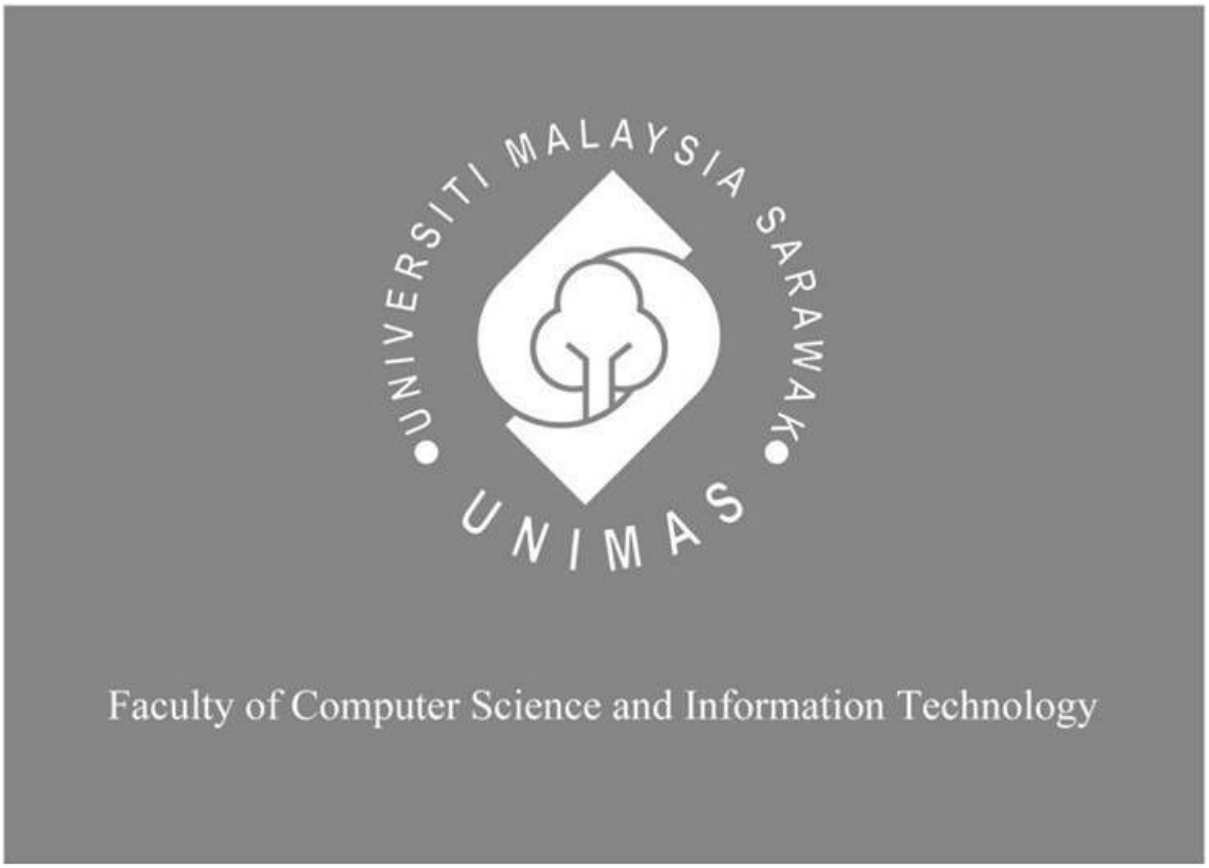

IMAGE PROCESSING BASED MOBILE ANTIBIOTICS SENSITIVITY TEST (MAST) APPLICATION

Sharifah Nurhidayah Binti Syed Mostamam

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Bachelor of Computer Science with Honours

(Software Engineering)

2019

IMAGE PROCESSING BASED MOBILE ANTIBIOTICS SENSITIVITY TEST (MAST) APPLICATION

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This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science with Honours
(Software Engineering)

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK
2020

UNIVERSITI MALAYSIA SARAWAK

THESIS STATUS ENDORSEMENT FORM

TITLE IMAGE PROCESSING BASED MOBILE ANTIBIOTICS SENSITIVITY TEST (MAST) APPLICATION

ACADEMIC SESSION: 2019/2020

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ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to everyone who have contributed directly or indirectly toward the success of this final year project. Firstly, I would like to appreciate the Faculty of Computer Science and Information Technology (FCSIT), Universiti Malaysia Sarawak (UNIMAS) for providing me the opportunity to apply my knowledge learnt in the past three and half years into this final year project. I am grateful to my supervisor, Dr. Jacey Minoi and as well as the final year project coordinator, Professor Dr. Wang Yin Chai for their advice and guidance through out to complete this final year project. This gratitude also goes to all lecturers of FCSIT for providing their knowledge and experiences in this three and half years that benefit me so much and helping me to finish this final year project. I would like to expression my heartfelt thanks to my beloved family for providing the love, encouragement, financial support without which this final year project could not have been completed. Finally, I also appreciate the moral support and ideas from my friends and course mates toward the success of this final year project.

