Biologically Inspired Analysis on Thermal Image Segmentation by MATLAB

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Abstract

Examining human skin condition with thermal images offer easier finding of lesion and abnormalities concerning temperature adjustment, e.g. fever screening, superficial lesions and tumor detection. Lesions, however has can cause many consequences, whether to grow as other abnormalities such as precancerous or malignant tumors. In the development era of technologies, a technique is introduced to work with the images obtained from thermal camera. In this paper, we have experiment Indexing Analysis using MATLAB Software. This technique is used to segmenting the image into few individual numbered blocks. A study of normal breast thermal image is used in this experiment and the result is observed under RGB color mode. Skin temperature on breasts area is observed and segmentation is done to sixteen blocks of three by three matrix size. Lesion can be seen respectively to the blocks of images and focus can be concentrated to the affected area or block.

Keywords - bio-inspired learning, image segmentation, Matlab Indexing Analysis, lesion detection, thermography analysis.

1 Introduction

Some organisms like reptiles and birds are colour blind and a number of them are blind at certain times of the day. They use their other sensory systems to detect and analyse the situations surrounding them such as heat, obstruction, mate and others. Scientists revealed that chimps are about ninety-eight percent similar to human in behaviour and life. However, this experiment relates to how animal reacts with other organisms via its own thermal sensors. Snake for example; see their prey in the dark using thermal sensor. Snake has its unique feature for detecting infrared radiation, enabling them to generate a 'thermal image' of predators or prey [1-2].

Snake, has most significant brain area as compared to some mammals and birds, named as midbrain, or also known as optic lobe. This area specially is to analyses optic and auditory sense received from primary organ, or eyes, and secondary sensor system such as tongue and nasal tunnel. [**taken from NO**] Snakes detect infrared signals through a mechanism involving radiant heat of the pit organ. Thus, infrared and thermography analysis obtained from this creature, can be adapted to be utilized in the human world. Human has no specific region in the brain lobe that can independently understand infrared view. Human eyes will understand thermal image by the set of colours produce by the camera. For better understanding, colour format is set by the user that can be change from the black-and-white format to the 16-bit colour or lower. In this paper, segmentation is done for the analyzer to have better comprehension on the image. The objective of manipulating with thermal image is to detect any physiological anomaly occurring under any surfaces, and in this case, under human skin. However, different skin or body has dissimilar contour, therefore segmentation is an initial step to further analyse thermal images for human body.

2 Problem Formulation

Screening is one of the methods to check under surfaces without intrusion of any instrument directly into skin layers. These days, medical experts use Magnetic Resonance Imaging (MRI) to virtually penetrate deeply into human and animal body. Besides that, ultrasound is widely applied for its popular use to detect pregnancy. So, thermograpy is chosen to be experimented than MRI and ultrasound.

Colours are initially set to be in RGB mode to make sure that it is limited in order to compare one bit of colour to another. The limitation is to define the scale of the output thermal image.

Numbers of segments are set accordingly to the ration of height and width of the focused area, thus breast area to width of a normal healthy person is 0.75 to 1. Segments are divided to 3 by 4 matrices as the region of the breast area is used as sample for this analysis and expected to be extended for breast cancer detection.

2.1 Segmentation Phase

The system is fed with a thermal image obtained from American College of Clinical Thermology (ACCT), founded by certified thermographers and thermologists with the American Medical Thermology Society. The image is then fed to MATLAB programming that was initially developed, and the system switches the colour format into RGB before resizes it to a size compatible for twelve segments. These segments cover the area of upper torso where in most cases, cancer cell are developed at the lymph nodes in this area.

