Color Thresholding Techniques Performance for Night Vision Surveillance Using Thermal Imaging

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Abstract- Visible surveillance is commonly an active research worldwide. The need of surveillance allows thermal imaging to participate in this study activity. The drawback of visible surveillance for night monitoring is overcome by the technology of the thermal imaging. To achieve the goal of the surveillance system , the works on detection must be very efficient to do the detection Throughout this research , we developed an algorithm involving thresholding technique for subject detection using thermal image to find the for night surveillance system.

Keywords: surveillance , thermal image , algorithm , subject detection

I. INTRODUCTION (*HEADING 1*)

Surveillance activity is done widely in various fields. With the capabilities to overcome the problem of the visible image surveillance , thermal image surveillance gain many intention around the world.

The key factor to make it effective is because they work equally well in the day and night. A regular visible camera is limited by its need for light, and night vision doesn't function during the day. The chance to see through smoke and fog also gives thermal a leg up on other surveillance techniques. Therefore, the thermal image captured from the thermal camera does see heat and does not reflected with light energy. Besides ,the images produce by thermal camera do not reflected with shadow.[1-3] This project is developed to enhance the detection of surveillance using thermal imaging for restricted area.

Several algorithms have been proposed for detecting and tracking the object.[4] Mostly designed for daytime surveillance. However ,the monitoring involved completely dark scenery need thermal visual[5].The detection for night surveillance widely done using visible camera. The proposed algorithms such as feature –based object detection[6-9], template based detection[10], inter-frame difference based detection[11]. Inter-frame difference or background elimination method for object detection had been used throughout these years. However ,these designed algorithms are having their own pro and cons depends on the condition of surveillance area. In this research we are focusing on the performance of thresholding to detect the object in thermal image for night surveillance.

Thresholding become a very famous technique used because the reason of a simple works, intuitive properties and ease of implementation. Regularly used thresholding method is local thresholding and global thresholding.[12]

II. SUBJECT DETECTION ALGORITHM

Surveillance system should be a reflection of the real world we live in .As people the world getting no secure, people are demanding for the real protection for the property and land. The thermal image surveillance system will have to raise up that the security to a higher level. Hence , this thermal imaging surveillance will provide a high sense of security. Therefore , to achieved the best performance of security , object detection is implemented. The object detection perform the task to detect the object when come across the surveillance area.

This paper aimed to detect the subject from the thermal visual. Throughout the detection , we have developed an algorithm of image processing use to detect the target subject. this method undergo the data acquisition and tracking operation. . Figure 1 shows the basic block diagram for this research. The process start with the data acquisition , followed by image processing and feature extraction.

We have developed the algorithm for subject detection .The algorithm start with the acquisition of the thermal video ,follows by the frame extraction , morphology

and edge detection operation. , after the edge detection operation , we performed thresholding technique for the detection . The following figure below shows the flow of the algorithm.

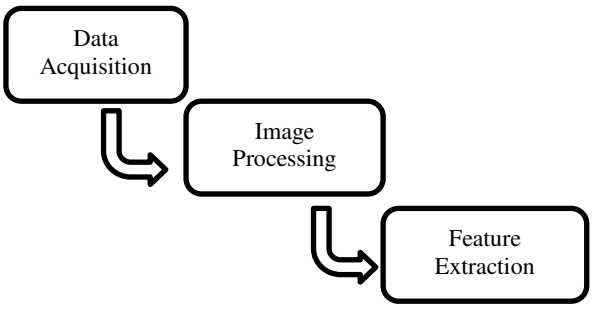

Figure 1: Block diagram of the software development

A. Data Acquisition Process

The system algorithm is going to works on the following way

i. Capturing the thermal live video through a thermal camera is to acquire the image of the object across the area to be monitored and kept under surveillance.
ii. Extracting the video into the frames .The 3 minutes video is extracted to 1024 frames to undergo the image processing stage. From this 1024 frames , we clustered these images into 3 dataset which are dataset of target subject , dataset of 1 target subject , and dataset of 2 target subjects .

