User Interface Design in Managing an Alarm System

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CERTIFICATION OF APPROVAL

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Approved by,

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January 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

FARAH SYAZANA AMIRUDDIN

ABSTRACT

Information visualization is defined as follow (UIUC DCI, 1998): a method of presenting data or information in non-traditional and interactive graphical forms. These visualizations can show the structure of information by using 2-D or 3-D color graphics and animations. It also allows one to navigate through it, and modify it with graphical interactions. [1] The end-users will communicate with the data in a more visualized manner and when data representation is understandable by end-users, it would lead to a better decision making. By applying visual representation in managing alarm system in the oil refinery, it would assist the high-level users in the management site to better visualized the alarms events and thus make better decision when it comes to the occurrence of abnormal situations. As the occurrence of abnormal situations would lead to triggering the alarms, this indicates that there must be action taken to resolve the issue. If no appropriate action being taken, it would cost money and endanger life. To be even worse, it might cause the plant to be shut down. Thus, the use of visual representation and data simulation would be one of the ways to resolve the problems. The objective of the project is to visualize the data in making it more understandable in the view of the end-users that dealing with the alarm system. To carry out this project, a visit to Petronas Penapisan Melaka Sdn Berhad (PPMSB) was done to understand the overview of how alarm management system works. Then a set of sample data was generated. The set of data would then be verified by the experts. This set of data would be simulated using a tool namely Context Free Art. The project would be focusing on only one unit, called the Crude Distillation Unit (CDU). Basically, the project mainly involving the collection of data, analyzing them and then visualizing them in a way that makes it easy for the end-users to refer to them.

ACKNOWLEDGEMENT

Alhamdulillah, thank you to Allah for still giving me the opportunity to breath and live in this world. I managed to finish the research study of my Final Year Project Part 1 and 2.

No success in this world is the product of one person's efforts, and certainly this one was no different. It would never have become reality without the help and supports of all people around me. Thus, this goes the same to my accomplishment of Final Year Project. Everybody around me did contribute something in order for me to successfully accomplish the project.

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Never to be forgotten, all other lecturers of CIS department especially to those in the team of Petronas Penapisan Melaka Sdn Bhd(PPMSB) project. My thank also goes to my two mates, Noor Syazwani and Nik Noraishah for sharing with me a lot information and knowledge about the area of study.

Many thanks to all, and may Allah pay back all your kindness.

Thank you,
Farah Syazana Amiruddin
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CHAPTER 1

INTRODUCTION

In this chapter, description of information visualization would be in more and detail and information visualization is actually one element in the user interface design.

1.1 Background of study

1.1.1 Application of Information Visualization

From the definition of (UIUC DCI, 1998) we know that information visualization is actually the method to present data or information in an interactive forms by either using the 2-D or 3-D effect, color graphics and animations [1]. (Ricardo Mazza, 2004) explained that to better understand several phenomena and situations in the real world, the data must be presented in a graphical form. Mazza further gives several examples of the events such as route on a city map, stock market trends during some period and the unemployment diffusion in Europe. [2] It is clear that there are certain situations need to be presented in a good visual form. In the organization where end-users need to handle huge amount of data, it is crucial for the end-users to really understand the data. A good visualized data would assist end-users to better understand the collection of data and thus would support the users in making any decisions or taking any actions with regard to the work they perform.

As for the oil and gas industry, the focus of the environment is on one of the units in oil refinery plant, which is the Crude Distillation Unit (CDU).

1.1.2 Crude Distillation Unit

According to [3], CDU is typically a front end process in the refinery. The purpose of this unit is to separate the crude oil into various products. Among the key products produced by the unit are Off gas, Naphtha, Kerosene, Light Gas Oil, (LGO), Heavy Gas Oil (HGO), Atmospheric Residue.

