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ON-LINE RECOGNITION OF DEVELOPING CONTROL CHART PATTERNS

AMIRAH MUHAMMAD IMRAN

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Bachelor of Computer Science (Data Engineering)

School of Computing
Faculty of Engineering
Universiti Teknologi Malaysia

MAY 2019

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DEDICATION

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time.

ACKNOWLEDGEMENT

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main thesis supervisor, Professor Dr. XX, for encouragement, guidance, critics and friendship. I am also very thankful to my co-supervisor Professor Dr YY and Associate Professor Dr. ZZZ for their guidance, advices and motivation. Without their continued support and interest, this thesis would not have been the same as presented here.

My fellow student should also be recognised for their support. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family member.

ABSTRACT

Abstract must be bilingual. For a thesis written in Bahasa Melayu, the abstract must first be written in Bahasa Melayu and followed by the English translation. If the thesis is written in English, the abstract must be written in English and followed by the translation in Bahasa Melayu. The abstract should be brief, written in one paragraph and not exceed one (1) page. An abstract is different from synopsis or summary of a thesis. It should states the field of study, problem definition, methodology adopted, research process, results obtained and conclusion of the research. The abstract can be written using single or one and a half spacing.

Your abstract is a brief summary of your research work. It provides information about the research problem, objectives, methodology used, findings, and recommendations. Your abstract should be just one paragraph, and typically not more than 100 words. Ensure that you stick to the word limit.

ABSTRAK

Translate to BM

TABLE OF CONTENTS

LIST OF TABLES

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LIST OF ABBREVIATIONS

ANN	-	Artificial Neural Network
GA	-	Genetic Algorithm
PSO	-	Particle Swarm Optimization
MTS	-	Mahalanobis Taguchi System
MD	-	Mahalanobis Distance
TM	-	Taguchi Method
UTM	-	Universiti Teknologi Malaysia
XML	-	Extensible Markup Language
ANN	-	Artificial Neural Network
GA	-	Genetic Algorithm
PSO	-	Particle Swarm Optimization

LIST OF SYMBOLS

δ	-	Minimal error
D, d	-	Diameter
F	-	Force
v	-	Velocity
p	-	Pressure
I	-	Moment of Inersia
r	-	Radius
Re	-	Reynold Number

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

What is the Final Year Project Industry (FYPi)?

Final year project industry (FYPi) is a course whereby each undergraduate student under Bachelor Science in Science Computer (Data Engineering) programme must undertake and pass in order to graduate. It aims is to equip students with knowledge and skills in problem solving/programming technique through appropriate academic and research activities. It is undertaken in two semesters each for SCSP 4112, SCSP 4233, SCSP 4235 and SCSP 4234.

1.1 Introduction

Introduction is an important chapter because it outlines the whole project and outcome. This is the first chapter that the examiners will read; hence giving a solid first impression is vital. A well written chapter will clearly describe the flow of the project. To have a well written chapter, a good understanding of the ground work is necessary

1.2 Problem Background

Problem formulation is a process to identify a problem, based on limitations or weaknesses of current systems or approaches.

Example:

Explain why current technology *T* is underperforming environment *Z*

How to identify the problem?

Identifying problems is a crucial process in a FYPi project. The following exercise will show a step by step guide in identifying the problem.

Step 1: Find the problem that needs solving, as such:

i. Problem given by the industry coach. It could be related to an organization, a community, a process or a procedure. The industry coach will provide the basic problem based on the real world and perhaps some ideas for a possible solution. The students can proceed from here.

ii. If the problem is not presented in a neat package, students themselves need to identify the problem domain. For example, *Mental Hospital XYZ*– how it works? How are the patients tracked currently? Can student propose an improved system? Do student think the new system would be better?

Now that the problem is identified, let's move on to the next step.

Step 2: Decide on what to do as this will determine the scope of the project.

Option 1: Do the student wants to develop a new enhanced system? If yes, follow the system development track.

Option 2: Do the student think that the current possible solutions in the market are not enough, and want to research a new way? If yes, follow the research track

Now follow the option that is selected. Refer to Table 4.2 for the exercise.

Table 4.2: Example of Formulating a Problem

System Development Based Project

● Study the current system and procedure in implementation at the mental hospital in Johor (for example)
● Study the available systems and procedure in other mental hospitals
● Study similar tracking systems that are available (e.g. UPS tracking of parcels)
● How to study? These methods (or instruments) may be followed:
  o Document analysis
  o Interview

- Observation
- Survey

- Proposing currently available technologies? Which will be best suited for the aim of the project (i.e. tracking the patients)
  - RFID
  - Chain them to the bedpost
  - Sensors
  - Buddy System
- Say that RFID is chosen. The possible questions that need to be addressed:
  - Why RFID? How does RFID help with solving this problem?
  - How does RFID function?
  - What are the hardware and software requirement?

Research Based Project

• Study the current system and procedure in implementation at the mental hospital in Johor (for example)
• Study the available systems and procedure in other mental hospitals
• Study similar tracking systems that are available (e.g. UPS tracking of parcels)
• How to study? These methods (or instruments) may be followed:
  ○ Document analysis
  ○ Interview
  ○ Observation
  ○ Survey
• Are the currently available technologies having flaws?
  ○ RFID – can be torn off, or the algorithm is weak/not optimized
  ○ Chain patient to the bedpost – too cruel/sadistic
  ○ Sensors – too expensive, not accurate
  ○ Buddy System – not effective and unreliable
• Let's say that two ways can provide a better solution to the problem, that is:
  ○ Enhance the RFID algorithm
  ○ Use embedded technology and embed a chip under the patient skin
• Choose one: Enhance the RFID algorithm.
• What now? Find the related issues.
  ○ Analyze the current algorithm
  ○ Analyze the available algorithm

- What are the issues?
- Performance
- Security
- Management
- Choose one issue (Remember: FYP cannot solve ALL the problems in the given time)

Example of project

System Development

This type of project is based on developing an application, software or embedded systems. The undertaken project must include programming elements with appropriate users's complexity and meets FYP scope. This type of project gives the students an opportunity to conduct exercise as a project developer in the area of computer networking, computer security and embedded system.

The projects must be determined and agreed upon by both academic supervisor(s) and industry supervisor. The complexity of system should comprise of at least two modules (sub-system). The project must involve following elements:

- Industry problems and needs
- Database design
- Manipulation of data

Examples of applications that have been developed in this area are web based application, smart building, RFID-based project, sensor, PDA-based application, mobile phone application including SMS, .NET application and TINI based systems.

Data Engineering

This type of project involve on the whole process of data processing. Students must be able to process the elements that move data from one system to another, possibly transforming the data along the way. The project must involve following elements:

- Data pipeline
- Data warehouse
- Extract, Transform, Load (ETL)

Research

This type of project is based on a research application that includes data analysis, comparative studies or enhancement of techniques or algorithms. FYPi research project aims to train student on techniques to solve industrial problem using computing technology. Student should be trained to identify/understand problems, set objectives, design methodology, analyse results and conduct technical writing.