The data acquisition process done using thermal camera by FLIR A615 series. This thermal camera chosen because of the specification of the resolution adequate for the research need. Data collection was done at the suitable places similar to surveillance area. The empty field area was chosen to take the thermal video . Significant to the scope of analysis for this paper which to detect the human is exist or non-exist , the data collected are the images of human in thermal images. The data collection done involved one to two target objects.

We have recorded 3.42 minutes thermal video of object motion in the outdoor security area by a FLIR A615. The video obtained is save in .avi format .The view of the video is fixed during the object motion .Repetitive activities of maximum two peoples are recorded at night. Each of the background is having the same current temperature.

The goal to achieved is to detect the object when moves in the security area. The thermal camera recorded the video in grayscale display. Figure 6 are the samples of the image of extracted frames from the recorded video.

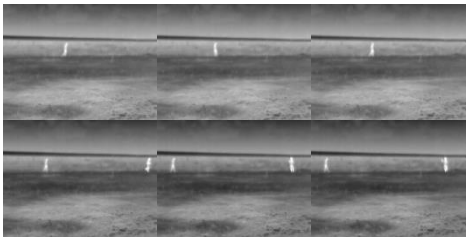

Figure 2: Samples of extracted frames from the recorded video show image with background only , images with 1 subject , and images with 2 subjects

B.Image Processing Operation

From the extracted frames , we completed the detection by using the image processing techniques. The filtering process used to have the good quality of image for the detection process

i. Morphology and Edge Detection Algorithm

Mathematical morphology is a branch of image processing that has been successfully used to provide tools for presenting , describing ,and analysing shapes in images.[12] By using the edge characteristic of the target , the identification and image analysis use the boundary information for the analysis to get better identification.[13, 14].The further steps of image processing continues with the mathematical morphology and classical edge detection. The mathematical morphology used are the dilation and erosion process applied in opening and closing operation . The size and shape of the structuring element give different results of detecting the subject. [15] .

The detection algorithm follows with the classical edge detection. The Edge detection commonly used as the basic step of image segmentation and recognition.][16] The combination of classical edge detection and mathematical morphology used to achieve the goal of identification. In this paper , the fusion method of classical edge detection and mathematical morphology detection is used to identify the existence of the target from the thermal image from the dataset obtained. Classical edge detection used are includes Prewitt , Sobel and Laplacian edge detector.

Prewitt is a good operator with the advantages for simple, fast processing speed, relatively smooth and continuous edge.[17] The Prewitt method finds edges using the Prewitt approximation to the derivative. It returns edges at those points where the gradient of I is maximum.

$$BW = edge(I,'prewitt') \quad (1)$$

While the second edge detector approached is Sobel. The Sobel method finds edges using the Sobel approximation to the derivative. It returns edges at those points where the gradient of I is maximum.

$$W = edge(I,'sobel') \quad (2)$$

And the final edge detector been used is The Laplacian of Gaussian method. This method finds edges by looking for zero crossings after filtering I with a Laplacian of Gaussian filter. [9]

$$BW = edge(I,'log') \quad (3)$$

Hence the target object had been classified either the target is exist on not exist in the scene by measurement of the existence pixel of that target object which is specifically the human. The value of the existence pixel differentiate whenever the intruder is exist or not.

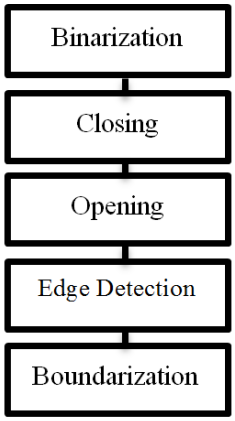

Figure 2 :Flow of morphology operation

i. Object Tracking Using Thresholding Method

Thresholding is the simple method but very useful to separate the background and the foreground. The idea of doing the thresholding operation is to select an optimal gray-level threshold value for separating objects in an image from their background based on their gray-level distribution.[18] The output from thresholding operation algorithm is a binary image whose one state will indicate the foreground objects and whose complementary state will correspond to the background. Depending on the application, the background of the image can be represented by grey-level 0, or black, and the foreground, which is 255 in 8-bit images; conversely, the foreground can be represented by black and the background by white .

