# EXPERT DECISION SUPPORT SYSTEM (EDSS) FOR DOCTOR SELECTION AT EMERGENCY DEPARTMENT USING CASE-BASED REASONING TECHNIQUE

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***BORANG PENGESAHAN STATUS TESIS***

JUDUL: EXPERT DECISION SUPPORT SYSTEM (EDSS) FOR DOCTOR SELECTION AT EMERGENCY DEPARTMENT USING CASE-BASED REASONING TECHNIQUE

SESI PENGAJIAN: 2014/2015

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## STUDENT'S DECLARATION

I hereby declare that this project entitled "Expert Decision Support System (EDSS) for Doctor Selection at Emergency Department Using Case-Based Reasoning Technique" is the result of my own research and effort except as cited in the reference. The technical report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## SUPERVISOR'S DECLARATION

I hereby declare that I have read this technical report and in my opinion this report is sufficient enough in terms of scope and quality for the award of the degree of **Bachelor of Computer Science (Software Engineering).**

Signature : .....

Name : ASSOCIATE PROFESSOR DR. NORAZIAH BINTI AHMAD

Date : 29th DECEMBER 2014

# DEDICATION

*Especially for my loving parents, Dad* ***Mr. Sue Loh Cheng*** *and Mom* ***Mrs. Lim Ooi Kam*** *who always being supportive and understanding. Thanks for guiding me to this path.*

*Not forgetting, my project leader yet supervisor,* ***Assoc. Prof. Dr. Noraziah Bt Ahmad,*** *who guided me and motivated me a lot throughout the project development. Besides, my project teammates,* ***Vilzen Low*** *and* ***Khalisah****.*

*Also special thanks to all my lovely friends for their help and understanding throughout the project development...* ***Benjamin, Henry, Yu Xun, Lai, Joee, Maggie, Yi Wen, Vilzen, and AIESECer, and etc...*** *It was my pleasure to meet you all. I won't forget you all instead!*

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Thank you very much.

# ABSTRACT

In real world, emergency always happen and it always needed an immediate action to solve it as patient's treatment duration is very crucial. Besides, there is no expert system to decide which doctor has to handle which emergency case based on expertise and resource allocation. In this project, "Expert Decision Support System" is to come out with the fast decision as it will be implemented to an emergency department and it needs a quick decision. The objective of this project is to design and develop an expert decision support system that able to decide which doctor to be assigned to which case based on type of emergency, prioritize which case should handle first based on stage of emergency. In this project, the proposed method that will be implemented is Case-Based Reasoning (CBR) technique in doctor selection process. By the end of this project, this system will be implemented in emergency department in order to come out with a support decision for doctor selection in each emergency case. This system is designed specifically for medical staff in emergency department.

# ABSTRAK

Dalam realiti, kecemasan sentiasa berlaku dan ia sentiasa memerlukan satu tindakan segera untuk menyelesaikannya disebabkan tempoh rawatan pesakit adalah sangat penting. Selain itu, ia tidak ada sistem pakar dalam pasaran untuk membuat keputusan bahawa doktor siapa untuk menangani kes kecemasan yang berasaskan kepakaran dan peruntukan sumber. Dalam projek ini, "Sistem Sokongan Keputusan Pakar" adalah untuk mengeluarkan keputusan yang cepat kerana ia akan dilaksanakan untuk jabatan kecemasan dan ia memerlukan keputusan yang cepat. Objektif projek ini adalah untuk mereka bentuk dan membangunkan sistem sokongan keputusan pakar yang dapat membuat keputusan bahawa doctor siapa yang akan ditugaskan kepada kes yang berdasarkan jenis kecemasan, keutamaan yang harus mengendalikan kes pertama berdasarkan tahap kecemasan. Dalam projek ini, kaedah yang dicadangkan yang akan dilaksanakan adalah teknik Taakulan Berasaskan Kes (CBR) dalam proses pemilihan doktor. Pada akhir projek ini, sistem ini akan dilaksanakan di jabatan kecemasan untuk mengeluarkan keputusan sokongan untuk pilihan doktor dalam setiap kes kecemasan. Sistem ini direka khusus untuk kakitangan
perubatan di Jabatan Kecemasan.

# TABLE OF CONTENTS


| | Page |
|---|---|
| **THESIS DECLARATION** | i |
| **BORANG PENGESAHAN STATUS TESIS** | i |
| **STUDENT'S DECLARATION** | ii |
| **SUPERVISOR'S DECLARATION** | iii |
| **DEDICATION** | iv |
| **ACKNOWLEDGEMENTS** | v |
| **ABSTRACT** | vi |
| **ABSTRAK** | vii |
| **TABLE OF CONTENTS** | viii |
| **LIST OF TABLES** | xi |
| **LIST OF FIGURES** | xii |
| **LIST OF ABBREVIATIONS** | xiv |
| **PART 1 INTRODUCTION** | 1 |
| 1.1 Project Purpose | 2 |
| 1.1.1 Problem Statement | 2 |
| 1.1.2 Motivations and Objectives | 3 |
| 1.1.2.1 Motivations | 3 |
| 1.1.2.2 Objectives | 3 |
| 1.2 Review of Previous Research and Relationship to Current Project | 4 |
| 1.2.1 Information Visualization to Support Management Decisions | 4 |
| 1.2.2 A Decision Support System for Supplier Selection Process | 5 |
| 1.2.3 A Decision Support System for Surgery Sequencing at UZ Leuven's Day-Care Department | 6 |
| 1.3 Explain the Current System and Its Limitation | 7 |
| 1.3.1 Comparison Table | 8 |
| 1.4 Explanations of Terminology | 9 |

1.4.1 Emergency Medical Communication Response (EMCR) 9
1.4.2 Expert Decision Support System for Doctor Selection 9
1.5 Project Scope 10
1.6 Outline of Material 11

**PART 2 REPORT BODY** 12

2.1 User Requirement 12
2.2 Design Description 13
2.2.1 Waterfall Model 13
2.2.1.1 Planning 15
2.2.1.2 Analysis 15
2.2.1.3 Design 15
2.2.1.4 Development 16
2.2.1.5 Maintenance 16
2.2.2 Context Diagram 17
2.2.3 Flow Chart 19
2.2.4 Use Case Diagram 20
2.2.5 Data Flow Diagrams 21
2.2.6 Entity-Relationship Diagram 25
2.2.7 Data Dictionary 26

2.3 Methods and Materials Used 28
2.3.1 Methods Used 28
2.3.1.1 Temporal Database 28
2.3.1.2 Case-Based Reasoning (CBR) 28
2.3.1.3 Artificial Intelligence (AI) Based Models 31
2.3.2 Materials Used 32
2.3.2.1 Hardware Specification 32
2.3.2.2 Software Specification 33

2.4 Technical Result 34
2.4.1 Development of Interface 34
2.4.2 Development of Database 38
2.4.3 Function of Prioritize Emergency Case 40
2.4.4 Function of Case-based Reasoning Technique 41
2.4.5 Data Models 45

2.5 Testing Plan and Result 46
2.5.1 Testing Plan 46
2.5.2 Expected Result 47
2.5.3 Actual Result 48
2.5.4 Discussion 50

**PART 3 CONCLUSION** 51

3.1 Conclusion 51
3.2 Future Work 53

**REFERENCES**

**APPENDIX**

# LIST OF TABLES


| Table No. | Table Name | Page |
|---|---|---|
| 1.3.1 | Comparisons Between the Existing Systems | 8 |
| 2.2.1 | EDSS Data Dictionary | 26 |
| 2.2.1.1 | EDSS Data for DOCTOR | 26 |
| 2.2.1.2 | EDSS Data for EMERGENCY | 26 |
| 2.2.1.3 | EDSS Data for PATIENT | 27 |
| 2.2.1.4 | EDSS Data for SCHEDULE | 28 |
| 2.3.1 | The Hardware Specification Table | 33 |
| 2.3.2 | The Software Specification Table | 34 |
| 2.5.1 | Draft for Acceptance Test in Pekan Hospital | 47 |

# LIST OF FIGURES


| Figure No. | Figure Name | Page |
|---|---|---|
| 2.2.1 | Waterfall Model | 14 |
| 2.2.2 | System Overview | 17 |
| 2.2.3 | Expert Decision Support System (EDSS) Context Diagram | 18 |
| 2.2.4 | Expert Decision Support System (EDSS) Flow Chart | 19 |
| 2.2.5 | Expert Decision Support System (EDSS) Use Case Diagram | 20 |
| 2.2.6 | EDSS Data Flow Diagram Level 0 | 22 |
| 2.2.7 | EDSS Data Flow Diagram Level 1.0 (Process 13) | 23 |
| 2.2.8 | EDSS Data Flow Diagram Level 2.0 (Process 13.2) | 24 |
| 2.2.9 | EDSS Entity-Relation Diagram | 25 |
| 2.3.1 | Case's Components – Relation between SP & SL | 30 |
| 2.3.2 | Local Similarity Formula | 31 |
| 2.3.3 | Global Similarity Formula | 32 |
| 2.4.1 | Start Page for NetBeans IDE 7.4 | 36 |
| 2.4.2 | Open Existing Project | 37 |
| 2.4.3 | Open Existing Project (cont.) | 37 |
| 2.4.4 | Main class for EDSS | 38 |
| 2.4.5 | Data source for EDSS | 38 |
| 2.4.6 | Add Jar File to Project Library | 39 |
| 2.4.7 | Add Jar File to Project Library (cont.) | 40 |
| 2.4.8 | Add JCBC driver to Project Library | 40 |
| 2.4.9 | Prioritize Emergency Case | 41 |
| 2.4.10 | Prioritize Emergency Case (cont.) | 42 |
| 2.4.11 | Case-Based Reasoning Technique | 43 |
| 2.4.12 | Case-Based Reasoning Technique (cont.) | 44 |
| 2.4.13 | Case-Based Reasoning Technique (cont.) | 45 |
| 2.4.14 | Data Model for 'DOCTOR' table | 46 |
| 2.4.15 | Data Model for 'EMERGENCY' table | 46 |
| 2.4.16 | Data Model for 'PATIENT' table | 46 |
| 2.5.1 | Actual Result | 49 |
| 2.5.2 | Actual Result (cont.) | 50 |

# LIST OF ABBREVIATIONS

| | |
|---|---|
| AI | Artificial Intelligence |
| CBR | Case-Based Reasoning |
| CD | Compact Disc |
| DB | Database |
| DFD | Data Flow Diagram |
| EDSS | Expert Decision Support System |
| EMCR | Emergency Medical Communication Response |
| ICU | Intensive Care Unit |
| IDE | Integrated Development Environment |
| MS | Microsoft |
| SL | Solution |
| SP | Specification |

# Part 1

# INTRODUCTION

This part is briefly discussed about the overview of the project. Basically, there are seven (7) sub sections for this technical report. The first section is the brief introduction, where briefly describe the project. The second section is the project review where discuss about the previous research and the relationship to the current project and further discuss about the system and its limitations in third section. Furthermore, the fourth section is the explanation of terminology and defines the scope of the project and its limitation of the study in fifth section. Lastly, the last section will briefly describe the whole technical report based on the sequences of each part of this technical report.

## 1.0 Introduction

Intelligence is the ability of think and understand instead of doing things by instinct or automatically. Artificial intelligence refers to the computer science principal that develops machine and software with human-like intelligence [1].

In artificial intelligence, an expert system is a computer system that can undergoes decision making process as a human expert with particular knowledge. Expert systems are designed to solve complex problems based on the reasoning regarding knowledge. Besides, it can speed the decision making process as all the knowledge being programmed, and the expert system will be able to give the output of decision based on knowledge.

In this project, "Expert Decision Support System" is to come out the fast decision as it will be implemented to an emergency department and it needed a quick decision once it needed decision making.

## 1.1 Project Purpose

This section is to clarify the purpose of this project with the three sub-sections: 1.1.1 Problem Statement, 1.1.2 Motivations and Objectives.

### 1.1.1 Problem Statement

In real world, emergency always happen and it always needed an immediate action to solve it as patient's treatment duration is very crucial. In this case, there is always some reason to cause the duration of patient waiting for treatment longer; the common reason is human being. Undeniable, human always cause problem, and always have different type of personality, office conflicts and so on. During emergency, the time consume is very critical and huge when the information flow and standard procedure by nurse. The most crucial part is no unit being informed before a complete form is filled.

Besides, there is no expert system to decide which doctor has to handle which emergency case based on expertise and resource allocation. To further explain this point will be usually a doctor won't be assigned to any cases, it will depends on which doctor is available; but, most of the time a doctor with different expertise will be assigned to a different emergency case to handle.

Lastly, based on understanding of research, there is no integration between units such as pharmacy has no interaction with registration and so on. All units have to wait to be informed by the nurse when it is needed during emergency. With this point, another part that will consume a lot of time where the unit itself cannot have any early preparation and have to wait until patient being deliver the unit only will start the procedure to give treatment to patient.

### 1.1.2 Motivations and Objectives

#### 1.1.2.1 Motivations

Several motivations that are indirectly related to the project are defined as follows:

i. To be able to shorten the time taken for information flow between units.

ii. To be able to inform every unit to have well preparation with basic information filled even before the patient arrive hospital.

#### 1.1.2.2 Objectives

Several objectives of the project are defined as follows:

i. To design and develop Expert Decision Support System (EDSS) that able to decide which expert doctor(s) will be assigned for each case based on the type of emergency.

ii. To prioritize which case should handle first based on stage of emergency and schedule of doctor availability.

iii. To implement the Case-Based Reasoning (CBR) technique for the selection of doctor at emergency department.

## 1.2 Review of Previous Research and Relationship to Current Project

In this sub section, we will briefly discuss about the entire process how this project came into concept and ideas. Besides, we will discuss the conclusion of each literature review and also the relationship to the current project.

### 1.2.1 Information Visualization to Support Management Decisions

In this literature review, it does not have any system and constructive evidence that can direct contribute how this entire system works. But, the main contribution of this literature is to discuss how importance of information visualization support the decision making process.

In short, this literature review strongly shows that three main functions of information visualization: (i) Communication, (ii) Knowledge Management, and (iii) decision support. A significant role of visualization is the **Communication** of information [4]. By visualization, information is able to transfer in the way of more understandable and easily accessible. Besides, in term of knowledge basis, visualization played an important role for **knowledge management** to be success or not. Due to different knowledge level and cultural background, different people might have different interpretation of information based on what they heard. With Visualization, it works as a catalyst and checkpoint to ensure the same information being transferred from 'sender' to 'receiver'. Visualization can act as a 'vehicle of thought' to assists people in **decision making support**. The basic idea here is that visualization provides an information which is easily imagine and understandable to be transform into simple knowledge where it can further support in decision making.

Through this literature review, the proposed system is required a better understanding of information as emergency is not allowed any extra buffer time and also the information has to be always correct and concise. Just for an example to be more easily understand, a picture is captured and sent back to ICU system, the doctor can easily understand how is the condition of the patient and where is the part of body is

injured instead of only few verbal information that stated where is the roughly part injured and it is always some misinterpretation between both parties.

### 1.2.2 A Decision Support System for Supplier Selection Process

In the process of selecting a supplier in this technological innovations and changing customer demands has significantly showed that how important is the process of selecting a correct supplier. The concept of having a product at right cost, in the right quantity, with the right quality at the right time from the right source is crucially important to survive nowadays [2].