ABSTRACT

In Antibiotic Sensitivity test (Kirby-Bauer test), bacteria applied on a Petri dish is subjected to various antibiotics. The inhibition zone is a circular area around the spot of antibiotic in which the bacteria is not encroaching into the region. Clinicians have to measure the radius of inhibition zone manually and they have numerous of sample to deal with everyday which can prompt to error. The process of measuring the radius of the antibiotic can be automated using image processing-based algorithm. In this work, an algorithm will be developed using open source library (OpenCV library) which will investigate image processing and circle detection.

ABSTRAK

Dalam ujian Kepekaan Antibiotik (ujian Kirby-Bauer), bakteria yang digunakan pada piring Petri tertakluk kepada pelbagai antibiotik. Zon inhibisi adalah kawasan bulat di sekeliling tempat antibiotik di mana bakterianya tidak menceroboh kawasan tersebut. Pakar perubatan harus mengukur jejari zon inhibisi secara manual dan mereka mempunyai bilangan sampel yang banyak dimana boleh menyumbang kepada kesalahan. Proses mengukur jejari antibiotik boleh diautomatikkan menggunakan algoritma berasaskan pemprosesan imej. Dalam karya ini, algoritma akan dibangunkan menggunakan ‘open source library’ (OpenCV library) untuk menyiasat imej pemprosesan dan pengesanan bulatan.

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1 INTRODUCTION

1.1 Introduction and Background

Antibiotic sensitivity Test is a test to determine the sensitivity of bacteria to an antibiotic. The growth of the bacteria is usually slowed down when they are under the influence of an antibiotic. However, many bacteria would develop new mechanisms of resistance against few antibiotics. Therefore, a test called antibiotic sensitivity test or Kirby-Bauer test is performed to ensure the antibiotic is fit to treat a patient (Hudzicki, 2016).

At the moment, the test is done manually by the clinicians. The clinicians must look at it which consume more time. This test is used by the clinicians to study the effectiveness of antibiotic in treating a certain bacterium because the bacteria is influence by antibiotic.

A small part of sample usually collected from any patient who have been infected are applied on a Petri dish. A few different antibiotics applied on different places then it is placed in agar. The antibiotic diffuses into agar.

Assuming the antibiotic is said to be effective against the bacteria if the bacteria is not encroaching into the antibiotic's region. The region with no bacterial growth is distinctly different in colour compared to other regions where the bacteria are growing. The test is done as shown in Figure 1.1.

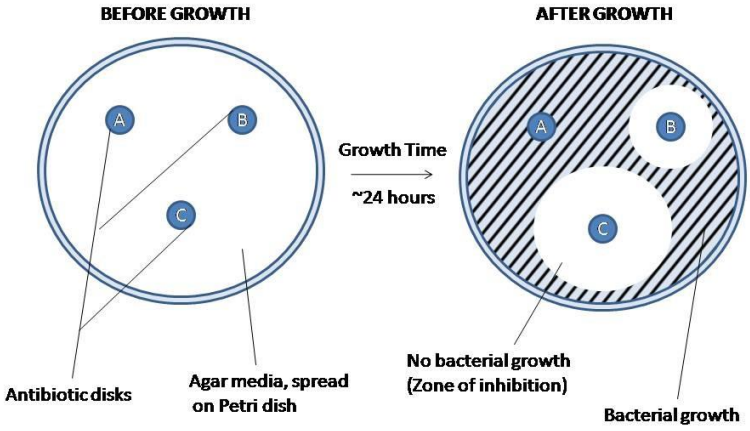

Figure 1:1: Antibiotic Sensitivity Test (Hudzicki, 2016).

Thus, this project is the presentation of an effective automating process to look, recognise, measure the radius and measure the sensitivity of the antibiotic reacts to any given bacteria. It is automated by identify an algorithm to detect the region of antibiotic and measure the size of the radius. This project will give the measurement of the antibiotics automate by creating the algorithm, the process is by using the mobile phone and install the created algorithm and image processing-based algorithm to take the acquire picture of Petri dish. A program based on an open source library which investigates image processing and circle detection developed to accomplish the aim of this project.

1.2 Problem statement

Clinicians measured the radius of the antibiotics on a Petri dish manually by using physical ruler. This method prompted into a lot of errors such as parallax errors and human errors. It also takes considerable effort and time to measure every value since it is done every single day in the hospital.

1.3 Objectives

The main objectives of the Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application are:

1. To detect and measure the radius of the antibiotics on a Petri dish.
2. To investigate and measure the sensitivity of the antibiotic by using the radius markers.
3. To develop the image processing algorithm to measure the radius markers.
4. To verify the result of the sensitivity by the manual approach.