Similar to project based, programming elements must be included in the research project. This type of project aims to groom the students with research skills in the area of computer networking, computer security and embedded system. It is suitable for students who are interested in Research and Development (R&D) careers such as academic professionals and researchers. Among the type of research project, that can be embark by students are as follows:

- Analytical models to support decisions in industry
- Data modelling
- Information architecture
- New theoretical model or framework based on data engineering
- Data driven business process design
- Data warehouse design
- Data visualisation
- Business inteligent development
- Algorithm design and development
- System development to prove a new concept in solving industry problem

Step 3: Formulate the scaffold of the problem solving by identifying the following points:

i. Problem background

ii. Problem statement: (where needed, you can have: hypothesis, research question)

iii. Objective

iv. Scope and assumption

v. Significance of project/research

1.3 Project Aim

- A single sentence statement.
- Explaining the key target of the project.
- Example:
  To develop a system *X* using technology Y to be employed in environment *Z*.

1.4 Project Objectives

- A minimum of three objectives and a maximum of four.
- Must be measurable

Objectives must be measurable and focused to the project. Measurable means that the outcome is clear. For example, if the objective is "*to study*"; the outcome will be a comparison table of several technologies. An example of an objective that cannot be measured is "*to help*". *Help* is very subjective, and it is difficult to detect the level that help has been given. Even the explanation is confusing, so this is not a good choice for an objective.

A generic example for the objectives is as follows, and it should be linked with the project:

i. Identify and study the problem domain; current and available technologies/system
ii. To analyze..
iii. To design..
iv. To implement the proposed solution/system
v. Test the developed solution/system for system performance and user acceptance

Table 4.4 shows the list examples of good objectives and examples of common mistakes that students often do when writing the objectives of their projects.

Table 4.4: Example of bad and good objectives statements for system development based project

Bad Objective	Good Objective
i. To study RFID tracking ii. To understand methods of RFID tracking Comment: Both of above objectives are not measurable.	i. To compare the methods of RFID tracking; current and available technologies/system ii. To design and implement the proposed solution/system iii. To test the developed solution/system for system performance and user acceptance
i. To use C language in developing the system. (This statement is a scope) ii. To improve the speed of the overall system performance. (This statement is an aim of the project)	i. To design (database/interface) using (technology/algorithm/method) – can be more than one design of subcomponents of system *X*. ii. To develop a system based on the design. (Example: System, server, client, integration.)

1.5 Project Scope

- Describes in detail tasks to be executed.
- Constraints regarding any part of the project development (e.g. size of system and technology).
- What will and will not be done as part of the project.

The scopes of the project are:

(a) Scope 1

(b) Scope 2

6.1 Project Importance

Importance of the project describes the justification of importance of a project. In essence, it is to explain why this project should be done and how it will solve the problem, while contributing to the targeted audience or domain.

1.6 Report Organization

CHAPTER 2

LITERATURE REVIEW

In Chapter 2, all the results and findings of the review of literature are presented. Literature review provides a sound basis for a good problem formulation and planning of project. From the literature review, student will be able to build the basic understanding of the project.

How to Start the Literature Review?

The process of starting a literature review is fairly simple if a strong understanding of project problem domain exists. The process can be grouped into these four major steps.

Step 1: Study the problem domain. Explain the area in which you are going to construct the project. Example:

- What is the objective or business of the organizations (example: What is the objective, purpose of the mental hospital)
- Organization Chart

Table 4.3: Example of Chapter 2 of the FYPi report

System Development Based Project	Research Based Project
Chapter 2 : Literature Review 2.1 Introduction 2.2 Inter-organisation Case Study (if any) • To identify user requirements 2.3 Current system analysis (e.g.: product/prototype/software/tools) • Characteristics of the system 2.4 Compare between existing systems	**Chapter 2: Literature Review** 2.1 Introduction to case study 2.2 Problem formulation • Study of domain from general to specific • Related studies • A description of the identified problem • Study of theory/algorithm/method that

• Ensure strength and weakness between systems 2.5 Literature review on technology used 2.6 Chapter summary	can contribute towards solving the problem. • Justification of chosen theory/algorithm/method • Every sub-topic within the domain must have a review 2.3 Suggestions to solve identified problems 2.4 Chapter summary

Step2: Study the current system and procedure in implementation at the mental hospital in Johor, study the available systems and procedure in other mental hospitals, study similar tracking systems that are available (e.g. UPS). Some approach can be:

i. Document analysis
   - Read papers, journals, articles, previous thesis, product catalog, books etc
   - Take note: comparison, list the features and characteristics, list the issues and etc.

ii. Interview
   - Interview the responsible person (e.g. mental hospital manager)
   - Outline the questions to ask, take notes of answers, analyze later

iii. Observation
   - Observe the implementation of the current system in practice, observe the process and procedure
   - Take notes and analyze later

iv. Survey
   - Outline the questions to ask; ask simple, straightforward questions
   - Choose the appropriate respondents
   - Collect and analyze later

Step 3: Study the existing solution to the problem. For example, developing a system using RFID is chosen then the study should include:

- Why RFID? How does RFID help with solving this problem?
- How does RFID work? Configuration, reading/writing

- Active tags against Inactive tags?
- Identify the software and hardware required.
- Study existing systems that uses RFID for tracking (advantages and disadvantages, limitations).

Step 4: If there exist a need for integration within the project, study how the integration is to be done. Study the available application/software, Application Programming Interface (API) and Software Development Kit (SDK) that can best work together to achieve the aim of the project. Example:

- Integration between RFID reader/writer and database
- Integration between RFID reader/writer and the web application

2.1 Introduction

2.2 Case Study (If any)

Study of domain from general to specific, related studies, a description of the identified problem.

2.2.1 Company JCORP Organization Structure

2.2.2 Manual Operation

6.2 Current System Analysis (Current System to Get Feedback)

2.3 Related previous study no Sentiment

2.4 Literature Review of Related Theory Used

For example
What is E-Commerce
What is the previous E-Commerce system architecture

2.5 Literature Review of Technology Used

2.6 Chapter Summary

CHAPTER 3

METHODOLOGY

The methodology chapter of the FYPi report (Chapter 3) describes the way or method of implementing the project. The chapter is crucial in planning the project to ensure a successful implementation. This guideline given here will provide essential help for students to have a well-written Methodology chapter of the FYPi report.

Methodology describes the overall approach and framework chosen for research and system development. The content for the methodology chapter of the FYPi report can hold methods, techniques or approach that is used during design and implementation of the project. In addition, this chapter also justifies the choice of methods or approach, as well as hardware and software requirements. It must be noted that the primary objective is not to explain the functions of each phase but rather the process that goes on within in. Table 5.1 shows the outline of Chapter 3 of the FYPi report. This outline must be followed, although slight modifications that enhance understanding of the project are accepted.

Table 5.1: Example of Chapter 3 of the FYPi report

System Development Track
Chapter 3: System Development Methodology 3.1 Introduction 3.2 Methodology choice and justification. 3.3 Phases within the chosen methodology (traditional or modern) ● Describes activities and process in each phase ● Design modelling (e.g. using UML) ● Design tools (e.g. Rational Rose) ● Gantt Chart for FYPi1 and FYPi2 3.4 Describe briefly the technology or tools used to develop the system.