There is some important selection process being proposed in this literature, such as Date Envelopment Analysis (DEA) that allow to have a simultaneous analysis of multiple input and having multiple output, Cluster Analysis (CA) that is a basic method of statistics, Case-based Reasoning (CBR) system that solved problem by making use of previous similar situations, Artificial Intelligence (AI) that is based on computer-aided systems, and also Analytic Hierarchy Process (AHP) where can deal with imprecision in supplier choice [2].

Through this literature review, the proposed project is to determine the most suitable doctor to be assigned to which emergency case based on scheduling, priority, type of emergency, expertise of doctor and also the availability. With this similar literature study, the method used can be relate to this project and further using it as a guideline and reference to implement it into the system itself.

### 1.2.3 A Decision Support System for Surgery Sequencing at UZ Leuven's Day-Care Department

In this literature review, there is a result obviously showed that there is only limited research effort towards decision support systems for organizational and managerial decision-making in hospitals [3]. This literature showed the effort of testing the applicability of a decision support system that to optimize the sequence of the surgeries in the day-care center.

In this system, patient is been categorized into few categories such as outpatient, inpatient, children, prioritized patients and so on. The aim of this study is to examine a case study how decision support systems can contribute to an improved outpatient surgical schedule [3].

Through this literature review, the proposed system is to check the scheduling the current availability of the doctor whether they are handling emergency case or ready or on-hold.

## 1.3 Explain the Current System and Its Limitation

The current system that using at Pekan Hospital is named "Emergency Medical Communication Response - **EMCR**" which is a system that integrates both front line (staff who handle patient direct) and backup line (staff who receive patient in each department) during emergency. It drafted a 'Care Plan' as a standard operating procedure during emergency case handling.

There is three (3) objective of this system: [5]

(i) **Safe Life** – To be able to transfer the first hand information (injuries) of patient and prepare the supposed care plan right after reach patient, before being send to hospital.

(ii) **Safe Time** – To be able to save up time during the process of awaiting for Medical Officer (MO), X-Ray Officer, Pharmacy Officer ( JTMP) on call.

(iii)**Safe from Complaint** – To avoid any delay on giving treatment and body checking.

The current system is using a tool called "Government Integrated Radio Network - GRIN" and each department will have a walkie-talkie to standby. Besides, there is mobile phone and also home phone were used for communication purpose. Last but not least, there is an EMCR reference book to jot down and act as a reference when handling emergency case.

While there is some limitations that would like to point out:

(i) All these processes are still done manually by hand-written and hardcopy still have to pass through nurse from unit to unit.

(ii) Information transfer through verbally on phone. Every time, the doctor/ staff on duty need to call and repeat again and again when communicate with different department.

(iii)There is no integration between each units, it solely depends on how the doctor/ staff on duty communicate and controlling the process of information flow.

(iv)There is no visualization, just using verbalization.

### 1.3.1 Comparison Table

**Table 1.3.1 Comparisons Between the Existing Systems.**

| | Features | Advantages | Disadvantages | Limitations |
|---|---|---|---|---|
| **Information Visualization to Support Management Decisions** | It is focus mainly on communication, knowledge management, and decision support. | Visualization provides information which is easily understandable. | It took some time to receive the picture captured from evidence. | Strong network coverage needed to transfer the picture captured. |
| **A Decision Support System for Supplier Selection Process** | It is supplier selection process based on CA, CBR, AI, and AHP to decide which the best choice is. | This selection process can have a product at right cost, in the right quantity. (Similar with the proposed idea of this project) | It is a decision support system where cannot direct give result but suggestions. | It limited to just giving suggestion to decision maker and will always depends on the decision maker. |
| **A Decision Support System for Surgery Sequencing at UZ Leuven's Day-Care Department** | It is focus mainly on optimization of decision support systems for organizational and managerial decision making in hospital. | Its visualization and algorithm performance on supporting decision support system in giving suggestion. | No online instrument and no linkage with electronic patient file. | The accuracy of the predicted resource consumption patterns |
| **Emergency Medical Communication Response - EMCR** | It integrates both front line and backup line department during emergency. | GRIN – A tool to make the communication flow faster and easier between departments. Faster in information delivery. | The doctor and emergency department staff cannot visualize the information delivered through phone call. | All processes still done manually by hand-written. No integration between departments. Verbalization but not visualization. |

## 1.4 Explanations of Terminology

### 1.4.1 Emergency Medical Communication Response (EMCR)

A system where integrate both parties between front line staff (people who have the first touch point with patient) and also secondary line staff (people who stand by at hospital and prepare to receive patient). EMCR drafted a 'Care Plan' to ensure the staff follow the standard of procedure when handling emergency case including emergency call reception, medical standby and reference cases. [5]

### 1.4.2 Expert Decision Support System for Doctor Selection

A system where able to decide the suitable doctor to handle emergency cases based on type of emergency, doctor availability, scheduling, expertise and other relevant cases.

## 1.5 Project Scope

The scopes of this project are:

i. System User

- The system is specially designed for emergency department, eg: doctor
- Not for user who did not involve in the decision making process of human resource management for emergency department, eg: patient.

ii. System Functionality

- The system provides a suggested decision to the on-duty doctor to decide who will be the best doctor available to handle each emergency case.

iii. System Data

- Doctor Schedule & Profile
- Emergency Case Type

iv. System Architecture and Platform

- The system will generate an output of suggested doctor to be assigned to handle the emergency case, and all the information will be sent and notified the doctor involved via mobile platform

## 1.6 Outline of Material

This project based technical report is divided into three (3) parts and each part is presented to discuss different aspects of the project. Below will be the outline of each part of this report:

i. Part 1 – Introduction

This part is to discuss the purpose of the project including the existing problem faced, the aim and objective of the project to solve the problem, and also the scopes. Besides, this section will discuss further about the existing system and its limitations.

ii. Part 2 – Report Body

This part will plays an important role in this report where it will discuss the user requirement, design description, development plan and also testing plan.

iii. Part 3 – Conclusion

After all these research and execution of the project, it will be a summary of the entire project and also some suggestions and comments towards the project are presented in this part.

# PART 2

# REPORT BODY

This part is briefly discussed about the body of the project. Basically, there are five (5) sub sections for this technical report. The first section is the user requirement, where briefly describe the functionality of the project. The second section is the design description where discuss about the proposed design to solve the problem of the project and further discuss about the methods and materials used to develop the system in third section. Furthermore, the fourth section is the technical result. Lastly, the last section will briefly describe the testing plan and result where test whether the project meet requirements.

## 2.1 User Requirement

This sub-section is to briefly describe the user requirement after the client meeting at Pekan Hospital. The user requirement is a documents where act as a specification of requirements from the user's point of view. A client meeting has been scheduled to meet the client and asking some question to guide the user to come out with the idea of the system and the design description will be created based on the user needs.

Followed up by the client meeting, user as a paramedic staff who mainly involved in emergency department has pointed out that the current system used for communication, Emergency Medical Communication Response has its own limitation and wish to enhance it. Based on the discussion, we came out a decision to design a mobile platform

used for expert decision support system to decide or assign the most suitable doctor to handle each emergency case.

Developer needs to spend a lot of time to understand the procedure to handle emergency case and also some common terms used in emergency department. During the analysis of requirement period, developer needs to visit Pekan Hospital frequently to collect necessary data.

Besides that, user has pointed out that they hope the system can implement virtualization for the photo of patient's injury part and integration between departments can be more efficient. All the user requirement and sign-off form can referred to Appendix A.

## 2.2 Design Description

In this sub section, we will briefly discuss about the entire process how this project runs throughout the planning and maintenance process. Besides, we will discuss all the other relevant diagrams that can describe the project clearer.

### 2.2.1 Waterfall Model

According to (Benington, Herbert D., 1983), the waterfall model is a sequential design process often used in software development processes.[6] In Waterfall Model, each progress is seen as flowing steadily downwards (just like a waterfall) through the phases of Planning, Analysis, Design, Development, and Maintenance. The Waterfall Model is ensuring every process is well executed and confirmed before move to the next process, this is to ensure the quality of each process. Besides that, Waterfall Model is obviously reflects the entire process of this project where the project have to pass down from one process to another by approved by both supervisor and user. Due to the reason stated, this model has been used in creating the Expert Decision Support System. Figure 2.2.1 below illustrates the Waterfall Model for this Expert Decision Support System.

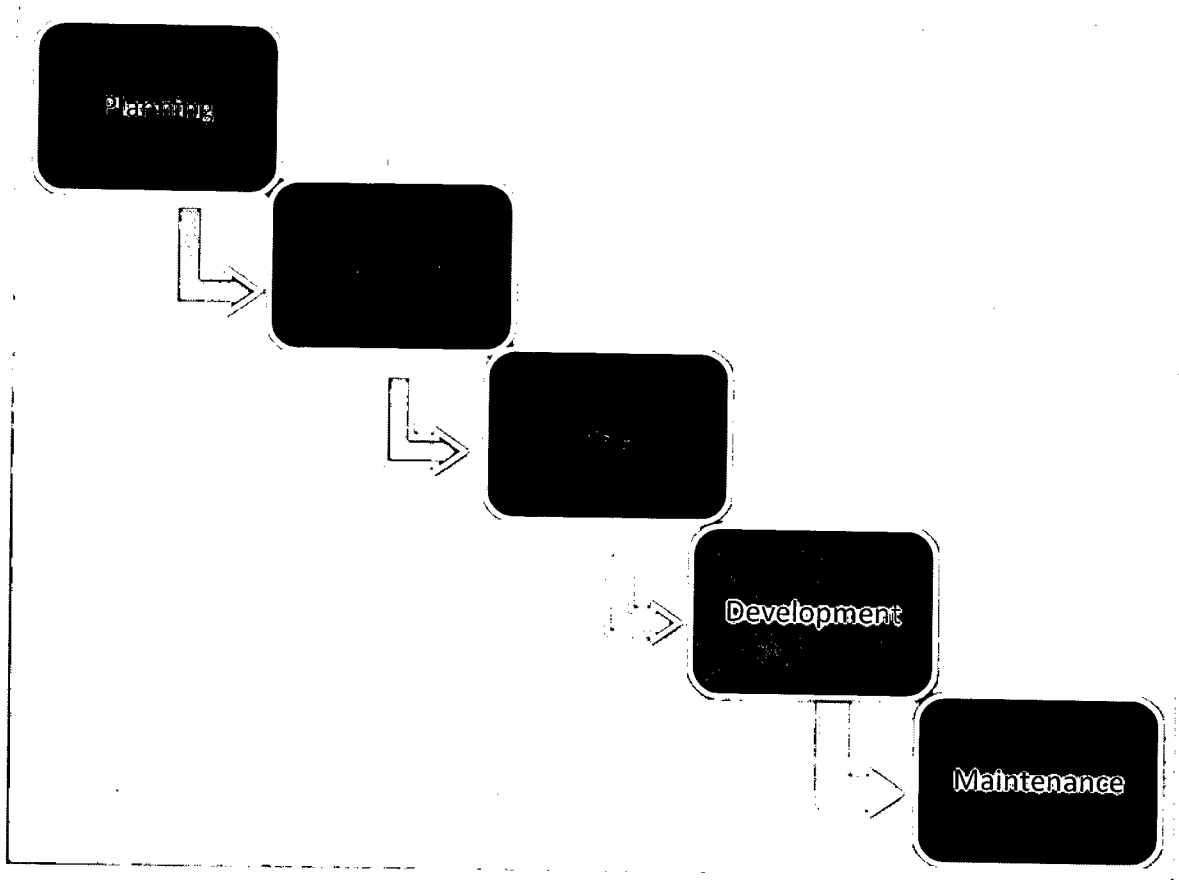


**Figure 2.2.1: Waterfall Model**

This Waterfall model consists of five (5) stages includes project planning, requirement analysis, system design, system development and maintenance.

#### 2.2.1.1 Planning

Project Planning is the earliest stage of the project. All the essentials information that defines this project has to be carried out such as problem statements, objectives, scope of the project and so on. Few meetings and discussions have been carried out with the supervisor, Associate Prof. Dr. Noraziah Binti Ahmad on the motivations for the project.

A Gantt Chart planning from the beginning of the project until the end has been drafted accordingly after the project title has been agreed by the supervisor. The Gantt Chart of the project can be referred to Appendix B.

#### 2.2.1.2 Analysis

Further analysis and research of the system requirements have been carried out. Comparison between proposed system design and current system has been carried out. Few client meetings have been carried with the paramedic staff in emergency department at Pekan Hospital. In this stage, we will be more understand the standard procedure of handling emergency and the common terms used to be implement in the project.

#### 2.2.1.3 Design

During this phase, the prototypes of the system will be created based on the system design from user requirement analysis. The flowcharts and some relevant diagrams allow user to understand the whole picture of the system. The designs of the system have been displayed through storyboard.

#### 2.2.1.4 Development

In this phase, developer is allowed to have about 3 months to develop the system. Throughout the development phase, developer will keep checking with the supervisor to ensure the system meets user requirements and the three objectives of the project.

#### 2.2.1.5 Maintenance

In this phase, this will be the final phase where testing and correcting the error to produce the final version of the system. The testing of the system development is carried out when the system is fully complete. As a result, an Expert Decision Support System will be delivered to the users in Pekan Hospital.

### 2.2.2 Context Diagram

Figure 2.2.2 shows that the overview of the entire system for the group project in emergency department at Pekan Hospital.

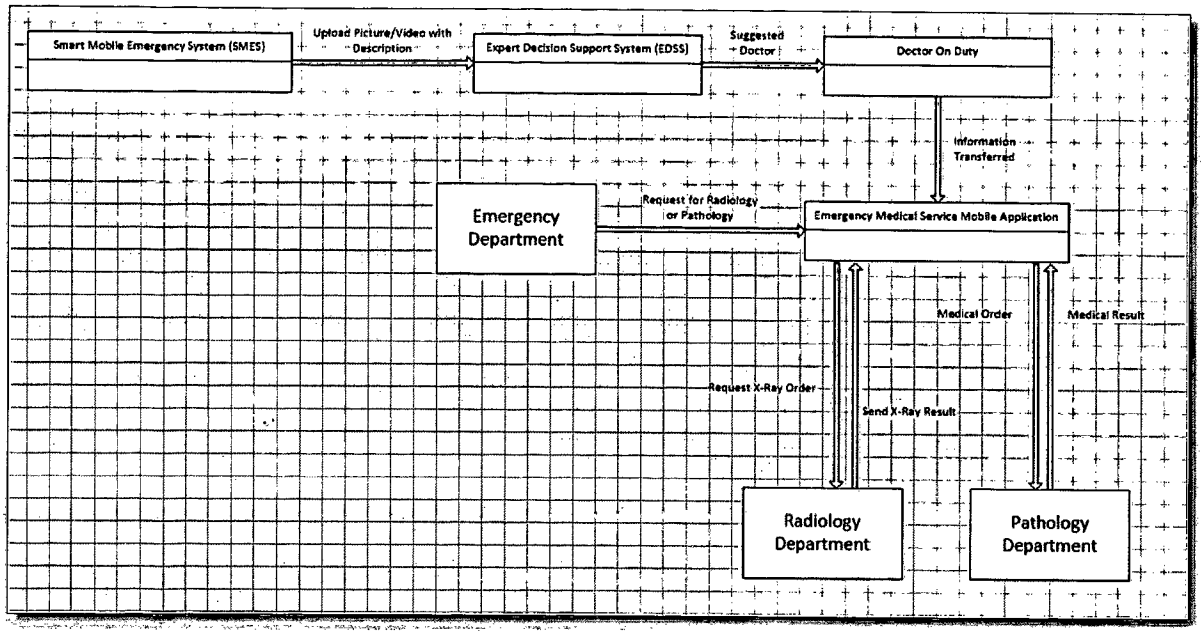


**Figure 1.2.2: System Overview**

Figure 2.2.3 shows the context diagram for Expert Decision Support System (EDSS). The input would be emergency profile, patient profile, doctor profile and doctor schedule to be able to decide the doctor to be assigned for each emergency case which is the output of this system.