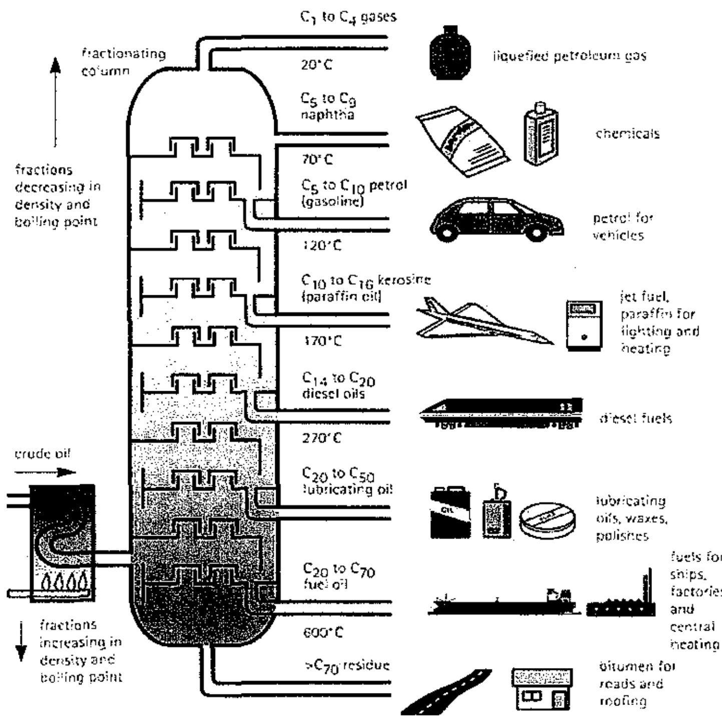


Figure 1: The General Overview of Crude Distillation Unit (CDU) [3]

1.2 Problem Statement

As abnormal situations occur in the oil refinery, it would lead to the triggering of different kind of alarms at the same time. All the alarms events would be put in the history section of the Distributed Control System (DCS). This would be a bit tedious for the higher level people who makes the analysis to check the history of the alarm as they occurs. Due to this matter, there should be a method to assist the higher level people to fast and easily understood the data.

The usage of graphical representation would be one of the best ways to represent the data, but anyhow bar chat, line graphs, or other kind of graphs and charts might not be relevant for the situation.

1.3 The Objectives Of The Project

- To investigate the parameters that would lead to the occurrence of the abnormal situations in the oil refinery.
- To simulate the set of data and represent them in a more presentable manner.

1.4 Scope Of Study

- Get an overview of the data from Petronas Penapisan Melaka Sdn Bhd (PPMSB)
- Focus the project on Crude Distillation Unit (CDU)
- Use a simple simulation tool for representing information in managing alarm systems.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a brief study of abnormal situations and plant alarm management system is being clarified. Moreover, this chapter also includes the importance of user interface in controlled environment and last but not least is the study of visualizing the information.

2.1 Abnormal situations and plant alarm management system

(Jane Gerold, 2003) reported that abnormal situations occur when disturbances causing a plant to not operate at its normal state. Therefore, a proper management is needed to avoid critical conditions from happening. A real life scenario also reported by (Jane Gerold, 2003) where an oil refinery in Europe is hit by lightning and fire breaks out. Five hours later, a vessel overfills, causing liquid to enter a flare line. Actually, the flare was only designed specifically for vapor usage. When the line fails, it released twenty tons of flammable liquid hydrocarbons, and this incident resulting in explosion and fire cause no cost in plant damages, but 26 minor injuries and additional unspecified costs due to lost production.[4]

The reference provides the definition of the abnormal situations. And from the real life case scenario, it could clearly be seen that abnormal situations in the oil refinery not only caused the loss of money, but most importantly can endanger life too. This would give great impact not only to the management but also the organization as a whole. As this thing happens, the organization would loss their credibility and in term of reputation and image would also be destroyed.

(Ravi and Roger, 2006) stressed that the potential severity and cost of an incident increases if timely corrective action is not taken. They also cited an example from a refinery abnormal situation is the failure of a butterfly valve. After several hours without detection by the automation system or operators, it caused the Cat Cracker (FCCU) to shut down. This resulting in shutting down the refinery, and caused in more than $1 million USD per day in lost revenue. [5]

Referring to the paper, the authors really stress on the importance of taking action in a specific duration of time if the abnormal situations occur in the oil refinery. They also give a very good example of the effect of abnormal situation, which in this case; they are using the failure of a butterfly valve as an example. It caused the plant to shut down and obviously that incident caused the organization a lot of money. This kind of thing should be avoided in the sense of it is some sort of human error and can be sort out.