3.5 System requirement analysis: hardware and software

- List and justify

3.6 Chapter summary

Research Track
Chapter 3: Research Methodology 3.1 Introduction 3.2 Operational Framework/Research Workflow • Details of each research phase of with regards to research objectives. • Gantt Chart for FYPi1 and FYPi2 3.3 Justification • Tools • Data • Technique 3.4 Performance Measurement 3.5 Chapter summary

A software development methodology refers to the framework that is used to structure, plan, and control the process of developing software. The framework of a software development methodology consists of:

i. A software development approach that consists of systematic software development process

ii. Software development models to assist in the software development process

iii. Software development tools

Software development approach is divided into two categories: traditional and modern approach. Examples of the traditional approach are Waterfall and Prototyping, while an example of a modern approach is Rational Unified Process.

Any approach selected to be used in the project must be justified. For instance, a Waterfall model is suitable to be used for the following types of project:

i. Project is for development of a mainframe-based or transaction-oriented batch system.

ii. Project has clear objectives and solution.

iii. Project requirements can be stated unambiguously and comprehensively.

iv. Project requirements are stable or unchanging during the system development life cycle.

In some situation, a Waterfall system development approach is not suitable to be applied. The types of project are as follows:

i. Large projects where the requirements are not well understood or are changing for any reasons such as external changes, changing expectations, budget changes or rapidly changing technology.
ii. Real-time systems.
iii. Event-driven systems.
iv. Leading-edge applications.

Projects that are suitable to apply prototype system development approach are as follows:

i. Project is for development of an online system, requiring extensive user dialog, or for a less well-defined expert and decision support system.

ii. Project is large with many users, interrelationships, and functions, where project risk relating to requirements definition needs to be reduced

iii. Project objectives are unclear.

However, the following projects might not suitable to apply prototype system development approach:

i. Mainframe-based or transaction-batch oriented system

ii. Project objectives are very clear;

The following projects might want to consider applying Rational Unified Process (RUP) (i.e. modern system development approach):

i. Large projects where requirements are not well understood or are changing due to external changes, budget changes or rapidly changing technology.

ii. Web Information systems

iii. Real-time or safety-critical systems

iv. A high degree of accuracy is essential

v. Computationally complex systems, where complex and voluminous data must be analyzed, designed and created within the scope of the project.

vi. Leading edge applications

For software model, students could use traditional method such as Entity Relationship Diagram (ERD) or choose to use Unified Modeling Language (UML) to represent their proposed system. At least the following components must be presented in the report/thesis as part of project's requirement analysis:

i. Use case diagram

ii. Sequence diagram

iii. Overall system architecture

Research

A research framework is a collection of interrelated steps or processes but not necessarily so well worked-out. The framework provides logical steps in guiding the research such as determining what things will be delivered, measured, what are the inputs to each steps and outputs of the research. An example of research framework is shown in Figure 5.1 below.

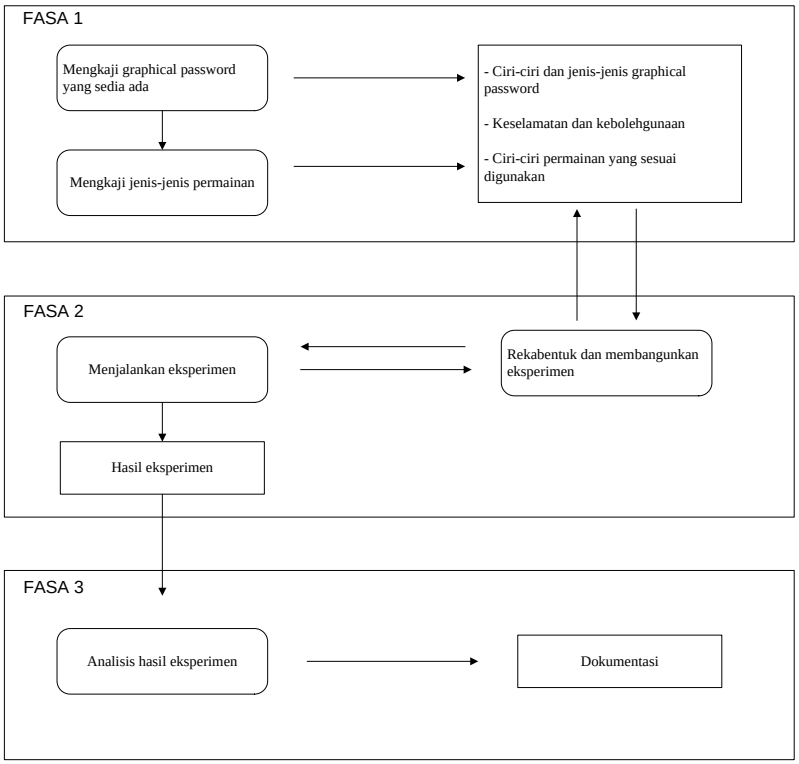


Figure 5.1: An example of research framework

iii. Data analysis and measurement techniques basically depend on the research nature and the research question. Some examples of data analysis are finding the average, median, standard deviation and the distribution. The results from the analysis can be presented in form of graphs (pie graphs, bar graphs, line graphs and etc), tables (values, percentage), matrices and etc.

iv.

Performance measurement is used to benchmark the result of the work with other existing similar works. Examples include speed, overhead, recall, precision and accuracy. In some cases this can be used to indicate the success of the research.

3.1 Introduction

3.2 Methodology Choice and Justification

3.3 Phases of the Chosen Methodology

3.4 Technology Used Description

3.5 System Requirement Analysis

3.6 Chapter Summary

This chapter described the guideline to write the methodology chapter of the FYPi report (Chapter 3). It also includes additional information on certain aspects of the methods used in system development and research projects respectively.

CHAPTER 4

ANALYSIS AND DESIGN

This chapter focuses on the design chapter of the FYPi report that is Chapter 4. Design is important because it differentiates from one project to another, and a mishap in design will spell failure in achieving the project objectives. This guideline will serve the purpose to demystify the design process.

The Content of Design Chapter

Design will outline the flow and modules in research and system development respectively. A good design will aide in a successful implementation of the project. In SCSP 4233 the design chapter will chart a provisional design that may require review as the project gets underway. In SCSP 4234, the design chapter reports the design of the completed system. The content will include system architecture, interface design, database design, and the related/appropriate techniques and algorithms. This chapter will also contain Data Flow Diagram (DFD), use case diagram, sequence diagram, class diagram, ERD and others, associated with the application development model chosen (structured or object-oriented). Table 4.1-Table 4.3 shows example outline of Chapter 4 of the FYPi report.