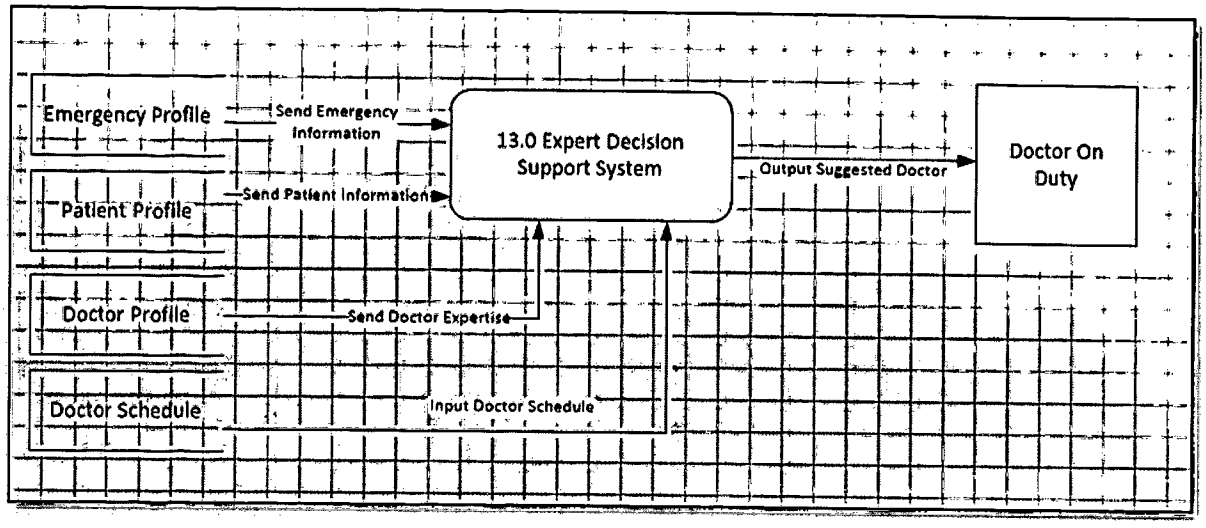


**Figure 2.2.3: Expert Decision Support System (EDSS) Context Diagram**

### 2.2.3 Flow Chart

Figure 2.2.4 shows the flow of the system. By following the algorithm, the system will first collect information from Paramedic and then process data with CBR technique to decide which doctor should be assigned and provide a suggested doctor as output.

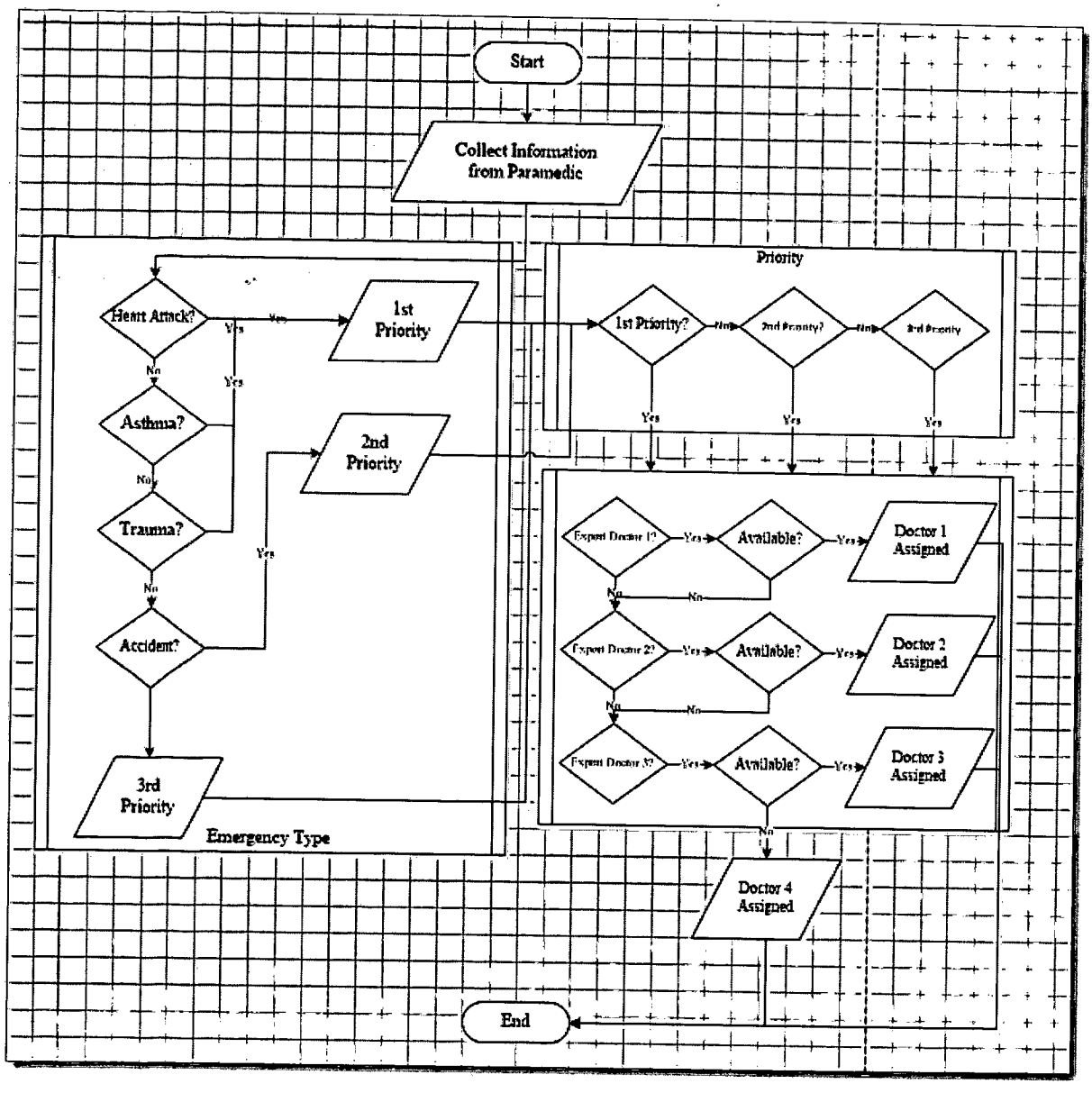


**Figure 2.2.4: Expert Decision Support System (EDSS) Flow Chart**

### 2.2.4 Use Case Diagram

Figure 2.2.5 shows the user who involves in this system. In this system, the only user who involves in this system is the doctor on duty or better known as admin.

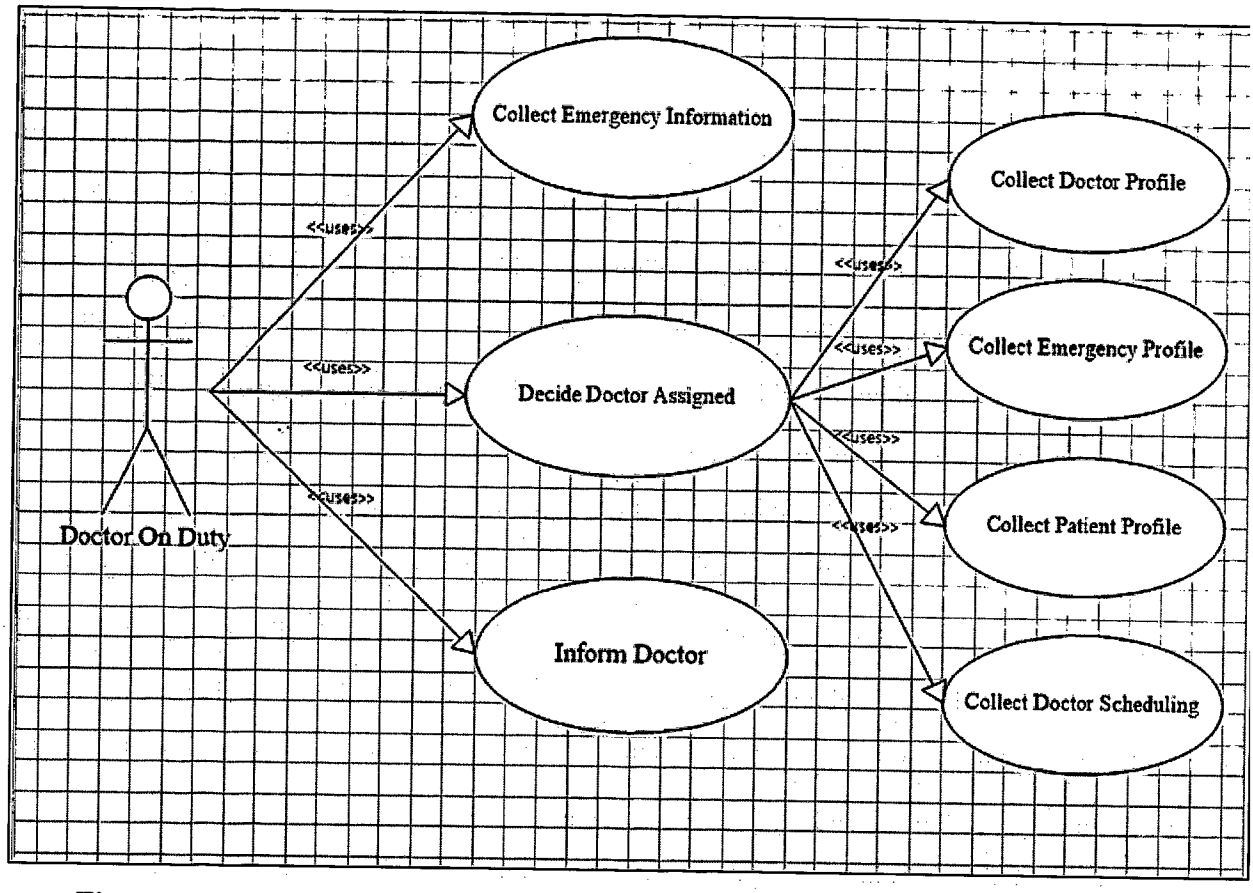


**Figure 2.2.5: Expert Decision Support System (EDSS) Use Case Diagram**

### 2.2.5 Data Flow Diagrams

Figure 2.2.6 shows the whole data flow diagram for the entire system designed for emergency department. Process 13 is the process which presents the data flow for EDSS.

The figure is shown in the next page due to the picture size and resolution to have a better view of the whole system flow of data.

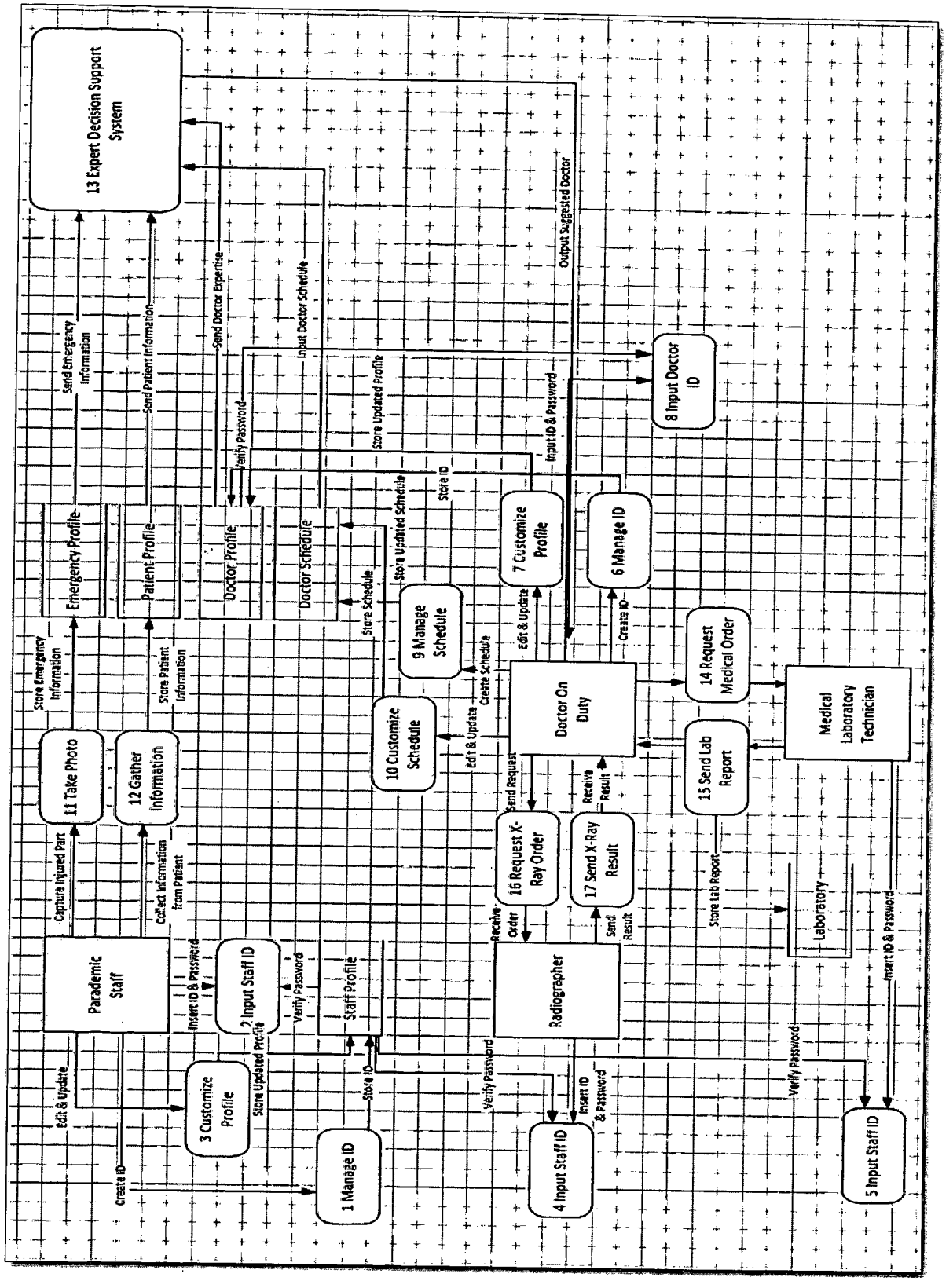


**Figure 3.2.6: EDSS Data Flow Diagram Level 0**

Figure 2.2.7 shows specifically the process 13 which is represents the data flow for EDSS. In this process, you will see how EDSS collect information and provide an output which is suggested doctor to Doctor on Duty.