1.4 Scope

Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application is limited to Android mobile application to allow flexibility and mobility to the system. The target user of this mobile based application is clinicians. The main focus will be on image processing based. Therefore, the scope of this project involves converting captured images and apply different image processing techniques to analyse the image better which can then be used in detecting circle and limited to a controlled environment(such as proper lighting, reflection, distance and image quality) to avoid as much acquisition variation.

1.5 Significance of project

This project is important in helping the clinicians to get the exact radius of the antibiotics. Through image processing based mobile antibiotics sensitivity test application, it can avoid a lot of error such as parallax errors and human errors face by using the manual method. Furthermore, this system also reduces the amount of work required from the expertise to measure the radius of the antibiotic. It gives the measurement instantly.

1.6 Methodology

The chosen methodology to develop the prototype of Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application is Agile Software Development

Methodology as this method is the most suitable to implement in shorter time. It consists of 6 phases in the System Development Life Cycle (SDLC) as shown in Figure 1.2 which are:

Planning: Objective and goal of the project is being defined as well as the schedule of the project being created to document it. It also allows the developer to define the business opportunity as well as determine the feasibility for the project as there are several issues need to be considered to complete the project.

System Analysis & Requirement: Analysis the problem in develops system and set the requirements needed to achieve the goal in the system. Problem statement and information will be collected to analyze the system. The analyst will try to analyse details of the organization procedure and information system that have been used to execute every task in organization.

Design: Plan design interface system. Design system follower requirement. All the design will be implemented with taking consideration of the successful rate on the system and to make sure that it is implemented within the timeframe. During this phase, it will also try to explain how the system works from start to end on paper. A research will be conducted to solve a problem if occurred. This execution will execute by using C language and OpenCV libraries for image processing

Implementation: When the design is fully completed, an implementation of that design is made by programmer. The system design will be written into real coding which is realized as a set of programs.

Testing and Integration: Find error occurs in the prototype. That will be manual of the measurement to compare with the result obtained.

Maintenance: In this project, there is no maintenance would be done.

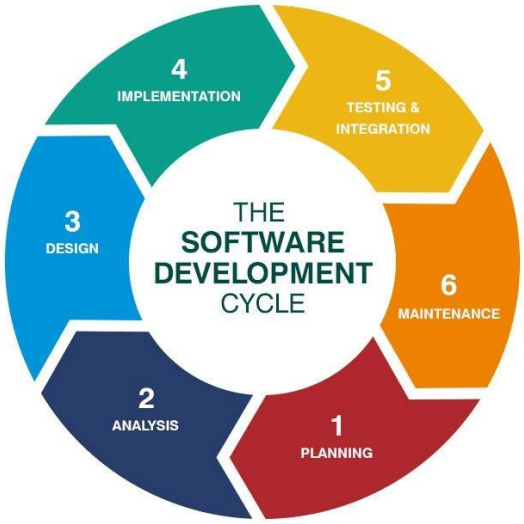

Figure 1:2: Agile Software Development Cycle

1.7 Project schedule

The project schedule is used as a guidance for develops to ensure the project is completed within the time frame. Gantt chart is created to describe the time schedule and to signify the milestones of the project. FYP 1 started from 16th September 2019 and final report submission will be on 12nd December 2019. Refer to appendix 1 for a detailed Gantt chart.

Task	Duration (days)	Start	Finish	Expected outcome
Planning Phase				

Identify problem	2	16/9/2019	17/9/2019	Problem has been identified.
Project objective	2	18/9/2019	20/9/2019	Project objectives have been identified.
Prepare proposal	26	21/9/2019	25/10/2019	Brief proposal has been done.
Documentation for planning phase	1	26/10/2019	27/10/2019	Information related to the topic has been collected.
Analysis Phase				
Prepare literature review	5	28/10/2019	1/11/2019	Search for related techniques.
Gather user requirements	3	3/11/2019	5/11/2019	Information related to the topic has been collected.
Analyse user requirements	11	6/11/2019	15/11/2019	Information related to the topic has been analysed.
Documentation for analysis phase	1	16/11/2019	15/11/2019	Compile and write report for analysis phase.
Design Phase				
Determine methodology	5	11/11/2019	15/11/2019	Methodology has been determined.

Requirement Elicitation and Analysis	3	16/11/2019	18/11/2019	Information related to the topic has been collected.
Basic design system	16	19/11/2019	4/12/2019	Design flowchart and system.
Documentation for design phase	1	5/12/2019	6/12/2019	Compile and write report for design phase.
Implementation Phase				
Develop user interface	30	20/1/2020	17/2/2020	Implement design system.
Develop image processing features	34	18/2/2020	22/3/2020	Implement image processing algorithm.
Documentation for implementation phase	1	23/3/2020	24/3/2020	Compile and write report for implementation phase.
Testing and Integration Phase				
Find error and compare result	14	24/3/2020	5/3/2020	Run testing
Documentation for testing phase	1	6/4/2020	14/4/202	Compile and write report for testing phase.
Final Report and Assessment Paper	1	15/4/2020	16/4/2020	Compile and write report for design phase.