Table 6.1**:** Example of Chapter 4 of the FYPi report

System Development Track
Chapter 4: Analysis and Design (SECP 4223/SECP4234)
4.1 Introduction
4.2 System Architecture (System Flow, Module, Input, Output)
4.3 Requirement analysis ● OOP (use case, sequence, and activity diagrams) or ● Traditional (Software Development Life Cycle)
4.4 Design ● System/Process Design o UML (Use case, Sequence etc)/DFD

4.4	Database design (if any) ● ERD (for traditional methodology) ● Normalized tables (to include primary key, foreign key, etc.)
4.5	Interface design ● Menu and screen design ● System navigation and content design ● For web page project to include page navigation
4.6	Chapter summary

Table 6.2**:** Example of Chapter 4 of the FYPi report

Data Engineering Track	
Chapter 4: Analysis and Design (SECP 4223/SECP4234)	
4.5	Introduction
4.6	System Architecture (System Flow, Module, Input, Output)
4.7	Requirement analysis ● OOP (use case, sequence, and activity diagrams) or ● Traditional (Software Development Life Cycle)
4.8	Design ● System/Process Design ○ UML (Use case, Sequence etc)/DFD
4.7	Database design (if any) ● ERD (for traditional methodology) ● Normalized tables (to include primary key, foreign key, etc.)
4.8	Data Engineering Process • Data Source • Extraction/Transformation/Loading
4.9	Dashboard • Chart and dashboard design
4.10	Interface design ● Menu and screen design ● System navigation and content design ● For web page project to include page navigation
4.11	Chapter summary

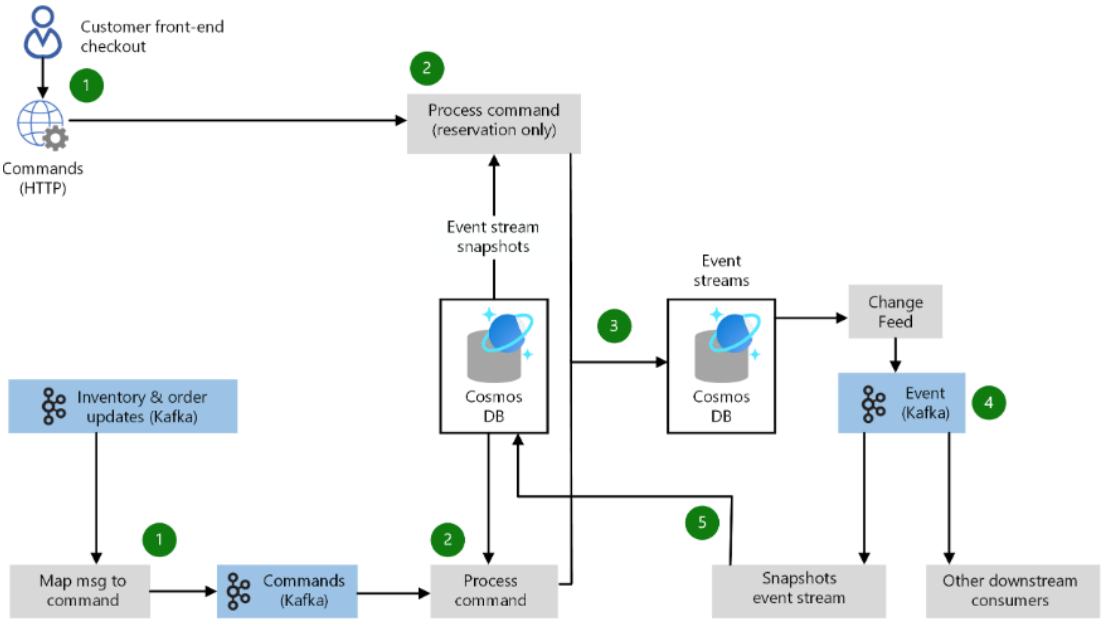
Table 6.3**:** Example of Chapter 4 of the FYPi report

Research Track
Chapter 4: Research Design and Implementation (SECP 4223/SECP4234) 4.1 Introduction 4.2 Proposed Solution • Explain possible solution 4.3 Experiment design • Identify overall flow • Identify and explain test-bed/simulation setup 4.4 Parameter and testing methods • Identify parameters involved • Identify parameters to be measured • Explain how testing is done 4.5 Chapter summary

Example of System Architecture

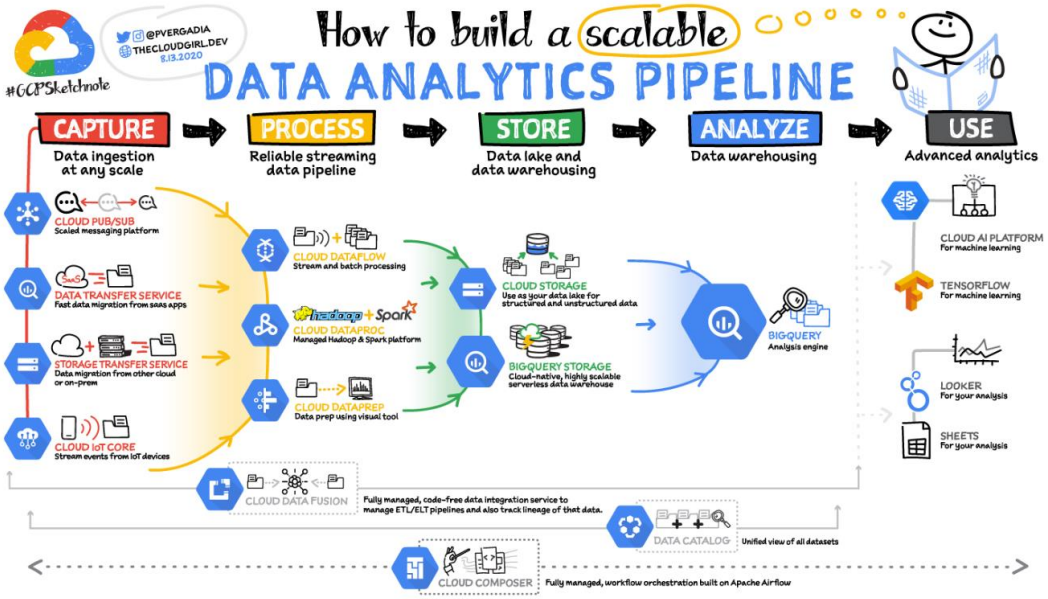
Example: Scalable order processing

https://learn.microsoft.com/en-us/azure/architecture/example-scenario/data/ecommerce-order-processing



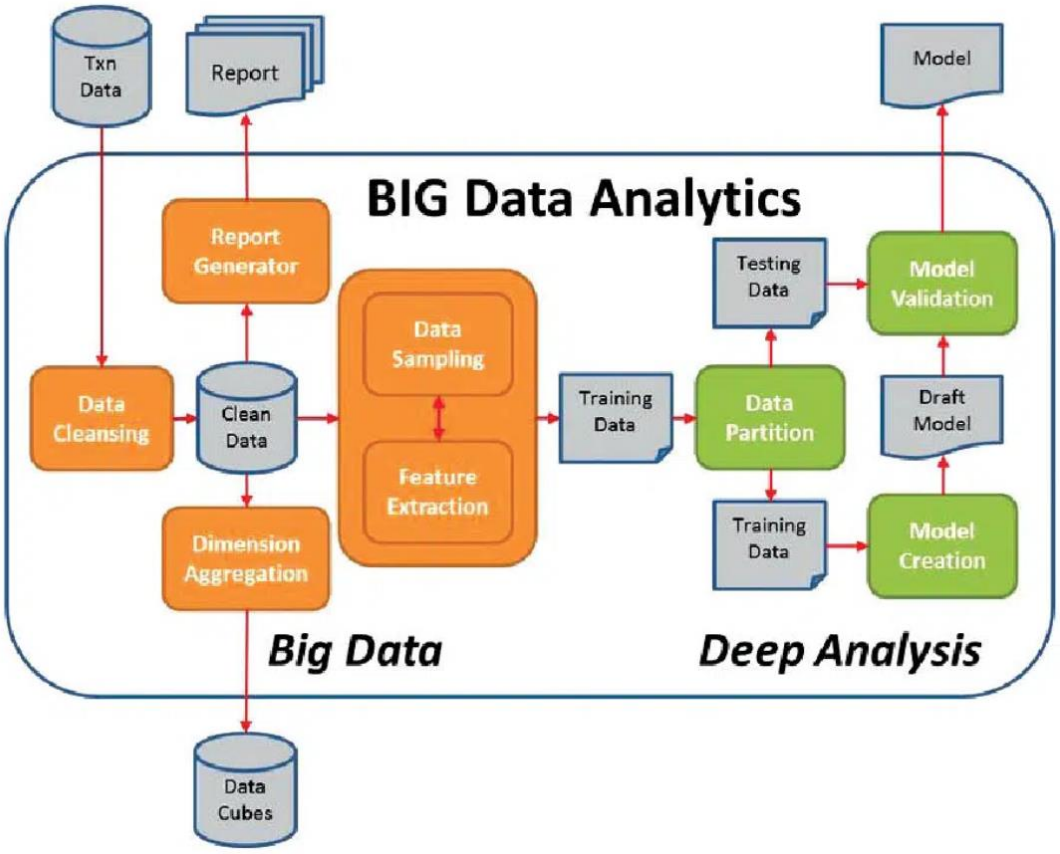
Example: Scalable Data Analytics Pipeline