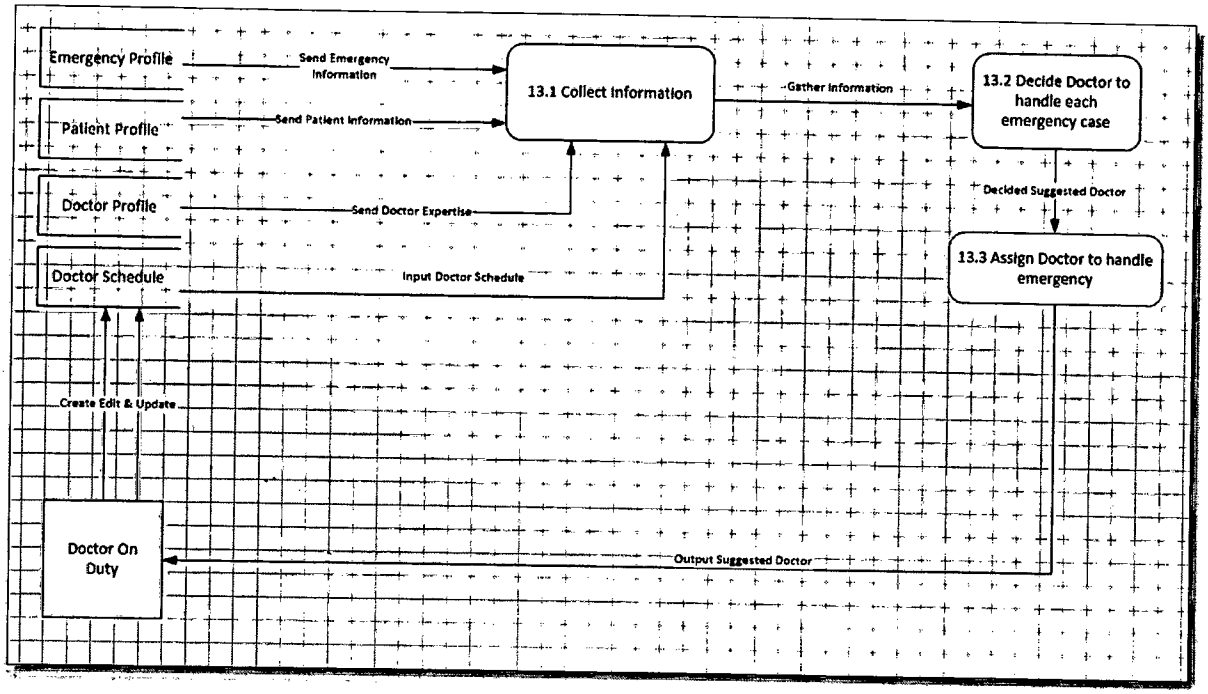


**Figure 2.2.7: EDSS Data Flow Diagram Level 1.0 (Process 13)**

Figure 2.2.8 shows the process 13.2 which is "Decide doctor to handle each emergency case". In this process, you will see the entire process on how this system decides a doctor to handle each emergency case.

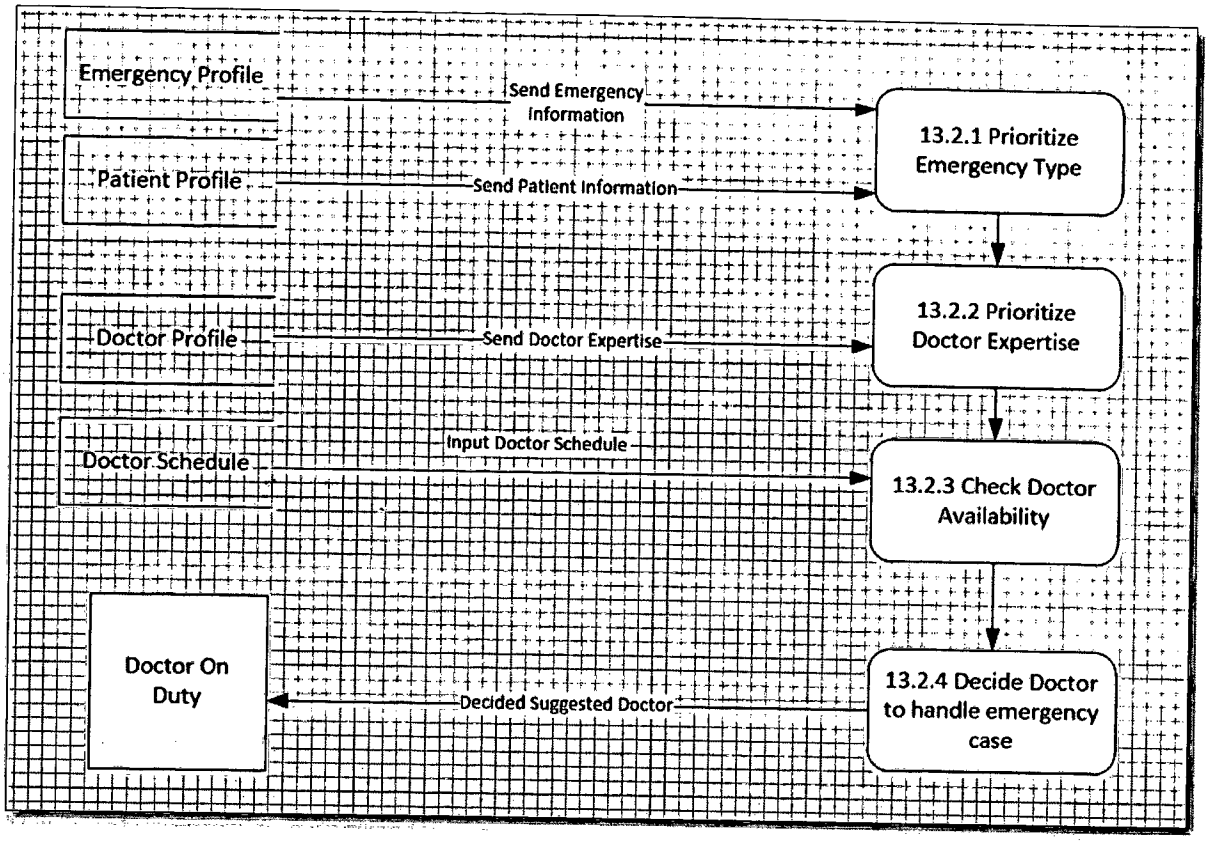


**Figure 2.2.8: EDSS Data Flow Diagram Level 2.0 (Process 13.2)**

### 2.2.6 Entity-Relationship Diagram

Figure 2.2.9 shows the entity relation diagram of EDSS. In this system, there will have total of four (4) tables to store information which are DOCTOR, SCHEDULE, PATIENT and EMERGENCY. Figure 2.9 is to show how each table is related to each other.

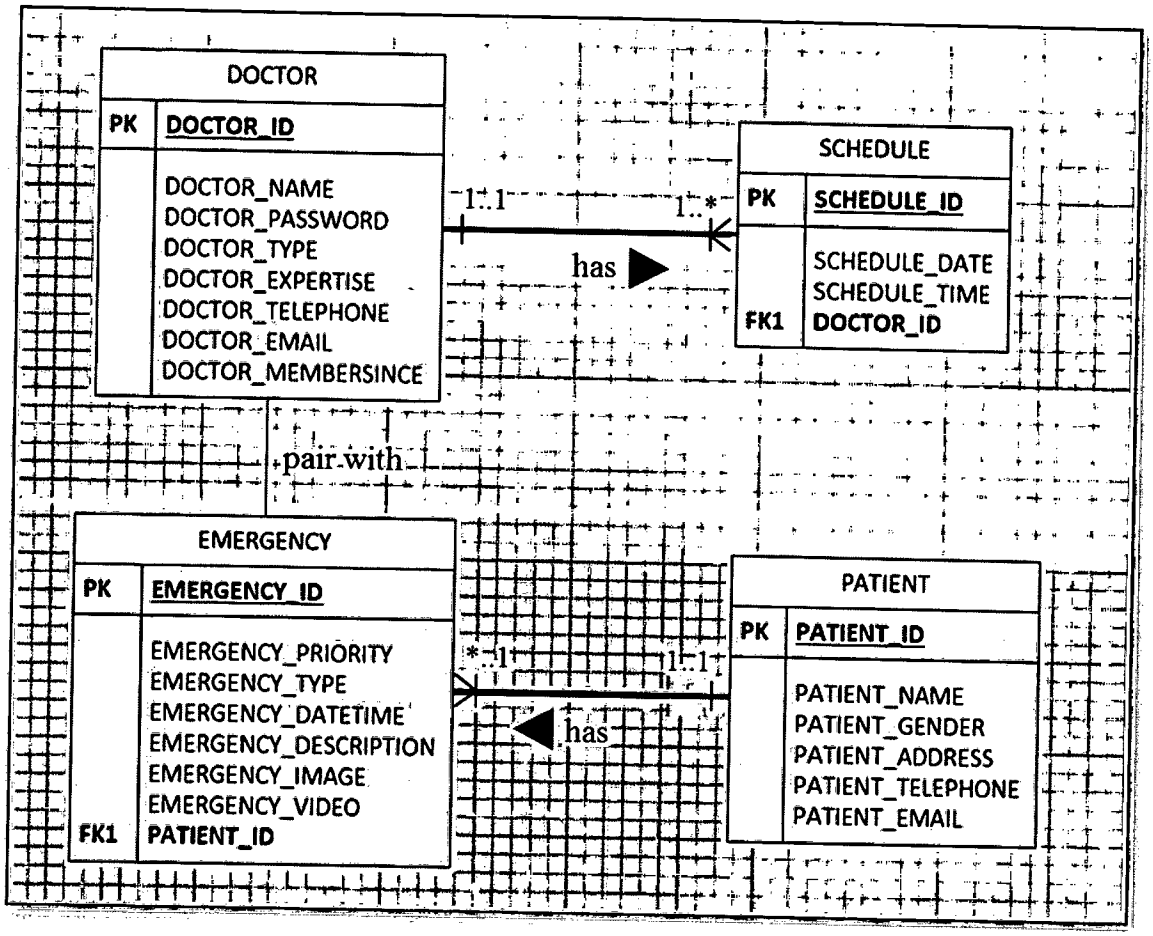


**Figure 2.2.9: EDSS Entity-Relation Diagram**

Design Assumption (Business Rule):

1. A doctor has one schedule of timetable.
2. A schedule is belongs to only one doctor.
3. A patient has one emergency case.
4. An emergency case belongs to one patient.

### 2.2.7 Data Dictionary

**Table 2.2.1: EDSS Data Dictionary**

i. DOCTOR table

**Table 2.2.1.1: EDSS Data for DOCTOR**

| Column Name | Data type | Size | Description | Constraints |
|---|---|---|---|---|
| DOCTOR_ID | Smallint | 5 | Doctor's ID | Primary Key |
| DOCTOR_NAME | Varchar | 50 | Doctor's Name | |
| DOCTOR_PASSWORD | Varchar | 15 | Password for Login | |
| DOCTOR_TYPE | Varchar | 50 | Type of doctor | |
| DOCTOR_EXPERTISE | Varchar | 50 | Doctor's Expertise | |
| DOCTOR_TELEPHONE | Varchar | 25 | Doctor's phone number | |
| DOCTOR_EMAIL | Varchar | 50 | Doctor's email | |
| DOCTOR_MEMBERSINCE | Datetime | date | First day of work | |

ii. EMERGENCY table

**Table 2.2.1.2: EDSS Data for EMERGENCY**

| Column Name | Data type | Size | Description | Constraints |
|---|---|---|---|---|
| EMERGENCY_ID | Smallint | 6 | Auto Increment by 1 | Primary Key |
| PATIENT_ID | Smallint | | Patient's IC number | Foreign Key |
| EMERGENCY_TYPE | Varchar | 25 | No | |
| EMERGENCY_DATETIME | Timestamp | - | Current Timestamp on Update current date and time | |

### 2.2.7 Data Dictionary

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| DOCTOR_EMAIL | Varchar | 50 | Doctor's email | |
| DOCTOR_MEMBERSINCE | Datetime | date | First day of work | |

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**Table 2.2.1.2: EDSS Data for EMERGENCY**

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|---|---|---|---|---|
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| PATIENT_ID | Smallint | | Patient's IC number | Foreign Key |
| EMERGENCY_TYPE | Varchar | 25 | No | |
| EMERGENCY_DATETIME | Timestamp | - | Current Timestamp on Update current date and time | |

| | | | | |
|---|---|---|---|---|
| EMERGENCY_DESCRIPTION | Varchar | 250 | Emergency's description | |
| EMERGENCY_IMAGE | Blob | - | Patient's image | |
| EMERGENCY_VIDEO | Blob | - | Patient's video | |
| EMERGENCY_PRIORITY | Int | 11 | Define by the system later | |

iii. PATIENT table

**Table 2.2.1.3: EDSS Data for PATIENT**

| Column Name | Data type | Size | Description | Constraints |
|---|---|---|---|---|
| PATIENT_ID | Smallint | 6 | Patient's IC number | Primary Key |
| PATIENT_NAME | Varchar | 50 | Patient's Name | |
| PATIENT_GENDER | Varchar | 10 | Patient's Gender | |
| PATIENT_ADDRESS | Varchar | 100 | Patient's address | |
| PATIENT_TELEPHONE | Varchar | 25 | Patient's phone number | |
| PATIENT_EMAIL | Varchar | 30 | Patient's email | |

iv. SCHEDULE table

**Table 2.2.1.4: EDSS Data for SCHEDULE**

| Column Name | Data type | Size | Description | Constraints |
|---|---|---|---|---|
| SCHEDULE_ID | Smallint | 6 | Auto Increment by 1 | Primary Key |
| DOCTOR_ID | Smallint | 6 | Doctor's ID | Foreign Key |
| SCHEDULE_DATE | Datetime | date | Schedule's date | |
| SCHEDULE_TIME | Datetime | time | Schedule's time | |

## 2.3 Methods and Materials Used

### 2.3.1 Methods Used

In the project, there are three (3) methods/ technique will be used to perform the function of doctor selection which are: (i) temporal database, (ii) Case-Based Reasoning (CBR), and (iii) Artificial Intelligence (AI) based models.

#### 2.3.1.1 Temporal Database

A temporal database is a database with built-in support in term of handling the data that in the form of timing or schedule [7]. In this project, we are mostly used valid time and also bitemporal data where combines both Valid and Transaction Time.

There are some other features that temporal database can provide:

- A time period data type
- Temporal primary keys
- Update and deletion of temporal records with automatic splitting and coalescing of time periods

#### 2.3.1.2 Case-Based Reasoning (CBR)

CBR is a method to solve problems by making use of previous similar situations and reusing information and knowledge about particular situations [2]. In this system, we are using 'Supervise Learning' which will generalize pattern based on dataset that consisting input and desire output.

CBR is an AI technique that imitates how human make a decision. In CBR, new problems are solved by recalling from previous solved problem which are store the case-base.

A case describes one particular diagnostic situation and a case has two main components:

- **Specification (SP):** set of attributes (features) and values – represent particular case or problem and it should have unique characteristic.
- **Solution (SL):** the case solution, represent the problem solving for such case.

Moreover, a collection of cases called "**CASE-BASE**".