Table 1: Project schedule table

1.8 Expected outcome

The expected outcome of the project is a working prototype of the proposed system which is Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application. This system will be accessible in mobile application platform that are capable to perform image recognition to detect and measure the radius of the antibiotics on Petri dishes based on image processing techniques. This process is known as antibiotics sensitivity test. The results of the antibiotic sensitivity test will be tested against the manual results by clinicians.

1.9 Outline of the Project Report

There have five chapters within the final year report. The report will include the details about the how the prototype will develop. Below is the summary of the five chapters for required for final year report.

Chapter 1.0: Introduction. This chapter describes the overview and introduction of Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application briefly. Besides that, the details of the proposed system within this chapter includes the following: problem statements, objective, methodology, project scope, significance of project, project schedule, expected outcome and outline of project report.

Chapter 2.0: Literature Review This chapter review various literature sources regarding the existing system compared to the Image Processing Based Mobile Antibiotics Sensitivity Test (MAST) Application. Comparing will be carrying out between the proposed systems with the other similar system. Moreover, comparison also includes technology, techniques, skills and software used in the project development.

Chapter 3.0: Requirement Analysis and Design This chapter will be consisting the requirement details such as user's requirement, software and hardware requirement for the proposed system. Besides that, step to obtain the requirement and design of the system such as programming codes, interface design and features will be included in this chapter. The requirements of the software and various design method also include in this chapter to understand and develop the proposed system.

Chapter 4.0: Implementation and Testing This chapter will be consisting on how the implementation of the algorithm was carried out and the problems faces during the process developing the system. The functionality of the proposed system, example of the data input and output of the system will be show out. Besides that, various testing techniques and analyzed of the system will carry out to ensure there are no errors occurred during the implementation. All the result and feedback according to the proposed system will record chapter.

Chapter 5.0: Conclusion and Future Work This chapter will provide the strengths and weaknesses of the system by determine whether all the objective and project scopes have been achieved based on the end-result of the proposed system.

2 LITERATURE REVIEW

2.1 Introduction

Mobile applications have grown tremendously and with the advancement of the mobile data enabled smartphones, more and more applications focusing on Android, iOS and others have emerged. Due to its mobility and improvement in its functionality, these mobile applications are going to keep on growing. Thus, the system is proposed with the idea of helping the clinicians to measure the zones of inhibition without required excessive amount of time and skill.

The use of automatic methods of analysis has made significant contributions to microbiology. Numerous methods and systems have been proposed for removing the manual control and excessive time consumption involved in microbiological techniques. One of the standard diagnostic method used by hospitals and laboratories is Antibiotic Sensitivity Test (Kirby-Bauer Test). The effectiveness and concentration are measured by the diameter of the zones of inhibition seen around the antibiotics. This system can detect and measure the radius of the zones of inhibition which grow around antibiotic in the Petri dish.

This chapter will review a lot of literatures that cover everything under the project. It is organized into the following sections.

Section 1 of this chapter will review the two research papers of the similar system. It will discuss all the image processing techniques currently used by the researchers and industry.

Section 2 of this chapter will discuss regarding the background study of the image processing techniques that can be used in order to achieve the goals of this project.

2.2 Reviews on Similar Existing System

Angling Zainuddin et al. (Zainuddin, 2017) introduced an antimicrobial effectiveness measurement system using circular Hough transformation method. An antimicrobial effectiveness was measured based on the diameter alteration of inhibition zone which formed by an antimicrobial in agar subtract. In this research, various methods have been used. In pre-processing the acquired image, the author used thresholding method to separate zone of inhibition zone as foreground from the background through RGB values. As for circle detection, Hough transform was used to detect the circle shape in an image. In this study, diameter zone of inhibition was unknown. Therefore, to determine the radius of each circle in the image, the Hough transform for a range of radiuses was computed. Then, it determined the radius corresponding to the maximum intersect at each pixel. In other case where radius is known, the coordinates of the center can be find through Equation 2.1

$$y = b + R\sin(\theta)$$

$$x = a + R\sin(\theta)$$

Equation 2:1: Coordinate of the center

where x and y are coordinates of the center and a and b are the coordinates of the edges whereas R is the radius. According to the author, the background color and range between camera and object affected measurement accuracy. The average measurement error of inhibition zone obtained from the antimicrobial object 1.05% and 1.09% at camera-object distance 12.2cm and 17.2cm respectively. Figure 2.1 shows the setup of how the system is carried out.