https://www.freecodecamp.org/news/scalable-data-analytics-pipeline/



Example: ***Architecture for Big Data analysis***

https://www.opensourceforu.com/2017/09/open-source-tools-you-can-use-to-handle-big-data/



Coding of System Main Functions

Additional Guideline for System Development

For interface design, apart from menu, screen, content, and system navigation design, students also need to illustrate page navigation design to assist readers in understanding the overall system workflow. Examples of use case, sequence, content and page navigation designs are as illustrated in Figures 6.1 to 6.4.

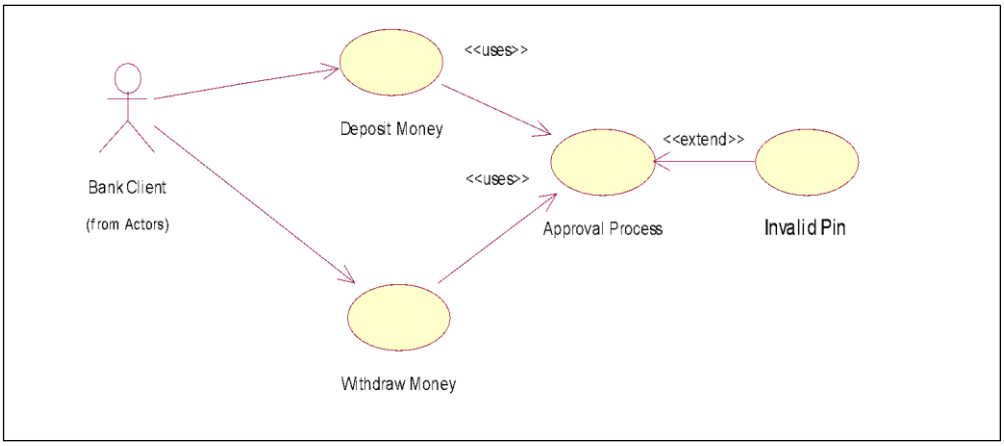
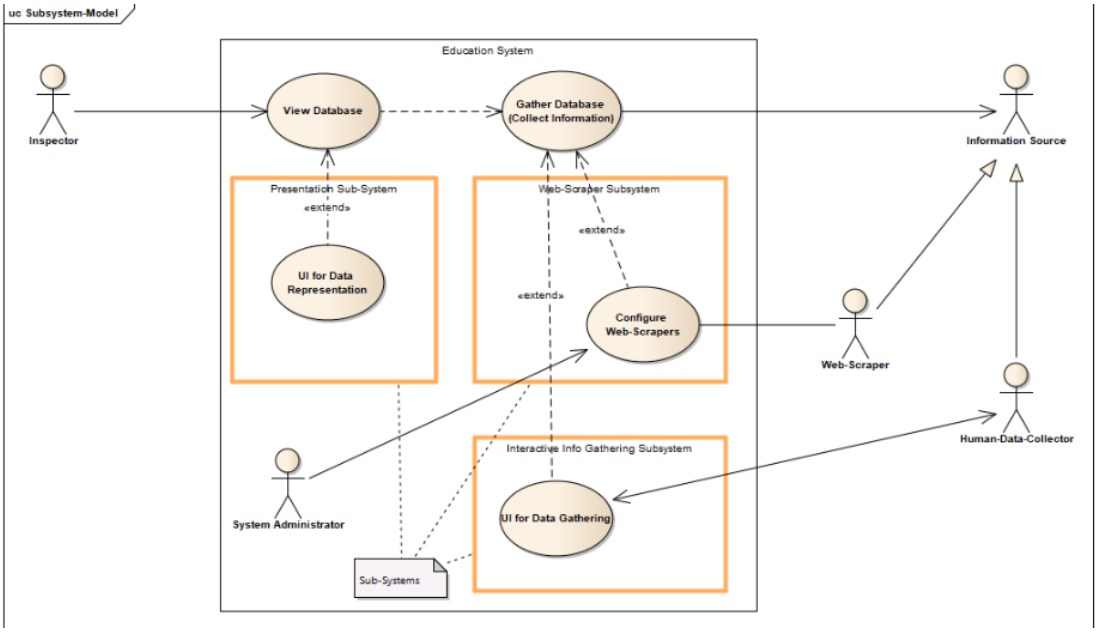


