs in all express way, highway, federal road, state road and municipal roads. The language (letters) of Malaysia road sign is use the official and national language of Bahasa Malaysia. However the English is also used for important place such as tourist attraction, airports, railway station and immigration points. Different shape and color of the road sign is using in different place, and categorize in different way.

In Malaysia are using the diamond shape sign and triangle sign as danger warning sign and circular sign as restrictive signs to maintain traffic. For the danger warning sign, triangle signs with red borders, white backgrounds and black symbols. For the diamond shape signs usually black borders, yellow backgrounds and black symbols. Some warning signs also have flashing yellow lights to call for more attention.

i)   Green-sign: toll expressways or highway.

ii)   Blue-sign: federal, state and municipal roads.

iii) Letters: State roads.

The type of the road sign in Malaysia is divided into few categories there is Direction and distance signs, Border-sign, important sign, Warning sign, Construction signs, Symbols, miscellaneous. Figure 2.1 is some of the road-sign used in Malaysia.
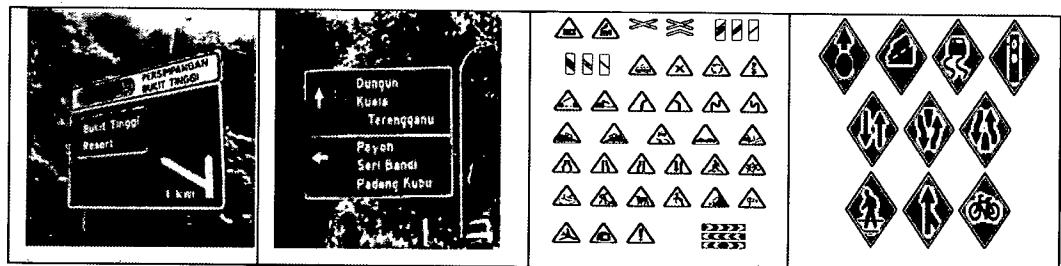

Figure 2.1: Road-Sign in Malaysia

2.3 Motion Video and Still Image

Image processing is used for two (2) purpose there us to improving the visual appearance of images to a human viewer and preparing images for measurement of the features and structures present.

For visual enhancement, many images are processed in the context of reproduction or transmission hence the human visual process and views respond is needed to know. The measurement of images generally required well defined of edges, brightness, color, texture, or some combination of these factor. These factors sometime may affect to the quality of an image be measured.

Still image is the image which is a single static image. In the still image there is limitation for people to control on the images. To process an image in order to gain more information is depend on the object captured. Choosing an object to be measure or view in more detail cannot be done by using still images, thus there is not flexible for people to analyze an image in different way compared to the video based image.

Video is a technology that electronically to captured, recorded, processed, stored and transmitted scenes in motion. For nowadays, the video camera is designed into the driver assistance system in order to provide information to driver while the driving task is on. For the video camera, it is able to get all the real-time information of the road because human do not fare as well with unfamiliar object or even with unfamiliar views of commons one. In the video is a real-time interactive computer graphics. People are able to control on what to be drawn on the display screen, and able to decide what is the object they wish to process.

2.4 Related System

Related system is the system which is similar or pervious system used as a references and guideline. Developer studied and analyze on related system to get the suitable method or techniques from existing system. From there, developer can design and plan a more high performance and quality of a system.

2.4.1 Classified Background Learning

In this system Xiao-jun Tan stated [17], using the video based real-time vehicle detection method to meet the robustness and efficiency requirement of real-world application. At the higher level, pixels of background images are classified into RGB curves. The robustness of the classification is further enhanced by using line detection and pattern connectivity.

2.4.1.1 Robustness and Performance on Video Stream

Real-time vehicle detection in a video stream relies heavy on image processing techniques, such as motion segmentation, edge detection and digital filtering. The method proposed by Xiao-jun Tan been stated [17], a video-based real-time vehicle detection method by classified background learning for real-time vehicle detection is concern to achieving of more robust and high performance. Due to the environment factors on the light effect, road condition, weather conditions and quality of the images will cause the performance on an images being

affected. Thus to get a better performance a high resolution cameras have yielded much higher performance requirements.