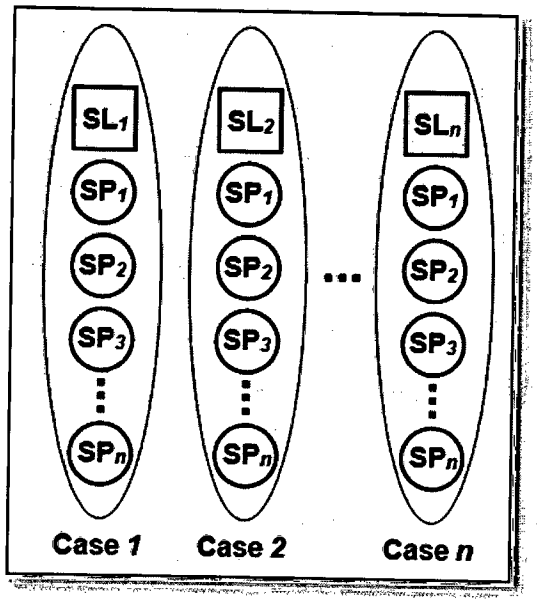


**Figure 2.3.1: Case's Components – Relation between SP & SL**

**Similarity measure** is used in problem solving and reasoning to match a previous experience/case (case-base) with the new unseen problem to find solution. Furthermore, similarity measure is the heart of the CBR system, and it is the most important component of this system as well. It is actually matching the new case with the previous cases from the case-base to find solution.

Similarity has two types: which are **Local Similarity** (used to compute the similarity between query (new problem) and case attributes values) and it known as feature level as well and also **Global Similarity** (build up from number of local similarity function. It is a weight sum of the local similarity) and it known as case/object level as well.

Local similarity is to find the similarity between two cases and it is based on similarity between each case attributes values (feature). Figure 2.11 shows the formula for Local Similarity.

$$sim(a,b) = 1 - \frac{|a-b|}{range}$$

Where,

| | |
|---|---|
| $a$ | is new feature, |
| $b$ | is previous features, and |
| $range$ | is the value of difference between the upper and lower boundary of the set. |

**Figure 2.3.2: Local Similarity Formula**

After a set of local similarities have been calculated for each feature in the case, a global similarity will be calculated. Global similarity provides a case-matching behavior using the global similarity calculation to find the relationship between two cases. There are many formulas available – *Weight Block-City formula.* Figure 2.12 shows the formula for Global Similarity.

$$sim(A,B) = \frac{1}{\sum w_i} \cdot \sum_{i=1}^{p} w_i \,.\, sim_i(a,b)$$

Where,

| | |
|---|---|
| $A$ | is new case, |
| $B$ | is previous cases, |
| $a$ | is new feature from local similarity, |
| $b$ | is previous features from local similarity, |
| $p$ | is the number of attributes, |
| $i$ | is the iteration |
| $w_i$ | is weight of attributes $i$ $\sum_{i=1}^{p} w_i = 1$, and |
| $sim_i$ | is local similarity calculate for attribute $i$. |

**Figure 2.3.3: Global Similarity Formula**

### 2.3.1.3 Artificial Intelligence (AI) Based Models

AI Based Models are based on computer-aided systems where applying artificial intelligence technique. In this project, Expert Decision Support System is based on rule based system.

Rule based system structure can simply divide into four (4) components: the knowledge base, database, reasoning and the conclusion. In this system, we are using a similar structure like this.

### 2.3.2 Materials Used

The materials used for this project is basically divided into two main parts: (i) hardware and also (ii) software.

#### 2.3.2.1 Hardware Specification

The following table lists the hardware requirement for the EDSS using desktop environment. Table 2.3.1 shows the list of hardware that will be used in this project.

**Table 2.3.1: The Hardware Specification Table**

| No. | Hardware Name | Quantity | Usage/ Purpose |
|---|---|---|---|
| 1. | Laptop or Desktop | 1 | Research, development, documentation |
| 2. | Compact Disc | 1 | Burn the system into disc |
| 3. | Pen drive or hard disc | 1 | Data backup |
| 4. | Server | 1 | To connect the internet |
| 5. | Tablet or smartphone | 1 | To demo the project in mobile platform |

### 2.3.2.2 Software Specification

Basically, the software requirements to be used in this system are simple and user-friendly. There is only one highlighted software would explain further below, which is NetBeans IDE 7.4, the main software used for coding. Table 2.3.2 shows the list of software that will be used in this project.

**Table 2.3.2: The Software Specification Table**

| No. | Software Name | Usage/ Purpose |
|---|---|---|
| 1. | Microsoft Windows 7 Professional 64 Bit | Operating System |
| 2. | Microsoft Office 2010 | Documentation |
| 3. | Microsoft Visio 2010 | Modeling and Designing |
| 4. | Microsoft Office Project 2010 | Planning for the milestones of the project |
| 5. | NetBeans IDE 7.4 | Main system environment |
| 6. | Xampp Studio v3.0.12 | Host web serviced database |

Software that will be used in the project is NetBeans IDE 7.4. NetBeans is an integrated development environment (IDE) for developing primarily with Java, and also with other languages such as PHP, C/C++, and HTML5. NetBeans IDE is a free, open source, cross-platform IDE with built-in-support for Java Programming Language. [7]

Below are the other features of NetBeans: [7]

- User interface management
- User settings management
- Storage management
- Windows management
- Wizard management
- NetBeans visual library
- Integrated development tools

## 2.4 Technical Result

This sub-section is to briefly describe the implementation part of the proposed design as discussed and mentioned in the previous section. It would be summarize all comparisons between technical results with all the previous work and research done on theories. The main purpose of this sub-section is to document all the process that involves in the implementation stage.

This sub-section also includes how to develop the interface whether using any tools or using source code. For Expert Decision Support System, it is developed using NetBeans IDE 7.4 JFrame and JTable for both coding and interfaces, while the database were created using MySQL with Xampp Control Panel.

### 2.4.1 Development of Interface

Interface is one of the most important elements in developing a system because the user interface allows user of the system interact with the system which provides the meaning of input and output. Input is to allow user to manipulate the system while output is to let the system provide the result of the user's manipulation. But, in EDSS, interface might not be the main focus due to this is an expert system that does not need any user to interact with where it still allows user to modify the information of doctor which using JFrame and JTable to display the database.

Figure 2.4.1 shows the start page when open NetBeans IDE 7.4.

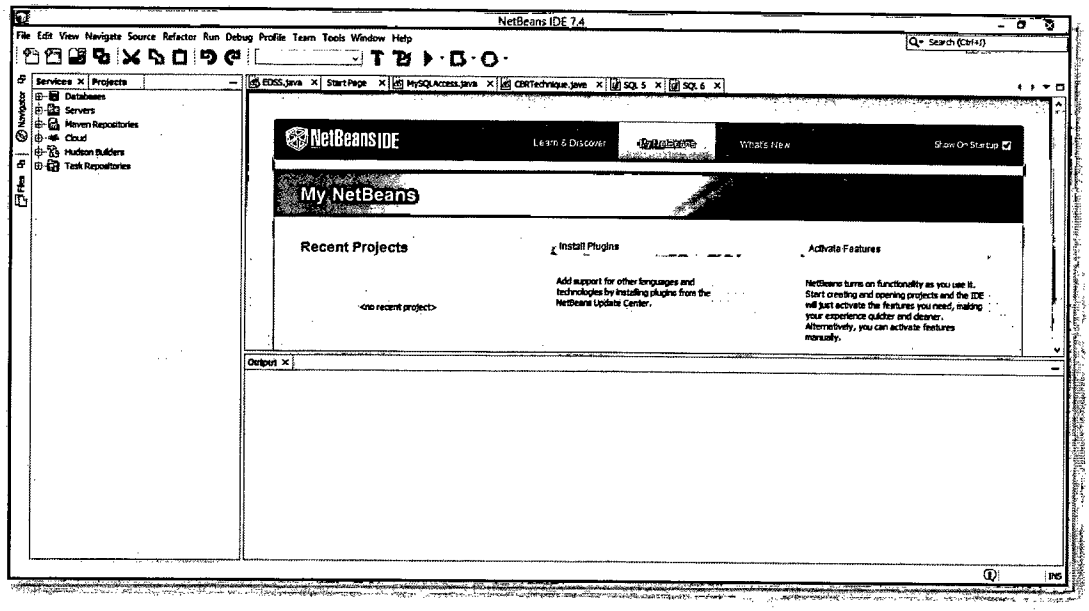


**Figure 2.4.1: Start Page for NetBeans IDE 7.4**

Figure 2.4.2 and 2.4.3 shows that opening an existing project in NetBeans IDE 7.4. To open existing project, follow the steps: NetBeans IDE 7.4 > File > Open Project… > NetBeansProjects > EDSS > Open Project.

For creating a new project, you can follow this step: NetBeans IDE 7.4 > New Project > Java > Java Application > Next > > Project Name > Finish.

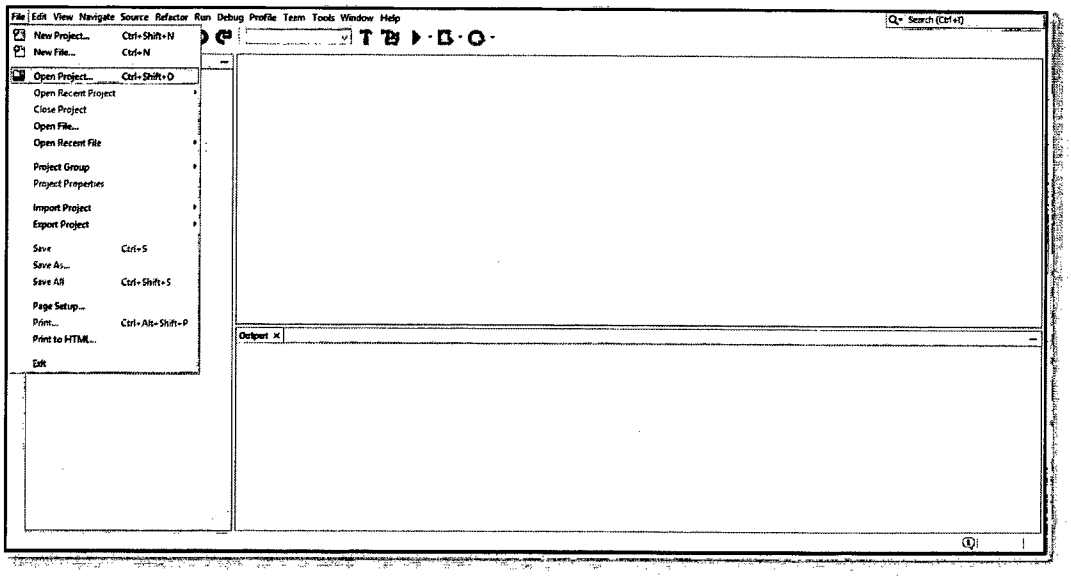

**Figure 2.4.2: Open Existing Project**

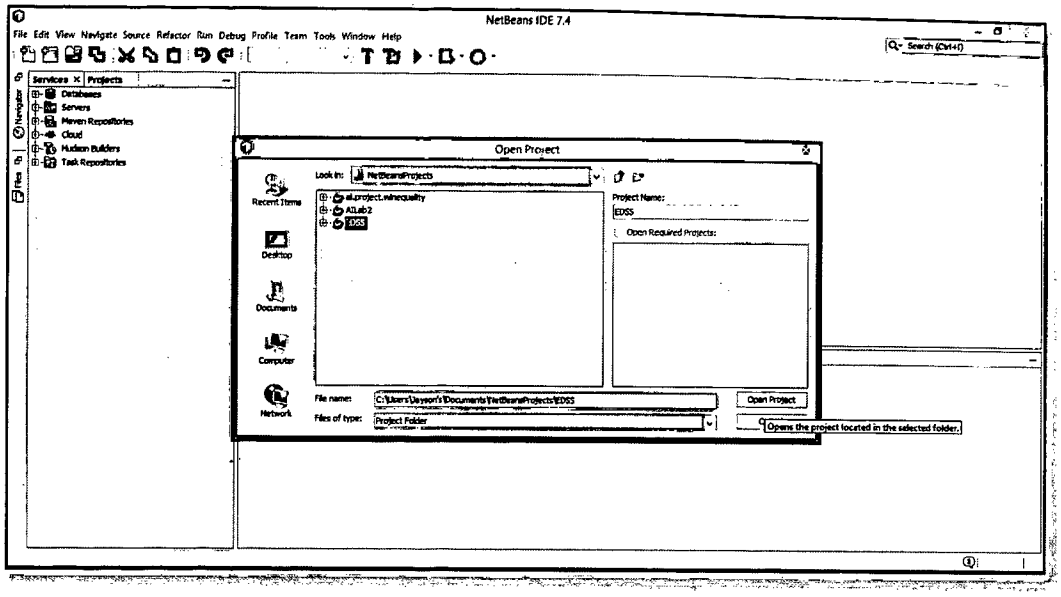


**Figure 2.4.3: Open Existing Project (cont.)**

After clicking open EDSS project, the existing project and its java class will display (as shown in Figure 2.4.4). There are 3 Java classes in EDSS package, 1 Java class in Database package and 3 jar file in libraries and can be searched at project explorer.

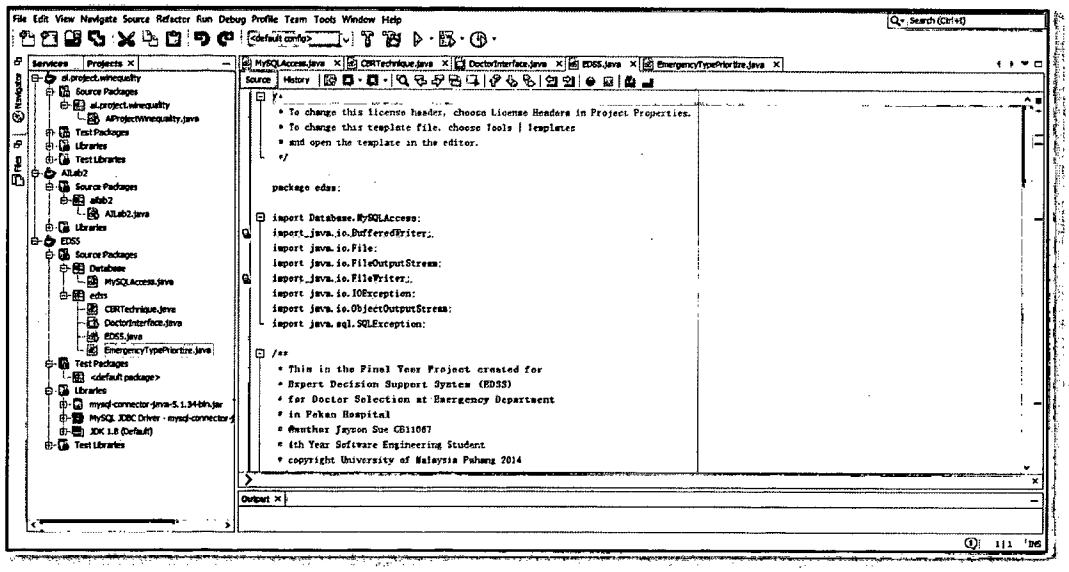


**Figure 2.4.4: Main class for EDSS**

Figure 2.4.5 shows that data sets in EDSS database.