Figure 6.1: Example of Use case diagram

Figure 6.2: Example of Use case diagram for data collection

https://itecnotes.com/software/use-case-diagram-for-data-collection/



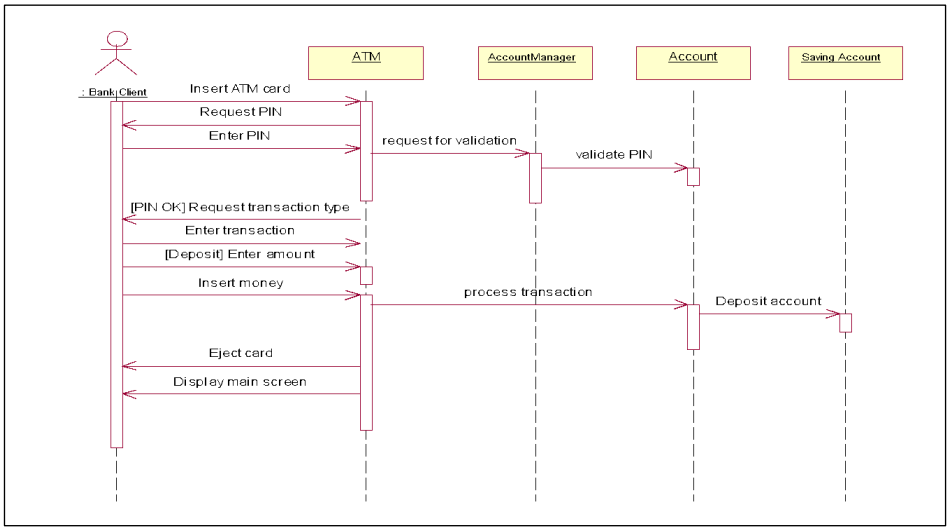


Figure 6.2: Sequence diagram

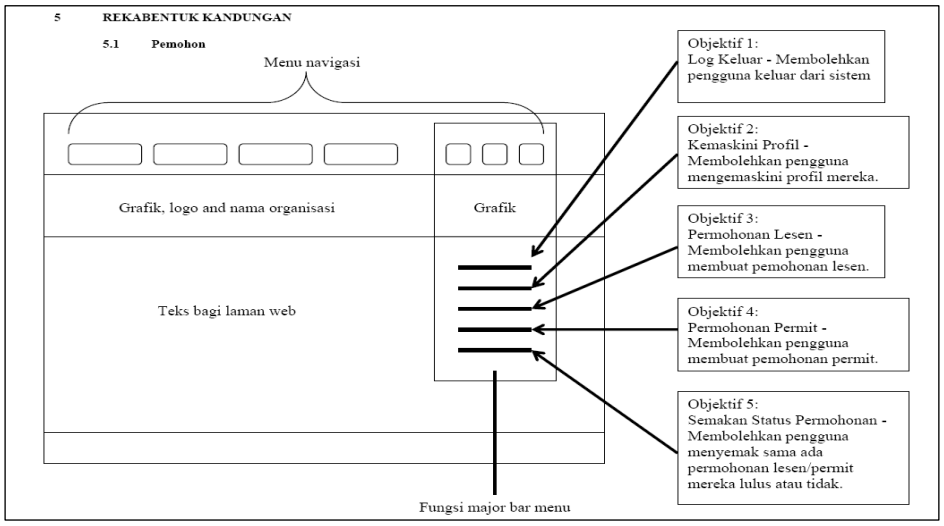


Figure 6.3: Content Design

Additional Guideline for Research

Experimental design involves elaboration on any algorithm or any instruments which may be used in the project.

All experiments were performed in a *Windows machine having configurations Intel (R) Pentium(R) 4, 1.70 GHz (over 1.72 GHz), 512 MB RAM*. We have used *RF version (R 2.2.0) in open source R-project* [19]. We have used the *KDD 1999 CUP labeled dataset* [6] so as to evaluate our approach. Stolfo *et al.* [8] defined higher level features that help in distinguishing normal connections from attacks. The *dataset contains 24 different types of attacks* that are broadly categorized in four groups such as probes, DoS (Denial of Service), U2R (User to Root) and R2L (remote to local). *Each instance of data consists of 41 features* which we have labeled as *f1, f2, f3, f4* and so forth. We only used DoS type of attacks, since other attack types have very small number of instances so that they are not suitable for our experiments [15]. The dataset is consists of training set and testing set. We randomly *split the set of labeled training set into two parts*; *learning set and validation set*. Learning set is used to adjust the parameters in RF. Validation set is used to estimate the generalization error of detection model. The generalization errors are represented

> as OOB errors in RF. In order to achieve both low generation errors, in other words, high detection rates, we have adopted *10-fold cross validation with 2000 samples*. Testing set is used to evaluate detection model built by learning set and validation set (Dong *et al*., 2006).

Above is a description of experimental setup extracted from a technical paper. Generally it contains, equipments used in the experiments, description of the dataset used and what are the parameters used. In the case of a project which involves a survey, it is necessary to explain the design of the questionnaire and the objective or reason for each question being asked. Sometimes, research based project may deal with modification of an existing algorithm. Therefore, it is required to show the flowchart and the pseudo codes of the modified algorithm.

Parameters used in the experiment are essential as they may affect the performance of the simulation of the proposed approach/algorithm. Therefore, they must be clearly mentioned in this chapter. Besides, there are also parameters that will be measure, for example, parameter to be measured is bandwidth, while parameters that may be involved are number of packets and types of packets.

EXAMPLE OF OUTLINE IN CHAPTER 4

4.1 Introduction

4.2 System Architecture

4.3 Requirement Analysis

4.4 Project Design

4.5 Database Design

4.6 Interface Design

4.7 Chapter Summary

This chapter described the guideline to write the design chapter of the FYPi report that is Chapter 4. The design approach is slightly different depending upon the type of project, either system development or research. It also includes additional information on certain aspects of design that can be employed in system development and research projects respectively.

Title	Title	Title	Title	Title	Title	Title

Table 4.1 Regression analysis for the results of preliminary feature screening

CHAPTER 5

IMPLEMENTATION AND TESTING

This chapter discusses the process and writing of a very important chapter in the SCSP 4234 Report that is *Implementation and Testing* (Chapter 5). The discussion of implementation and testing is vital as it relate with the importance and achievement of the project. It is expected that student will be able to write the chapter effectively with the guide provided in this chapter.

Implementation, Testing

The implementation chapter will successfully explain all the results achieved through project coding, experiments and testing. The chapter may be expanded into more than one chapter according to the project. The results of the project implementation are discussed in detail here. Documents and proof of correctness of the project must be attached. Testing types and techniques, as well as testing results, must be stated. Table 5.1 and 5.2 shows suggested outline of Chapter 5 of the FYPi report

Table 5.1:Example of Chapter 5 of the FYPi report

System Development Based Project
Chapter 5: Results, Testing and Discussion
5.1 Introduction 5.2 Coding of system's main functions 5.3 Essential interfaces that show system's results and achievements 5.4 Testing 5.4.1 Black box testing ● System flow, input/output, error messages 5.4.2 White box testing 5.4.3 User testing

5.5 Chapter summary

Table 5.2: Example of Chapter 5 of the FYPi report

Research Based Project
Chapter 5: Results, Analysis and Discussion
5.1 Introduction 5.2 Research results and analysis • Discussion • Tables, Graph etc. 5.3 Chapter summary

Additional guideline for system development

Software testing is one of important phases in a system development process. There are two common testing methods, which are White Box Testing and Black Box Testing. Next section briefly describes these two software testing methods, respectively.

White box testing

White-box testing is a method of testing application software. It tests the internal structures or the workings of an application, as opposed to its functionality. White-box testing examins the internal perspective or logic of the system. This method requires programming skills to design test cases. Different input data are chosen to exercise all possible paths through the code and to determine the appropriate outputs.

White-box test design techniques include:

i. Control Flow testing / Branch Testing
ii. Data flow testing (Data Tracking)
iii. Path testing (Logic Testing)

White-box testing can be applied at the module, integration and system levels. It can test paths within a module, paths between modules during integration, and between subsystems during a system level test. Though this method of test design can uncover many errors or problems, it might not detect unimplemented parts of the specification or missing requirements.

Black box testing

Black-box testing is a method of software testing that tests the functionality of an application. Specific knowledge of the application's code/internal structure and programming knowledge in general is not required. Test cases are built around specifications and requirements that is what the application should suppose to do. It uses external descriptions of the software, including specifications, requirements, and designs to derive test cases. The test designer selects valid and invalid inputs and determines the correct output.

Additional guideline for research

Following the research method described in the Methodology chapter, discussion should include the analysis and discussion of the results. It is encouraged that discussions are accompanied with graphs, charts or tables for enhanced clarification. Figure 7.1, figure 7.2, figure 7.3 and figure 7.4 are some examples of result presentations and discussion of the result.