2.4.1.2 Identifying Moving Object

Frame-oriented and pixels-oriented method is being discussed in this system. These techniques are used to identifying moving object of background subtraction or background learning. A predefined threshold is used to judge whether there is motion in the image scene. If the diversities of the current frame and its predecessor are less then threshold, the current frame is subtracted as the background. Those methods are easy to implement and have low CPU usage.

The background of the pixel methods is obtained by calculating the average value of each pixel for a period much longer than time required for moving objects to traverse the field to view. However, this approach will fail when the environment factors on lighting conditions and movement of an object in slow or temporarily stationary background image become corrupted, thus and object detection will fails completely.

2.4.1.3 Correlation Technique

Spatio-temporal Shape and Flow Correlation for Action Recognition, Yan Ke [18] also proposed the similar method correlate spatio-temporal shapes to video clips that have been automatically segmented and it works on over segmented videos. This means the processing of an image do not require background subtraction for reliable object segmentation. And with the combination techniques of Shechtman and Irani's flow-based correlation can detect a wide range of actions in video. An important advantage stated in the discussion is no background subtraction needed and this method can process videos with limited camera motion. The combination of spatio-temporal

shapes and Shechtman and Irani's flow-based correlation technique are tends to classifier and demonstrate improved performance on a challenging event detection task and a standard video classification task.

2.4.1.4 Comment Among The Technique

While from the research done by Xiao-jun Tan [17] and Yan Ke [18], the several challenges that address to achieve the task is the motion detection and object tracking from real video data and it is also being discuss by Somboon Hongeng [19]. There are often unstable due to poor video quality, shadow, and environment factors. The interpretation of low-lever features on the appearance of object may be dependent on the view point. There is spatial-temporal variation in the execution style of the same activity by different actor, leading to a variety of temporal durations. And the similar motion pattern may be caused by different activities.

Robust and tracking of moving object from an image sequence of video is an important key to reliable activity recognition. Tracking moving object involves making hypotheses about the shapes of the object from moving region and tracked

them correctly in the presence of the features. If some knowledge about the object being tracked or about the scene is available, tracking can be simplified. Otherwise, correspondence between regions must be established based on pixel level information such as shape and texture.

2.4.2 Detection, Categorization and Recognition of Road Signs for Autonomous Navigation

In this paper Aly A. Farag and Alaa E. Abdel-Hakim [8] proposed the Bayesian approach on detecting road signs in the captures images based on their color information. At the same time Bayesian classifier categorize the detected road sign according to color content. The Scale Invariant Feature Transform (SIFT) is employed in order to extract a set of invariant features for the detected road signs labels. Recognition is done by matching the extracted features with previously stored features of standard signs.

2.4.2.1 Bayes Classification

Aly A. Farag and Alaa E. Abdel-Hakim [8] successful used the classification techniques to detect the road sign in the capture image based on image color content. The color category of the road sign is very important in the recognition process, because with the different color of content it would bring the different interpretation of information means. The Bayes classifier does not just label the captured image only, but it also categorize the label to the different category of road sign which is follows the international standard.

System for Traffic Sign Detection, Tracking, and Recognition Using Color, Shape, and Motion Information, purposed by Claus Bahlmann [9] had used the same classification approach of Bayesian generative modeling. It is making use of the tracking information, hypotheses are fused over multiple frames to provide and show high detection and recognition accuracy.

2.4.2.2 Scale Invariant Feature Transform (SIFT)

Aly A. Farag and Alaa E. Abdel-Hakim [8] stated the SIFT is used to match the detected labels with the standard road-sign. It mainly for generation of invariants features in an image for object detection, recognition and tracking application. SIFT guarantee that the key point located on the regions that has been detect and scales of high variations would make these location stable for characterizing the image.

2.4.2.3 Comment Among The Technique

Bayes Classification is used for labeling the captured image according to the color information in the image and the SIFT is used to match the detected labels. SIFT are highly distinctive, relatively easy to extract, allow for correct object identification with low probability of mismatch and are easy to match against a (large) database of local features. In addition to object recognition, it can be performed in close-to-real time, at least for small databases and on modern computer hardware [10].

Bayes classifier is the acceleration of features extraction and matching operation of the SIFT transform by shrinking the matching area to the labels only.