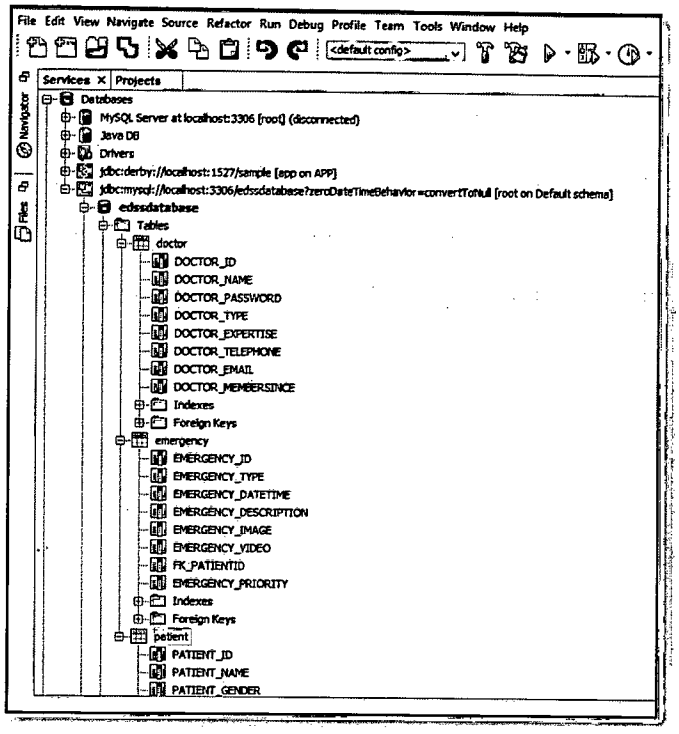


**Figure 2.4.5: Data source for EDSS**

### 2.4.2 Development of Database

Database plays an important role in EDSS as this system is mainly retrieve data and information from database and process to provide output. Figure 2.4.5, 2.5.6 and 2.5.7 show that adding Java Connector and JCBC driver in project libraries in order to use the database MySQL. To add Java Connector, we need to follow the following steps: Project Explorer > Libraries > right click > Add JAR/Folder... > Look in: (C:// > Program Files > MySQL > MySQL Connector J > mysql-connector-java-5.1.34-bin) > Open.

To add JCBC Driver, follow these steps: Project Explorer > Libraries > right click > Add Library > search MySQL JCBC Driver > click Create. (Shown in Figure 2.4.7)

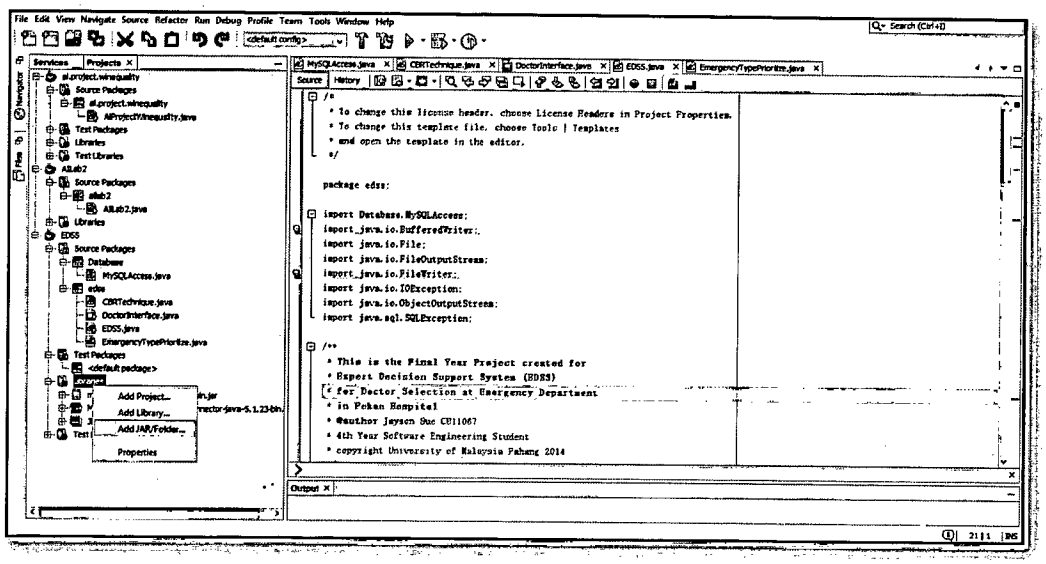


**Figure 2.4.6: Add Jar File to Project Library**

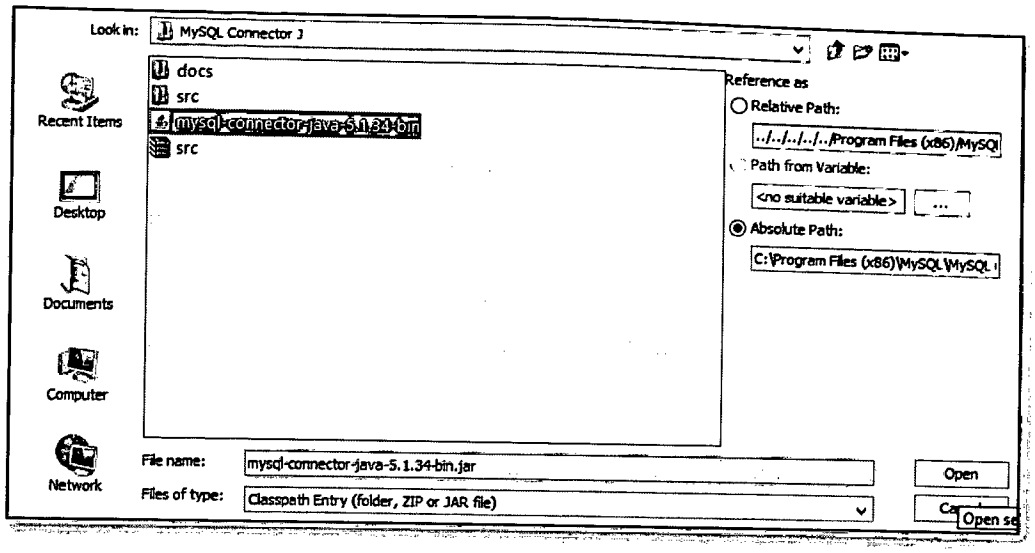


**Figure 2.4.7: Add Jar File to Project Library (cont.)**

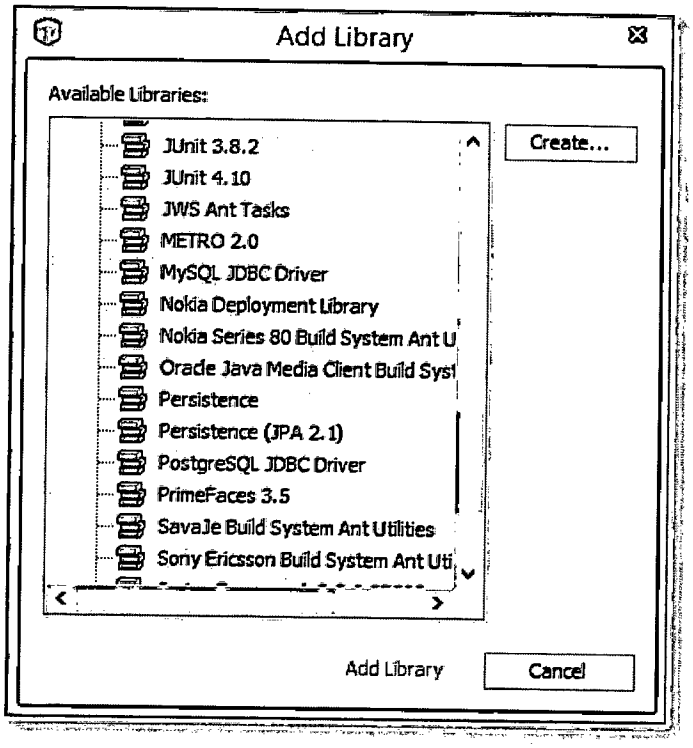


**Figure 2.4.8: Add JCBC driver to Project Library**

### 2.4.3 Function of Prioritize Emergency Case

One of the functions of this system is to prioritize the emergency case based on emergency type. Figure 2.4.8 and 2.4.9 shows the coding of EmergencyTypePriortize.java class. Figure 2.4.8 shows the prepared statement for database connection to EDSS database. Few imports needed and you can add easily by clicking the pop-up error later by NetBeans.

```
public class EmergencyTypePriortize {
    //Declaration
        private Connection con = null;
        private Statement stmt = null;
        private ResultSet rs = null;
        //The Connection information to connect local database
        String databaseUrl = "jdbc:mysql://localhost:3306/edssdatabase";
        String user = "root";
        String password = "";
        String query = "SELECT * FROM EMERGENCY"; //SQL Query Command
    /**
     *
     * @throws SQLException
     * @throws ClassNotFoundException
     */
    public void SetEmergencyPriority () throws Exception {

        try{
            //Load the MySQL Driver, each DB has its own driver
            Class.forName("com.mysql.jdbc.Driver");
            //Setup connection with DB
            con = DriverManager.getConnection(databaseUrl, user, password);
            //statemnt that allows to issue SQL query to the database
            stmt = con.createStatement();
            //ResultSet gets the result of SQL query
```

**Figure 2.4.9: Prioritize Emergency Case**

Figure 2.4.9 shows the declaration and function to priortize the emergency case, by retrieving the data from Emergency Table from Database, it able to priortize each case based on the emergency type. For example, case 'Heart Attack' is prioritized as integer ("1") and it updated the EMERGENCY_PRIORITY column with value of '1'.

```
//ResultSet gets the result of SQL query
rs = stmt.executeQuery(query);

PreparedStatement ps = null;
//statemnt that allows to issue SQL query to the database

while (rs.next()){
        String type = rs.getString("EMERGENCY_TYPE");
        System.out.println(type);

//To Initialize Each Emergency Case into different priority
if("Heart Attack".equals(type)){
ps = con.prepareStatement("UPDATE EMERGENCY SET EMERGENCY_PRIORITY = ? WHERE EMERGENCY_TYPE ='Heart Attack'");
ps.setInt(1, 1);
}
else if("Asthma".equals(type)){
ps = con.prepareStatement("UPDATE EMERGENCY SET EMERGENCY_PRIORITY = ? WHERE EMERGENCY_TYPE ='Asthma'");
ps.setInt(1, 2);
}
else if("Trauma".equals(type)){
ps = con.prepareStatement("UPDATE EMERGENCY SET EMERGENCY_PRIORITY = ? WHERE EMERGENCY_TYPE ='Trauma'");
ps.setInt(1, 3);
}
else if("Accident".equals(type)){
ps = con.prepareStatement("UPDATE EMERGENCY SET EMERGENCY_PRIORITY = ? WHERE EMERGENCY_TYPE ='Accident'");
```

**Figure 2.4.10: Prioritize Emergency Case (cont.)**

### 2.4.4 Function of Case-based Reasoning Technique

Case-Based Reasoning (CBR) is the main highlight of this system, where it can decide which doctor is the most suitable person to handle each emergency case. In this system, CBR only access based on emergency type, doctor type and doctor expertise to find out which is the most suitable doctor.

Figure 2.4.9, 2.4.10 and 2.4.11 show how the function CBRTechnique class plays a role in this system.

Figure 2.4.9 shows the algorithm that finding largest and smallest case base and the differences between each other after tracing the information from the Case Base text. Range is being defined from here as well after knowing which largest and smallest variables are in the case base.

```
for(int j=0; j<4; j++){//Largest-smallest comparison
    Double smallest = Double.parseDouble(casebase[0][j]);
    Double largest = Double.parseDouble(casebase[0][j]);
    for(int i = 1; i < x; i++) {
        if(Double.parseDouble(casebase[i][j]) < smallest) {
            smallest = Double.parseDouble(casebase[i][j]);
        }
        if(Double.parseDouble(casebase[i][j]) > largest) {
            largest = Double.parseDouble(casebase[i][j]);
        }
    }
    range[j]=largest-smallest;//culcalate for the range between largest and smallest
}

String[] theLine2;

for(int c=0; c<3; c++){
    for(int d=0; d<4; d++){
        problem[c][d] = new String();
    }
}
```

**Figure 2.4.11: Case-Based Reasoning Technique**

Calculation behind the process:

For new case [1][2][1][?] compared with Case Base No.1 : [1][2][1][1]

SimEmergencyType (1,1) = 1 – (1-1)/(1-1)

= 1

SimDoctorType (2,2) = 1 – (2-2)/ (2-2)

= 1

SimDoctorExpertise (1,1) = 1 – (1-1)/(1-1)

= 1

GlobalSim (A,B) = 0.333 * 1 *3 = 0.999

Suggested Case = [1] which is doctor with ID: 1

Figure 2.4.10 shows the algorithms to find the local similarity between new case and case base with the formula defined earlier in Section 2.3. After getting the local similarity, summing up all the variables to find the global similarity as well and the formula can be found in Section 2.3 as well.

```
int[] key = new int[y]://Declaration for position of highest global similarity case in 1 comparison
Double[] Glargest = new Double[y]://Declaration for the Largest Global similarity in 1 comparison
for(int a=0; a<y; a++) {//y is the number of line in New Problem.txt
    for(int b=0; b<x; b++) {//x is the number of line in CASEBASE.txt
        total[b] = 0.0://Initialize total of line
        for(int c=0; c<3; c++){
            //System.out.print(Double.parseDouble(problem[b][c])):
            difference[b][c] = Double.parseDouble(problem[a][c]) - Double.parseDouble(casebase[b][c])://Difference in single column between case-base and new problem
            //System.out.print(difference[b][c]):
            if(difference[b][c] < 0.0){
                difference[b][c] = difference[b][c] * -1://Convert negDoubleative difference to positive
            }
            local[b+(a*x)][c] = 1 - difference[b][c] / range[c]://local similarities, a indicate the position of new problem in new problem array and x indicate the number of line
            total[b] = total[b] + local[b+(a*x)][c]://total of local similarities in 1 line
        }
        global[b]= 0.125 * total[b]://Global similarity in 1 line
    }
    Glargest[a] = global[0]://Comparison to find the largest global similarity in 1 comparison

    for(int d=0; d<x; d++){
            if(global[d] > Glargest[a]) {
                Glargest[a] = global[d]://Largest global similarity in 1 comparison
                key[a] = d; //The position of highest global similarity case
            }
    }
    problem[a][3] = casebase[key[a]][3]://Copy the class of highest global similarity to new problem class column
}
```

**Figure 2.4.12: Case-Based Reasoning Technique (cont.)**

Figure 2.4.11 shows the output displaying algorithm which can make it as a reference for doctor-on-duty to see which the result is reliable and transparent.

```
System.out.print("\nSolved:\n\n");//Display new problem after sloved
for(int i=0;i<y;i++){
    for(int j=0;j<4;j++){
        System.out.print("["+problem[i][j].toString()+"] ");
    }
    System.out.println();
}
for(int e=0; e<y; e++){//Display of report on CBR with new problem class. case-base with highest similarity. local similarity in each column. and global similarity
    System.out.println("\n\nClass for new problem " + (e+1) +":\t\t"+problem[e][2]);
    System.out.println("Case with highest similarity: "+key[e]);
    System.out.println("SimLocalEmergencyType("+Double.parseDouble(problem[e][0])+", "+Double.parseDouble(casebase[key[e]][0])+"):\t\t"+local[key[e]+(e*x)][0]);//Local similar
    System.out.println("SimLocalDoctorType("+Double.parseDouble(problem[e][1])+", "+Double.parseDouble(casebase[key[e]][1])+"):\t\t"+local[key[e]+(e*x)][1]);
    System.out.println("SimLocalDoctorExpertise("+Double.parseDouble(problem[e][2])+", "+Double.parseDouble(casebase[key[e]][2])+"):\t\t"+local[key[e]+(e*x)][2]);
    //System.out.println("SimLocal???("+Double.parseDouble(problem[e][3])+", "+Double.parseDouble(casebase[key[e]][3])+"):\t\t"+local[key[e]+(e*x)][3]);
    System.out.println("SimGlobal:\t\t"+Clargest[e]);
}



(IOException e) {
 e.printStackTrace();
y {
 try {
        if (br != null)br.close();
 } catch (IOException ex) {
```

**Figure 2.4.13: Case-Based Reasoning Technique (cont.)**

## 2.5 Testing Plan and Result

This sub-section is to briefly describe the testing plan and also the expected result of Expert Decision Support System (EDSS) using Case-Based Reasoning Technique and discuss the result as a whole.