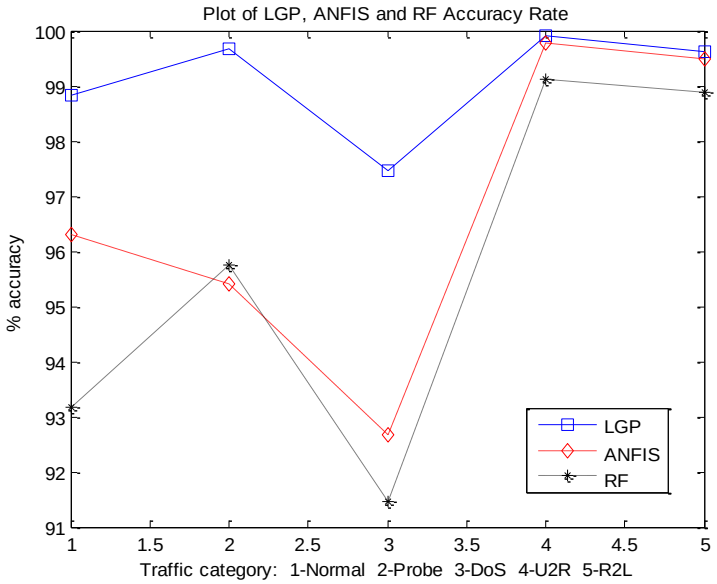


Figure 7.1: Example of a line graph

Performance Measure	Baseline(%)	RRA(%)	EA-IDS(%)
Overall Accuracy	96.764	98.845	**99.144**
FAR	16.082	5.591	**2.453**
Hit Rate	99.944	**99.948**	99.550

Figure 7.2: Example of a table

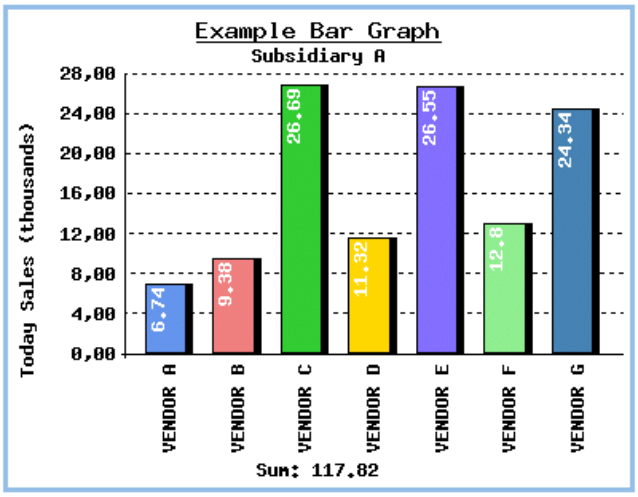


Figure 7.3: Example of a bar chart

Performance Measure	Baseline(%)	RRA(%)	EA-IDS(%)
Overall Accuracy	96.764	98.845	**99.144**
FAR	16.082	5.591	**2.453**
Hit Rate	99.944	**99.948**	99.550

Generally, the overall detection accuracy has improved from 96.764% (Baseline) to 99.144% (EA-IDS) and FAR was greatly reduced from 16.082% (Baseline) to 2.453. The hit rate remains stable which is almost reaching 100% correctly ability to segregate between attacks and normal.

Figure 7.4: Example of a table with its discussion.

EXAMPLE OF OUTLINE IN CHAPTER 5

5.1 Introduction

5.2 Coding of System Main Functions

5.3 Interfaces of System Main Functions

5.4 Testing

5.5 Chapter Summary

This chapter presented guidelines for analysis and discussion chapter of the FYPi thesis. This chapter is important as it presents the outcomes of the project or findings of the research.

CHAPTER 6

CONCLUSION

This chapter focuses on the concluding in the FYPi report. Conclusion in SCSP 4233 and SCSP 4234 is handled differently. This guideline presents an effective way of concluding the FYPi report.

FYPi Conclusion Chapter (Chapter 6) summarizes the whole project undertaken by a student. It discusses results and achievements of the project as well as suggestions and future works. Project strength, weaknesses and suggestions to improve must be stated clearly and concisely.

Table 8.1: Example outline of Chapter 6 of SCSP 4233 & SCSP 4234 report

System Development Based Project	
SCSP 4233 **Chapter 5: Conclusion** 5.1 Introduction ● Restate the project significance and objectives. 5.2 Achievements ● Briefly explain findings based on literature review ● Briefly explain any objectives that has been concluded or partially concluded 5.3 Suggested plan for project implementation/execution (SCSP 4234)	SCSP 4234 **Chapter 6: Conclusion** 6.1 Introduction 6.2 Achievement of project objectives ● Project contribution 6.3 Suggestions for future improvement

Table 8.1: Example outline of Chapter 6 of SCSP 4233 & SCSP 4234 report

Research Based Project	
SCSP 4233 **Chapter 5: Conclusion** 5.1 Introduction • Restate the project significance and objectives. 5.2 Achievement/milestone achieved • Briefly explain findings based on literature review • Briefly explain any objectives that has been concluded or partially concluded 5.3 Preliminary results (if any) 5.4 Suggested planning for SCSP 4234	SCSP 4234 **Chapter 6: Conclusion** 6.1 Introduction 6.2 Achievement of project objectives 6.3 Research Contribution (if any) 6.4 Suggestions for improvement and future works

6.1 Introduction

- Restate the project significance and objectives.

6.2 Achievement of Project Objectives

- Briefly explain findings based on literature review
- Briefly explain any objectives that has been concluded or partially concluded

6.3 Suggestions for Future Improvement

Suggested plan for project implementation/execution.

NOTES

When labeling the figures and tables in the appendices, it is recommended that it begins with the name of the appendix. For example, figures in Appendix A will be labeled Figure A1, Figure A2 and so on; while tables in Appendix A will be labeled Table A1, Table A2 and so on. It is not advisable to continue the labeling from the main text, even if the appendix is an extension of the main text. For example, if Appendix C holds the database tables that are not put into the main text in Chapter 4 (Design), it must not be labeled as Figure 4.xx.

APPENDIX

Appendices provide supporting materials that will strengthen the explanation and review of the project. Listed below are some of the generic items that may be put into appendices (please be reminded that this list is not exhaustive).

i. **User manual:** A comprehensive guide to the developed system. It should include installation guideline, screenshots, navigation explanations and anything else that will guide the user of the system. User manuals are not a requirement for research projects.

ii. **Supporting documents:** Supporting documents can be in the form of graphs, figures, questionnaires, surveys, and interview excerpts. It is not advisable to put ALL of the questionnaires and surveys in the appendices. A better option is to put a random sample of a completed one.

iii. **Data used in research**: For research-based projects, it is at times prudent that snippets of data or the datasets used for the research is shown in appendix.

REFERENCES

Chen, M.-C. and Huang, S.-H. (2003) 'Credit scoring and rejected instances reassigning through evolutionary computation techniques', *Expert Systems with Applications*, 24(4), pp. 433–441.

Clerc, M. and Kennedy, J. (2002) 'The particle swarm - explosion, stability, and convergence in a multidimensional complex space', *IEEE Transactions on Evolutionary Computation*, 6(1), pp. 58–73.

Gosnell, M., Woodley, R., Hicks, J. and Cudney, E. (2014) 'Exploring the Mahalanobis-Taguchi Approach to Extract Vehicle Prognostics and Diagnostics', in *Computational Intelligence in Vehicles and Transportation Systems (CIVTS), 2014 IEEE Symposium on*, pp. 84–91.

