# COUNTING CELL IN BEE COMB USING COMPUTERIZED 2-DIMENSIONAL SHAPE-DETECTION

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DECEMBER 2010

Date : 31 December 2010

Project File No. : 600-IRDC/ST/DANA 5/3/Dst (89/2008)

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Dear Professor,

**FINAL RESEARCH REPORT ON "COUNTING CELL IN BEE COMB USING COMPUTERIZED 2-DIMENSIONAL SHAPE-DETECTION"**

With reference to the above matter, I am pleased to submit six copies (2 for RMI Shah Alam and 3 for RMU UiTM Sarawak) and a softcopy of the final research report entitled "Counting Cell in Bee Comb Using Computerized 2-Dimensional Shape-Detection" by the research team from UiTM Sarawak.

Thank you.

Yours sincerely,

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Leader

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# ABSTRACT

In the apiary industry, bee colony has to be at optimum health in order to produce most favourable amount of honey or to act as pollination agents for crop plantations. Current methods in the evaluation of bee colony health through trained personnel visual judgement and estimation and manual counting using wire grid as guidance are time consuming and the accuracy is individual dependant. This research explored the use of image processing methods to improve the existing methods. In the field of image processing, Hough transform is a common techniques used for the detection of lines and circles. Although the cells in bee comb were in hexagonal shape, the spaces in the cells were observed to be circular that made it possible for the application of circular Hough transformation. In addition, the cells had the attributes of no overlapping on each other, making the cells clearly visible. A prototype for cell detection algorithm using circular Hough Transformation detecting the number of cells in bee comb from a digital image was developed. The accuracy of the result obtained which was based on the number of the cells counted from the prototype compared to the manual counting showed an average cell detection rate of 79.2%. The minimum detection rate was 74% while the maximum detection rate was 84%. The difference in the output of cell counting through circular Hough Transformation and manual count was caused by detection errors. Detection errors were divided into two types: false acceptance and false rejection. False acceptance referred to the error of counting non-cell while false rejection referred to the error of undetected cell. The developed prototype also implemented a classification module to classify the detected cells into three categories namely the brood area cells, honey cells and empty cells. The effectiveness of the implemented classification method was verified by an extensive set of 6435 cells from sampled bee combs. The result shows that the method implemented is fast while the classification accuracy is satisfactory.

# CHAPTER 1 INTRODUCTION

## 1.1 Introduction

Computer vision is a scientific field that creates a simulation model to retrieve information from images. Image processing is a related field to computer vision which normally involves two-dimensional images as detection based on relative of interesting image data which can be further analyzed by more computationally demanding techniques to produce a correct interpretation. Identifying two-dimensional shapes from images such as photograph has been a classical problem in computer vision [1]. Many applications could be developed using a two-dimension shape identification solution. Some of the applications that have benefited from shape identification are like vehicles detection from aerial images and also human facial recognition such as smile detection features that are available in some of the digital camera today.

Even though researchers have carried out many studies, it is difficult to have one model that would work for all applications. Many models have been introduced to optimise the result of the shape detection but many models only work on a certain circumstances. For instance, [2] create shape detection using images pattern spectrum while [1] adopted edge-based shape detection in their research accordingly.

The comb of honeybees consists of hexagonal wax cells harbouring the younger generations of the bee hierarchy and functioning as stores of honey and pollen. Therefore, it is reasonable to exploit the most effective shape detection method that could be applied on the application in detecting the bee's cell on bees' hive. In this research, the various commonly used methods on shape detection will be experimented to identify the most suitable method to perform bee's cell detection.