Leukaemia’s Cells Pattern Tracking Via Multi-phases Edge Detection Techniques

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Abstract—Edge detection involves identifying and tracing the sudden sharp discontinuities to extract meaningful information from an image. The purpose of this paper is to improve detecting the leukaemia edges in the blood cell image. Toward this end, two distinctive procedures are developed which are Ant Colony Optimization Algorithm and the gradient edge detectors (Sobel, Prewitt and Roberts). The latter involves image filtering, binarization, kernel convolution filtering and image transformation. Meanwhile, ACO involves filtering, enhancement, detection and localisation of the edges. Finally, the performance of the edge detection methods ACO, Sobel, Prewitt and Robert is compared to determine the best edge detection method. The results revealed that the Prewitt edge detection method produced an optimal performance for detecting edges of leukaemia cells with a value of 107%. Meanwhile, the ACO, Sobel and Robert yielded performance results of 76%, 102% and 93% respectively. Overall findings indicated that the gradient edge detection methods are superior to the Ant Colony Optimization method.

Index Terms—Leukemia Edge Detection; Medical Image Processing; Pattern recognition; Ant Colony Optimization.

I. INTRODUCTION

Edge detection is an essential operation in numerous fields such as medical image processing, shape recognition, defect detection on mechanical parts and various industrial and machine vision applications [1]. Edge detection is used to identify and locate the sudden significant changes and discontinuities in digital images such as photometrical images, physical geometrical characteristics, leukaemia blood cells, etc. [2,3]. Generally, edges are significant local changes or sudden discontinuities which normally occur on the boundaries of two different regions in the digital images and often carries useful physical information [4]. The edges in an image indicate higher frequency information of an object, and hence they play an important role in image processing and pattern recognition.

Apart from this, an edge is defined as a group of connected pixels lying between boundaries of two regions in an image. In binary images, edges are the black pixels with one nearest white neighbour. Image edge detection is the process of detecting and extracting edges from digital images to retrieve essential details of image analysis. Therefore, detecting edges plays a crucial role in many applications in the field of image processing, computer vision and image segmentation [5].

Due to the importance of image edge detection for analysing the sudden changes and discontinuities in an image, various researchers have implemented edge detection methods in medical image processing such as [6-10]. According to [11], edge detection process involves four primary interrelated steps which are filtering, enhancement, detection and localisation. Filtering is an essential pre-processing operation that is used to suppress reduce noises in an image [12]. Despite the importance of filtering process, selecting the appropriate filters is a crucial criterion in image processing field. Indeed, filtering may affect the strength and degrade the contents of the edges in an image. Thus, the primary concern in edge detection filed lies in the scale of the filters.

The edge detection is carried out with the strong edge contents which usually contain the information needed to describe the content of an image. Distinguishing strong edges among the weak ones is an essential criterion which determines the efficiency of the edge detection methods. For instance, thresholding can be employed for determining the true edge points in an image [13].

In fact, detecting the leukaemia in blood cells is still a major challenge and active research in medical image processing. It has become imperative to develop algorithms that can detect and trace the immature cancerous cells in the blood.

The rest of the paper is organised as follows. The related significant studies of detecting leukaemia edges are presented in Section "Related Studies". The methods employed in this study for detecting leukaemia edge detection are elaborated in Section "Methodology". The results of the of the proposed edge detection methods are demonstrated in Section "Results and Discussion", and Section "Conclusion" is dedicated to bringing about the summary of the paper.

II. RELATED WORKS

Over the past decades, medical image processing has become an essential method to interpret and visualise medical images. As a result, researchers have developed multiple powerful methods for storing, detecting, transmitting, displaying and analysing medical images. However, the most challenging aspect of medical imaging lies in the development of an optimal algorithm that can detect cancerous cells with better accuracy and efficiency [14].

Leukaemia is a type of cancer disorder which affects the White Blood Cells (WBCs), whereby immature and abnormal WBCs are produced vigorously by the bone marrow into the bloodstream [15]. The current methods to diagnose leukaemia are carried out by trained specialists in expensive laboratories. However, this procedure to determine leukaemia is not sufficient due to the imitation of similar signs and the complex nature of blood images [16]. The acute leukaemia