Gupta, A. (2015) 'Classification of Complex UCI Datasets Using Machine Learning Algorithms Using Hadoop', *International Journal of Scetific & Techology Research*, 4(5), pp. 85–94.

Hu, J., Zhang, L., Liang, W. and Wang, Z. (2009) 'Incipient mechanical fault detection based on multifractal and MTS methods', *Petroleum Science*, 6(2), pp. 208–216.

Huang, C.-L., Chen, Y. H. and Wan, T.-L. J. (2012) 'The mahalanobis taguchi system—adaptive resonance theory neural network algorithm for dynamic product designs', *Journal of Information and Optimization Sciences*, 33(6), pp. 623–635.

Jain, A. K. A. K., Duin, R. P. W. and Mao, J. (2000) 'Statistical pattern recognition: a review', *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 22(1), pp. 4–37.

Khalid, S., Khalil, T. and Nasreen, S. (2014) 'A survey of feature selection and feature extraction techniques in machine learning', *2014 Science and Information Conference*, pp. 372–378.

Li, C., Yuan, J. and Qi, Z. (2015) 'Risky group decision-making method for distribution grid planning', *International Journal of Emerging Electric Power Systems*, 16(6), pp. 591–602.

Lv, Y. and Gao, J. (2011) ‘Condition prediction of chemical complex systems based on Multifractal and Mahalanobis-Taguchi system’, in *ICQR2MSE 2011 - Proceedings of 2011 International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering*, pp. 536–539.

der Maaten, L. J. P., Postma, E. O., den Herik, H. J., van der Maaten, L., Postma, E. O., van den Herik, J., der Maaten, L. J. P., Postma, E. O. and den Herik, H. J. (2009) ‘Dimensionality Reduction: A Comparative Review’, *Technical Report TiCC TR 2009-005*, 10(January), pp. 1–41.

Motwani, R. and Raghavan, P. (1996) ‘Randomized algorithms’, *ACM Computing Surveys*, 28(1), pp. 33–37.

Qinbao Song, Jingjie Ni and Guangtao Wang (2013) ‘A Fast Clustering-Based Feature Subset Selection Algorithm for High-Dimensional Data’, *IEEE Transactions on Knowledge and Data Engineering*, 25(1), pp. 1–14.

Rao, V. M. and Singh, Y. P. (2013) ‘Decision Tree Induction for Financial Fraud Detection’, in *Proceeding of the International Conference on Artificial Intelligence in Computer Science and ICT (AICS 2013)*, pp. 321–328.

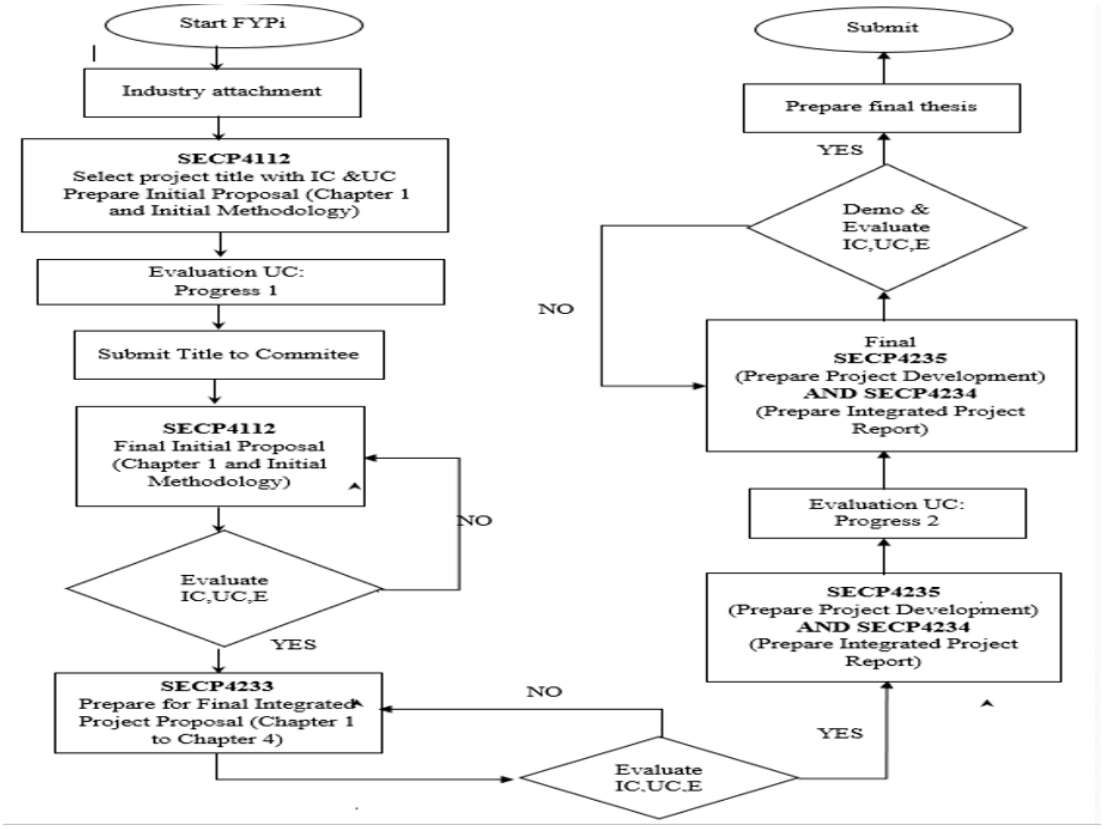
Shi, Y. and Eberhart, R. (1998) ‘A modified particle swarm optimizer’, 1998 IEEE International Conference on Evolutionary Computation Proceedings. IEEE World Congress on Computational Intelligence (Cat. No.98TH8360), pp. 69–73.

Soylemezoglu, A., Jagannathan, S. and Saygin, C. (2011) ‘Mahalanobis-Taguchi system as a multi-sensor based decision making prognostics tool for centrifugal pump failures’, *IEEE Transactions on Reliability*, 60(4), pp. 864–878.

Theodoridis, S., Koutroumbas, K., Holmstrom, L. and Koistinen, P. (2009) *Pattern Recognition, Wiley Interdisciplinary Reviews Computational Statistics*.

Zaki, M. J., Wong, L., Berry, M. J. A., Linoff, G. S., Hegland, M., Zaki, M. J. and Wong, L. (2003) ‘Data Mining Techniques’, *WSPC/Lecture Notes Series: 9in x 6in*, 10(1–2), p. 545.

Appendix A


Start FYPi
Industry attachment
SECP4112
Select project title with IC &UC
Prepare Initial Proposal (Chapter 1 and Initial Methodology)
Evaluation UC:
Progress 1
Submit Title to Commitee
SECP4112
Final Initial Proposal
(Chapter 1 and Initial Methodology)
NO
Evaluate
IC,UC,E
YES
SECP4233
Prepare for Final Integrated Project Proposal (Chapter 1 to Chapter 4)
NO
Evaluate
IC,UC,E
YES
SECP4235
(Prepare Project Development)
AND SECP4234
(Prepare Integrated Project Report)
Evaluation UC:
Progress 2
Final
SECP4235
(Prepare Project Development)
AND SECP4234
(Prepare Integrated Project Report)
NO
Demo &
Evaluate
IC,UC,E
YES
Prepare final thesis
Submit

Appendix B Psuedo Code

Appendix C Time-series Results Long