Regularly , an automatic thresholding has been widely used in machine vision industry for automated visual inspection of defects [13]. . Commonly, a still of an image is used to distinguish the best foreground or object.We use the color thresholding technique do define the chosen color respect to the target color characteristic. The threshold value to detect the object is really important to make sure the object is detected unless the detection is failed.[19]

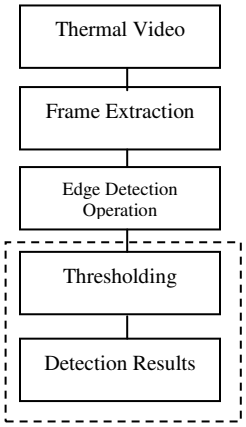

Figure 4: Detection algorithm using thresholding

III. RESULTS AND ANALYSIS OF SUBJECT DETECTION

Through this research , we have obtained two results by using two difference type of detection algorithm. This result is to perform the best detection algorithm for the night surveillance system.

We evaluate our algorithm with 2 datasets containing to observe the detection and do the analysis. The analysis is respect to value of N.N is the value of connected components exist in the image. The pixels labelled 0 are the background. The pixels labelled 1 make up one object; the pixels labelled 2 make up a second object; and so on. By evaluating the value of N through all the images in the dataset , we analyse the accuracy of the detection . Sample of the result are tabulated below. The detection results using both algorithm are describes by the accuracy table . Figure 8 show the graphical result on the detected object according to the filtering stage using morphology operation.

. The 1024 frames extracted from the thermal video were then evaluated. From the detection we obtained the result from each frame. The result show the total number object detected and tracked for each single frame. The results are used to measure the accuracy of the detection and tracking. The detection of the subject respect to the real number of the existence subject are tabulated in following table .

Figure 5: Graphical result on the subject tracking using threshold

Table 1:Thresholding detection results

Dataset	Frames Name	Real Subject Exist	Value of N
Zero Subject	Obj1	0	0
	Obj2	0	0
	Obj3	0	0
	Obj4	0	0
	Obj5	0	0
	Obj6	0	0
	Obj7	0	0
	Obj8	0	0
	Obj9	0	0
	Obj10	0	0
	. .	. .	. .
	Obj653	0	0
One Subject	Obj654	1	1
	Obj655	1	1
	Obj656	1	1
	Obj657	1	1
	Obj658	1	1
	Obj659	1	1
	Obj660	1	1
	Obj661	1	1
	Obj662	1	1
	. .	. .	. .
	Obj984	1	1
Two Subject	Obj985	2	2
	Obj986	2	2
	Obj986	2	2
	Obj987	2	2
	Obj988	2	2
	Obj989	2	2
	Obj999	2	2
	Obj1000	2	2
	Obj1001	2	2
	. .	. .	. .
	Obj1024	2	2

The detection performance is measured by percentage of the subject detected. The percentage calculation done with following formula :

$$\text{Accuracy percentage}(\%) = \frac{\text{Number of correct detection of existance subject}}{\text{Number of real subject exist}} x100 \quad (6)$$

From the results we can see that the detection is performed well where 100% of object appear in security is detected by using the detection algorithm of thresholding.

Table 2: Results of accuracy

Algorithm	Accuracy
Thresholding accuracy	100%

IV. CONCLUSIONS

This study demonstrate the performance from detection algorithm for thermal surveillance . The algorithm is using the image processing techniques from the primary step of data acquisition , follows by the morphological and edge detection operation. The final step to be evaluated is thresholding. This step done to completed the detection and tracking process. The detection performance is very good by using the thresholding technique since this technique able to extract the wanted object from the background.

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