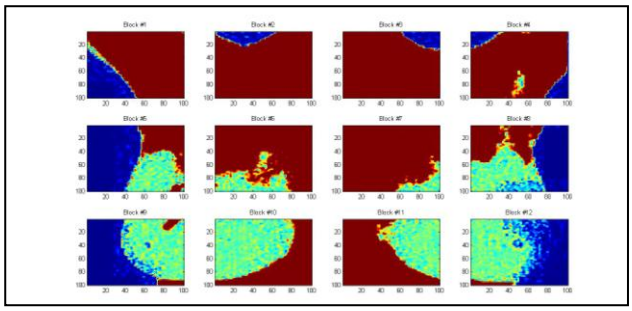

Figure 1: Segmentation of Thermal Image in RGB Mode

Analyzer can be focused to individual segment and relate to their properties. For example, the underarm region at both sides shows different output. Although some tumour can grow at underarm lymph nodes, it does not show significant symptoms of abnormalities. The cause of dissimilarities at both areas may be the reflection of thermal camera at each contour. The left breast (on the right side of reader's view) is also showing dissemination of darker blue and dissimilar to the other side, may also occurs from the reflection.

2.2 Progress of Experiment

The output image from this experiment can also be a benchmark for a normal breast study to be compared with the other studies. The individual block of the image is extracted and analyse thoroughly with the colour scale of RGB mode. This segmentation is done by Indexing Analysis, which is executed by MATLAB software and observes its output using Kohonen Network. Current stage of the progress is extracting individual blocks and classifies the scale of the colour in RGB mode.

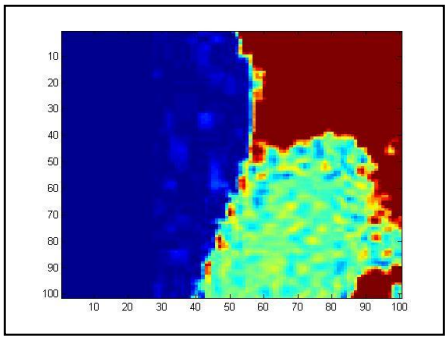

Figure 2: Single Block of Segmentation from MATLAB Execution.

A review from Medical Applications of Infrared Thermography paper shows abnormal body temperature is a natural indicator of illness. Infrared thermography (IRT) is a fast, passive, non-contact and non-invasive alternative to conventional clinical thermometers for monitoring body temperature [5]. Besides, IRT can also map body surface temperature remotely. Last five decades witnessed a steady increase in the utility of thermal imaging cameras to obtain correlations between the thermal physiology and skin temperature. IRT has been successfully used in diagnosis of breast cancer, diabetes neuropathy and peripheral vascular disorders. It has also been used to detect problems associated with gynaecology, kidney transplantation, dermatology, heart, neonatal physiology, fever screening and brain imaging. With the technology of modern infrared cameras, data acquisition and processing techniques, it is now possible to have real time thermographic images, which is likely to surge further research in this field. The present efforts are focused on automatic analysis of temperature distribution of regions of interest and their statistical analysis for detection of abnormalities [3-6].

3 Conclusion

The image is contemplated to be analysed individually using other network for automatic anomalies detection and applied to other cases with abnormalities found in the area. The other network is supposedly used to compare its colour dissemination and analyses its properties. It is the other way of checking the condition of the patient superficially for abnormalities. It applies biological behaviour of snake to see whether its prey is still alive or dead. There are a region in the brain called visual cortex that analyses colour and the properties represented by the colour.

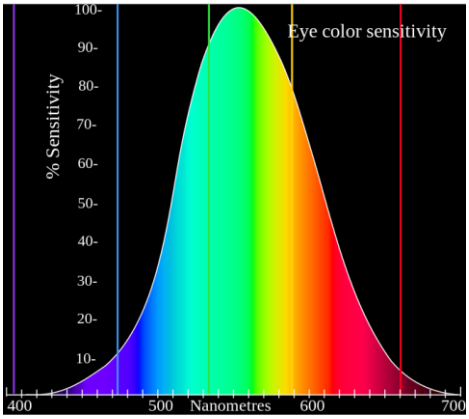

Figure 3: Brightness sensitivity relative to the wavelength read by the brain (Source: Wikipedia)

However, colours are read by the brain with wavelength. In example, red representing the heat dissipation from blood flow under the skin and the cones cell inside the human eyes stimulates wavelength is depending to the colour is lightness as shown in the graph above [7], referring to human eye sensitivity. Thus, these wavelength are expected to be calculated in the next stage of understanding each blocks using other method in Neural Network; Kohonen Self-Organising Map.

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