### 2.5.1 Testing Plan

As promised to the user from Pekan Hospital, we went back to hospital Pekan to undergo an acceptance test. A list of test case is being proposed to test the system. Finally, user is satisfies with the result and given a sign off form in **Appendix A**.

Table 2.5.1 shows the draft of list of test case items that would be in the acceptance test form.

**Table 2.5.1: Draft for Acceptance Test in Pekan Hospital**

| Test Case | Input Values to Execute test case | Expected vs. Actual Result | Pass/Fail |
|---|---|---|---|
| Prioritize Emergency Case | - Emergency Type | Prioritize based on predefined value for each emergency type | |
| Decide doctor handle emergency case | - Doctor Type<br>- Doctor Expertise<br>- Emergency Type | Doctor who have highest similarity with old cases | |
| Assign Doctor to handle emergency | - Doctor ID<br>- Emergency ID<br>- Patient ID | Send notification to doctor mobile application with patient and emergency information | |

### 2.5.2 Expected Result

The thesis project entitled Expert Decision Support System (EDSS) for Doctor Selection at Emergency Department using Case-Based Reasoning Technique has met all the objectives which are:

iv. To design and develop Expert Decision Support System (EDSS) that able to decide which expert doctor(s) will be assigned for each case based on the type of emergency.
v. To prioritize which case should handle first based on stage of emergency and schedule of doctor availability.
vi. To implement the Case-Based Reasoning (CBR) technique for the selection of doctor at emergency department.

The first objective is magnificently achieved by the success of creation of Expert Decision Support System (EDSS) that able to decide which expert doctor(s) will be assigned for each case based on the type of emergency. Doctor will be notified by sending out a notification with emergency case and also patient's information. It allows the communication more convenient, faster, and most importantly accurate.

The second objective is successfully achieved by retrieving the raw data of emergency case; it is able to prioritize which case should be handling first. It can be proved in Section 2.4.

The third objective is clearly achieved as this is the main feature of the system, and it able to find out which doctor should be assigned to handle which emergency case by finding their similarity of new case and old cases. It can be proved also in Section 2.4.

### 2.5.3 Actual Result

The result of EDSS emergency case raw data was retrieved from the system. Figure 2.5.1 and 2.5.2 shows the result of DEMO emergency case which is Trauma and Heart Attack, and both cases are assigned to doctor with SOLVED solution of [1] and [4].

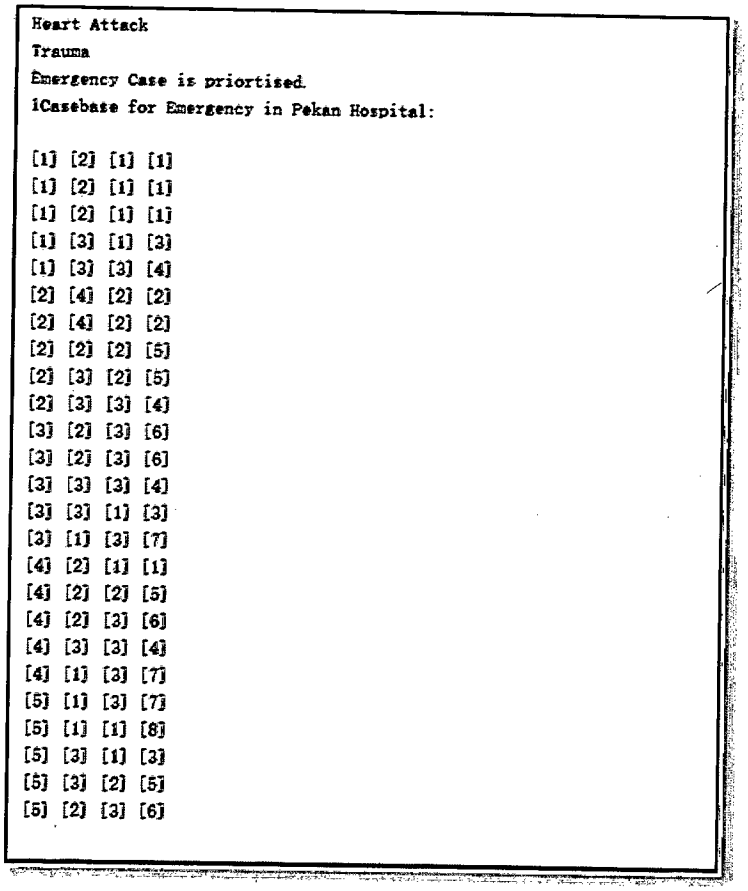


**Figure 2.5.1: Actual Result**

# PART 3

# CONCLUSION

This part is briefly discussed about the conclusion of the project. Basically, there are two (2) sub sections for this conclusion. The first section is conclusion, where briefly summarize all the research done and implementation for the last 12 months. The second section is the future work or can says as suggestion where discuss about the proposed future enhancement which can be done for the research purposes.

## 3.1 Conclusion

In the previous section, the goals of this project are mentioned before, which are:

vii. To design and develop Expert Decision Support System (EDSS) that able to decide which expert doctor(s) will be assigned for each case based on the type of emergency.

viii. To able to prioritize which case should handle first based on stage of emergency and schedule of doctor availability.

ix. To implement the Case-Based Reasoning (CBR) technique for the selection of doctor at emergency department.

Expert Decision Support System for Doctor Selection is designed exclusively for paramedic staff and doctor who work closely at emergency department. It is able to provide the suggestion of doctor with expertise who suit the best to handle each

emergency case. Based on emergency case type, doctor expertise, and also doctor availability, Expert Decision Support System is able to provide a fast and accurate decision. Due to it is implemented in mobile platform, it is able to allow user to have more space and ways to access the information and it is more convenient. The user can be notified whenever and wherever they are with accurate and complete necessary information.

Expert Decision Support System is a mobile application that allows doctor on duty to have a suggested doctor to handle each emergency cases, it will definitely shorten the time used by user to decide who should assign during a very hectic emergency period.

As a conclusion, this project is successfully achieve all the objectives which are able to assign one (1) doctor to handle each emergency case based on the type of emergency, to prioritize which case should be handle first, and lastly to implement Case-Based Reasoning (CBR) technique for the selection of doctor

## 3.2 Future Work

For future enhancement, there are few suggestions that I would like to point out:

i. Case study review

- The case study need to be review and discuss with the expert doctor again as it is a bit too simple to implement. The emergency case data and information provided by the paramedic staff is too simple and too less case base that provide variables for decision making.

ii. Improve the selection technique

- Case-based reasoning technique might not be the best solution to give the fastest decision after study. It took time to collect information from expert doctor at emergency department and the result might vary based on the expert doctor and a lot of different external factors could affect the result.

iii. Data Communication Platform

- As this project is an integrated system with another two different modules. A different platform of the system made the data communication process slowed down. The integration part need to be reviewed as the different platform used by the other modules of the entire system made the system a bit more complicated and it takes time for data communication.

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# APPENDIX A

UNIVERSITI MALAYSIA PAHANG
FACULTY OF COMPUTER SYSTEMS & SOFTWARE ENGINEERING

# INTERVIEW MINUTES

**Attendance:**

1. En. Shafrizam Bin Abdul Wahab
2. En. Mohd. Rajimi Bin Kadir
3. Sue Qi Jian
4. Low Ching Chuan
5. Khalisah binti Abdul Basid
6.

**Purpose of the Project:**

1. Menjimatkan masa untuk setiap kes kecemasan.
2. Bersindat pantas. setiap Unit ~~tetap~~ mendapat gambaran awal tentang keadaan pesakit secara lebih terperinci.

**Procedure/ Processes during emergency:**

1. Terima panggilan dari fasiliti lain /ppp attending ambulan call untuk hantar pesakit
2. Mengambil data pesakit mengikut format buku daftar EMCR
3. Menandakan patak yang berkenaan/berkaitan dalam response plan dan mengambil tindakan serta merta.
4. Kes tiba :-
    1. Assesment, triaging dan daftar CHIS)
    2. History taking and clerking
    3. Order ix - Lab / x ray
    4. Menjalankan pro sedur
    5. Waiting result
    6. Assesment by medical officer
    7. Ke Treatment
5. Discharge / Admit / Refer

/Death - / Transfer
11 Hosp.

**Standard Material/ Attribute needed:**

**i. Ambulance**

1. Menggunakan Goverment Integrated Radio Network (GRIN) sebagai penghubungan antara Unit kecemasan dan ambulan.
2. Bagi arahan melalui audio.
3. Liputan yang menyeluruh
4. Talian berhubung dengan HTAA (Hospital Tengku Ampuan Afzan)
5. Para medik memberi rawatan terus di tempat kejadian
6. Call needed?
7. Info pesakit diberi secara audio
8. Panggil: matmal / jururotgen / juru x-ray yang terlibat.

**ii. ICU**

1. Terima maklumat daripada ambulan
2. Tulis maklumat pesakit dalam dbuku daftar emcr dan mengenalpasti rawatan yang di perlukan.
3. Menghubungi pihak yang berkenaan seperti doktor, matmal, juru x-ray, operation theater
4. Menjangka masa pesakit tiba (expected time arrived)

**iii. Doctor**

1. Permenant doctor
   - Bertugas pada waktu pejabat
2. Hospital pelan ditandakan oleh general doctor
3. Tugas general doctor dalam mengendalikan :-
   i) kes kecemasan
   ii) Sakit Buan
   iii) Penyakit kulit
   iv) Trauma
4. Terdapat 2 peringkat doktor dalam hospital pelan.
   i) Doktor Aktif - memberi rawatan segera kepada pesakit di dalam hospital.
   ii) Doktor Pasif - memberi rawatan segera kepada pesakit luar dan dalam hospital.

iv. Others

MOHD RAJMI BIN KADIR
Pembantu Peg. Perubatan U32
Unit Kecemasan & Trauma
Hospital Pekan, Pahang.
0139839767

1. Maklumat pesakit dicatat secara manual. Tidak di komputerkan (Computerized)
2. Semua maklumat disampaikan melalui panggilan.
3. Maklumat pesakit tidak diutamakan. Memberi rawatan dahulu
   1) Tidak mempunyai nama pesakit, nama waris, nombor telefon.

Data Needed:

- [x] Sample Data for Patient Case (if not confidential/ masking data)
- [x] Current System / Manual Processes
- [x] Structured Data for Form registration (kad pesakit < kad kuning (kes biasa), kes polis)
- [x] Form needed by every unit ×
- [ ] Sample Case for one of the emergency — insuran

Unit Responsible:

| | | |
|---|---|---|
| i. Pharmacy | : (Name) | (Phone) |
| | (Email) | |
| i. ICU | : (Name) | (Phone) |
| | (Email) | |
| ii. Emergency | : (Name) | (Phone) |
| | (Email) | |
| iii. X-ray (+ Naitias) | : (Name) | (Phone) - 1109, - 1102 |
| | (Email) | |
| iv. Blood Dialysis | : (Name) | (Phone) |
| | (Email) | |
| v. MLT | : (Name) | (Phone) |
| | (Email) | |
| vi. Physiotherapy | : (Name) | (Phone) |
| | (Email) | |
| vii. Wad | : (Name) | (Phone) |
| | (Email) | |
| viii. Others | : (Name) | (Phone) |
| | (Email) | |

1112
1109 ) x-tray
1119 - Lab
1138 - kecemasan

Agreement

I hereby verify this meeting as second official meeting/interview between Hospital Pekan and Faculty of Computer Systems & Software Engineering, Universiti Malaysia Pahang. All the data and information should be kept confidential and it is only for the purpose of Final Year Project by Sue Qi Jian, CB11067; Low Chang Chuan, CA11080; Khalisah Binti Abd. Basid, CA11078.

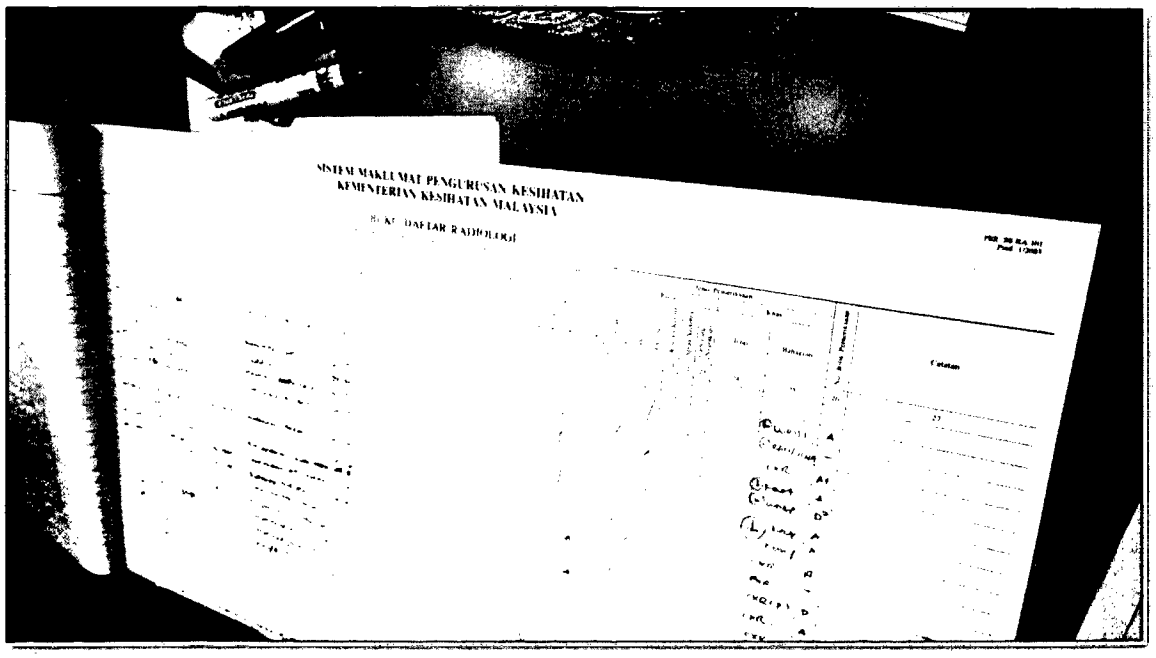
Prepared by,

(Khalisah Binti Abd. Basid)
CA11078
Student of FSKKP
Universiti Malaysia Pahang
Representative

Verified by,

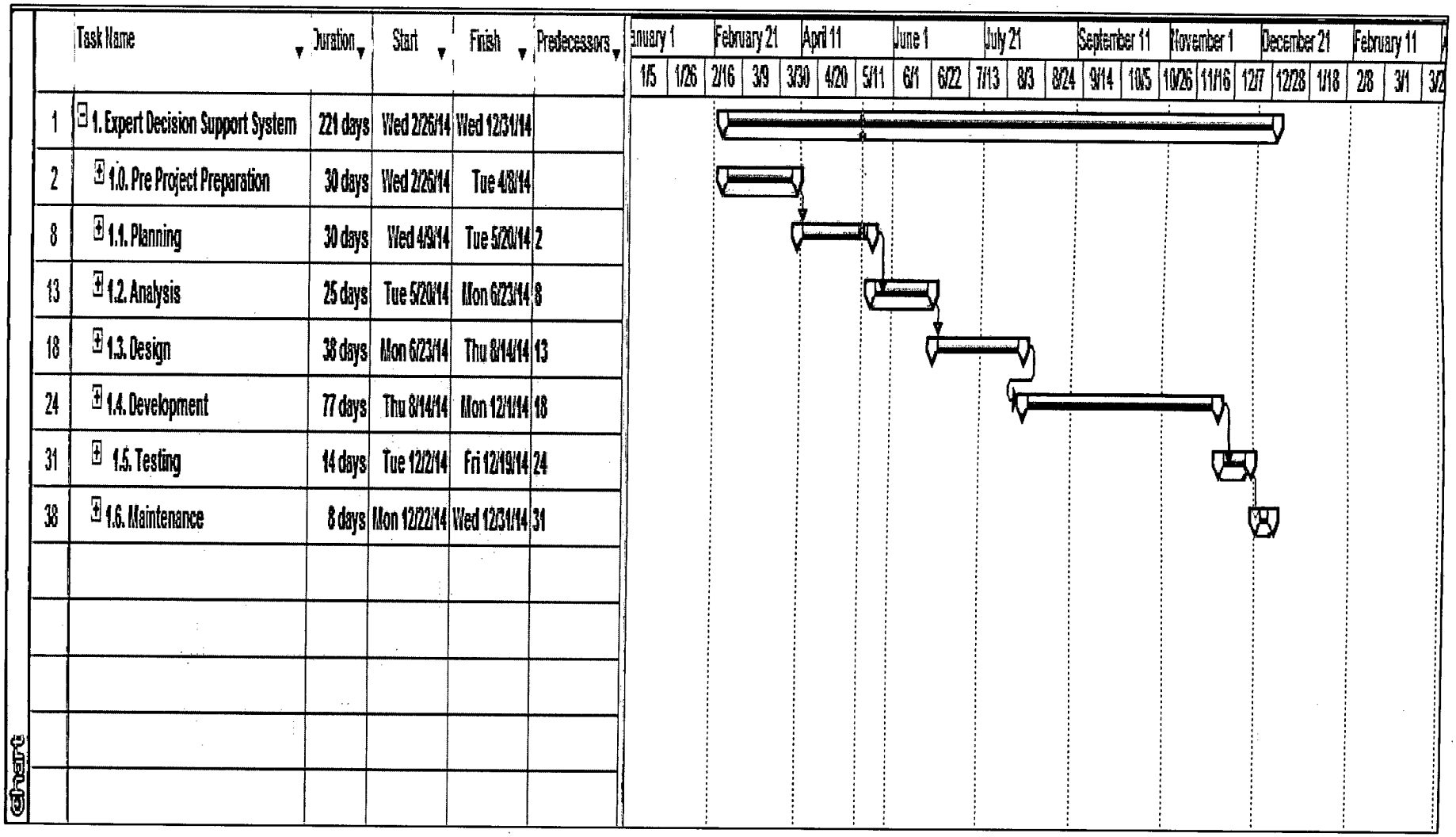
( MOHD RAJIMI BIN KADIR )
Oggobiog Peg. Perubatan U32
Unit Kecemasan & Trauma
Hospital Pekan, Pahang.


Patologi


SISTEM MAKLUMAT PENGURUSAN KESIHATAN
KEMENTERIAN KESIHATAN MALAYSIA
Catatan

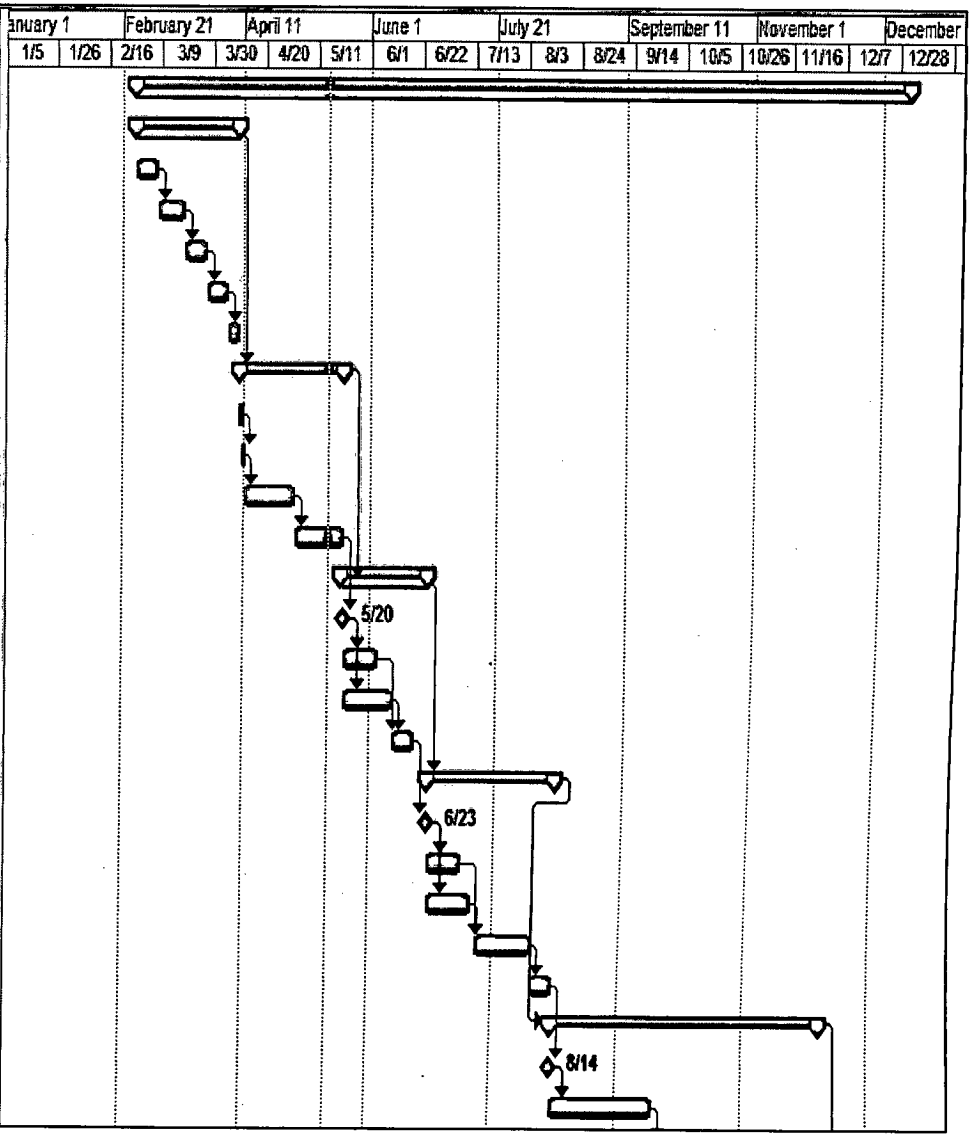

UNIT PENGIME
DIAG

# APPENDIX B


Gantt Chart
Task Name
Duration
Start
Finish
Predecessors
1 1. Expert Decision Support System 221 days Wed 2/26/14 Wed 12/31/14
2 1.0. Pre Project Preparation 30 days Wed 2/26/14 Tue 4/8/14
8 1.1. Planning 30 days Wed 4/9/14 Tue 5/20/14 2
13 1.2. Analysis 25 days Tue 5/20/14 Mon 6/23/14 8
18 1.3. Design 38 days Mon 6/23/14 Thu 8/14/14 13
24 1.4. Development 77 days Thu 8/14/14 Mon 12/1/14 18
31 1.5. Testing 14 days Tue 12/2/14 Fri 12/19/14 24
38 1.6. Maintenance 8 days Mon 12/22/14 Wed 12/31/14 31
January 1
February 21
April 11
June 1
July 21
September 11
November 1
December 21
February 11
1/5 1/26 2/16 3/9 3/30 4/20 5/11 6/1 6/22 7/13 8/3 8/24 9/14 10/5 10/26 11/16 12/7 12/28 1/18 2/8 3/1

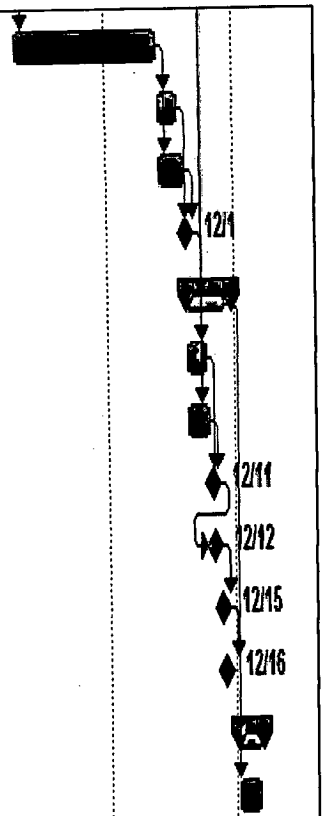
Gantt Chart

| | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **1. Expert Decision Support System** | **221 days** | **Wed 2/26/14** | **Wed 12/31/14** | |
| 2 | **1.0. Pre Project Preparation** | **30 days** | **Wed 2/26/14** | **Tue 4/8/14** | |
| 3 | 1.0.1. Supervisor Hunting | 7 days | Wed 2/26/14 | Thu 3/6/14 | |
| 4 | 1.0.2. Proposed Title | 7 days | Fri 3/7/14 | Mon 3/17/14 | 3 |
| 5 | 1.0.3. Project Discussion | 7 days | Tue 3/18/14 | Wed 3/26/14 | 4 |
| 6 | 1.0.4. System Distribution | 6 days | Thu 3/27/14 | Thu 4/3/14 | 5 |
| 7 | 1.0.4. Title Finalization | 3 days | Fri 4/4/14 | Tue 4/8/14 | 6 |
| 8 | **1.1. Planning** | **30 days** | **Wed 4/9/14** | **Tue 5/20/14** | 2 |
| 9 | 1.1.1 Meeting with Customer | 1 day | Wed 4/9/14 | Wed 4/9/14 | |
| 10 | 1.1.2. Delegation of Task | 1 day | Thu 4/10/14 | Thu 4/10/14 | 9 |
| 11 | 1.1.3. Define Project Scope & Risk | 14 days | Fri 4/11/14 | Wed 4/30/14 | 10 |
| 12 | 1.1.4. SPMP | 14 days | Thu 5/1/14 | Tue 5/20/14 | 11 |
| 13 | **1.2. Analysis** | **25 days** | **Tue 5/20/14** | **Mon 6/23/14** | 8 |
| 14 | 1.2.1. Meeting with Customer | 0 days | Tue 5/20/14 | Tue 5/20/14 | 12 |
| 15 | 1.2.2. Analyze the Problem | 10 days | Wed 5/21/14 | Tue 6/3/14 | 14 |
| 16 | 1.2.3. Requirements Analysis | 14 days | Wed 5/21/14 | Mon 6/9/14 | 14 |
| 17 | 1.2.4. SRS | 7 days | Tue 6/10/14 | Wed 6/18/14 | 16,15 |
| 18 | **1.3. Design** | **38 days** | **Mon 6/23/14** | **Thu 8/14/14** | 13 |
| 19 | 1.3.1. Meeting with Customer | 0 days | Mon 6/23/14 | Mon 6/23/14 | 17 |
| 20 | 1.3.2. GUI Design | 10 days | Tue 6/24/14 | Mon 7/7/14 | 19 |
| 21 | 1.3.3. Design Components | 14 days | Tue 6/24/14 | Fri 7/11/14 | 19 |
| 22 | 1.3.4. Design Database | 17 days | Mon 7/14/14 | Tue 8/5/14 | 21,20 |
| 23 | 1.3.5. SDD | 7 days | Wed 8/6/14 | Thu 8/14/14 | 22 |
| 24 | **1.4. Development** | **77 days** | **Thu 8/14/14** | **Mon 12/1/14** | 18 |
| 25 | 1.4.1. Meeting with Customer | 0 days | Thu 8/14/14 | Thu 8/14/14 | 23 |
| 26 | 1.4.2. Development of Database | 30 days | Fri 8/15/14 | Thu 9/25/14 | 25 |



Gantt Chart

| | | | | | |
|---|---|---|---|---|---|
| 27 | 1.4.3. Coding | 40 days | Fri 9/26/14 | Thu 11/20/14 | 26 |
| 28 | 1.4.4. Integrate Databases | 6 days | Fri 11/21/14 | Fri 11/28/14 | 27 |
| 29 | 1.4.5. Integrate System | 7 days | Fri 11/21/14 | Mon 12/1/14 | 27 |
| 30 | 1.4.6. System Prototype | 0 days | Mon 12/1/14 | Mon 12/1/14 | 28,29 |
| 31 | **1.5. Testing** | **14 days** | **Tue 12/2/14** | **Fri 12/19/14** | 24 |
| 32 | 1.5.1. Unit / Integration Testing | 6 days | Tue 12/2/14 | Tue 12/9/14 | 30 |
| 33 | 1.5.2. System Testing | 7 days | Tue 12/2/14 | Wed 12/10/14 | 30 |
| 34 | 1.5.3. SQAP | 1 day | Thu 12/11/14 | Thu 12/11/14 | 33,32 |
| 35 | 1.5.4. STP | 1 day | Fri 12/12/14 | Fri 12/12/14 | 34 |
| 36 | 1.5.5. SCMP | 1 day | Mon 12/15/14 | Mon 12/15/14 | 35 |
| 37 | 1.5.6. SVVP | 1 day | Tue 12/16/14 | Tue 12/16/14 | 36 |
| 38 | **1.6. Maintenance** | **8 days** | **Mon 12/22/14** | **Wed 12/31/14** | 31 |
| 39 | 1.6.1. Support Users | 7 days | Mon 12/22/14 | Tue 12/30/14 | 31 |



# APPENDIX C

Universiti Malaysia PAHANG

Faculty of Computer Systems & Software Engineering

**Project Deliverable Sign Off**

**Project Name** : EXPERT DECISION SUPPORT SYSTEM (EDSS) FOR DOCTOR SELECTION AT EMERGENCY DEPARTMENT USING CASE-BASED REASONING TECHNIQUE

**Project Manager** : SUE QI JIAN

**Date** : 19th December 2014

**Deliverable Sign-off**

The Approver's signature below indicates that the contents of the attached document have been reviewed and accepted subject to the following categories.

| Deliverable | Version | Description |
|---|---|---|
| EDSS | 1.0 | Expert Decision Support System |

Categories:

A Agree with contents
B Agree, subject to incorporation of comments
C Disagree, comments included

| Approvers Name/Title | Signature | Sign Date | Category | Comments |
|---|---|---|---|---|
| Khalisah Bt Abdul Basid Project Teammate | | 19/12 | A | — |
| Vilzen Low Project Teammate | | 19/12 | A | — |
| Mohd Rajimi Bin Kadir Assistance Medical Officer | | 19/12 | A | — |