There is an example from the Health and Safety Executive (HSE) report on a 1994 major refinery accident. In the report, it was stated that there were too many alarms and they were poorly prioritized. Besides that, it was also reported that the control room displays did not help the operators to understand what was happening. [6]

Based on the above report, it is very obvious that alarm management system must be well-managed in order to assist the operators to handle the abnormal situations in appropriate manner. With the existence of good system, together with understandable data, it would really help the end-users in the refinery for a better manage of the situation if abnormal situations occur.

2.2 The Importance of User Interface in Controlled Environment

Referring to [7], for the oil and gas industry, adhering to government regulations and meeting production goals requires better and more intelligent oil refinery construction. It also stated that an intelligent oil refinery construction goes beyond the design and development stages.

It could be said that even in the government regulations, it stated that the oil refineries must obey to provide an intelligent oil refinery construction including the system. An intelligent oil refinery not only depends on the construction alone, but also all the other systems related to it. This is obviously to avoid any accidents to happen in the plant, which it would not only cause the organization money but, people's life.

Towsey et al (2003) described the phenomenon of environmental site characterization activities at a large industrial facility can be a complex and costly endeavor. The high volume of data generated from groundwater sampling, soil sampling and other field activities is often difficult to manage. They also stated that as computer technologies have advanced, new data management and data and visualization tools have enabled engineers and geologists to efficiently conduct these site characterization activities.[8]

Towsey et al (2003) provided that the emergence of computer technologies would be an advantage for the oil refineries and plants to provide a new way of handling data and information. It allows the engineers and geologists to conduct the site characterization activities, and would also help the operators in the control room in the plant to handle large amount of data efficiently.

Process control rooms have been widely used at large manufacturing plants. (Sung H. Han, Huichul Yang, Dong-Gwan Im, 2006) further classified the example of the manufacturing plants such as manufacturing plants, nuclear power plants, and chemical plants. According to the authors, the operator's task in the control room also be performed through a traditional man-machine interface (MMI). Anyhow, just after computers replaced the MMI, operator's tasks significantly changing. For such, they need to control and monitor all the operations in process plants through computer user interface such as keyboards and visual display units (VDUs). [9]

As explained by (Wang and Hwang, 1995; Johannsen 1997; Kawai, 1997), user interface of computer-based controlling system is one of the most important factors for improving the task efficiency and preventing safety-related accidents from happening in the process plants. [9]

As described earlier in this section, one of the best ways to address the matter of improving the efficiency in the processing plants is by focusing on information visualization.

From some research within the topic of the importance of applying information visualization in the controlled environment, it could be said that very little has been reported regarding the topic. Thus, not so many articles, journals or researches had been conducted between this area specifically. It is merely to be a new research area to be developed and expected to be important in the future.

2.3 Visualizing the Information

Based on literature review, there are two patterns found in representing the information visually which are using the data simulation and using tree representation algorithm. Data simulation would be quick and easier method while tree would be a bit difficult to develop as it is involving algorithm.

2.3.1 Data Simulation

According to [10], simulation is basically an approach used to model large, complex stochastic systems for forecasting or performance measurement purposes. Furthermore, it also stated that the reason why simulation being selected as a modeling tool is usually because it is less restrictive. Other modeling techniques may impose material mathematical restrictions on the process, and also require multiple intrinsic assumptions to be made.

From the definitions, it could clearly be seen that simulation is actually a useful approach to make it easy to view large or huge data for many purposes especially for forecasting or to measure performance. Simulation is also simpler than other modeling techniques because it does not require difficult mathematical restrictions and also does not require multiple intrinsic assumptions to be made.

There are various tools to represent the data in a tree representation using data simulation and Context Free Art is one of the tools that can be very useful in presenting the data into a tree structure (details will be explain in Section 3.3).

2.3.2 Tree Representation

As described by (B.Johnson and B.Shneirderman, 1990) Tree Maps visualization technique is an interactive visualization technique to present hierarchical information. Tree-Map visualization method maps hierarchical information to rectangular 2-D display in a space-filling manner

Its interactive control allows the users to specify the presentation both structural and content. [11]

Based on the report, it is very clear that even as early as 1990, there had already been research conducted in the visualization area. The Tree- Map approach is very useful in presenting huge amount of hierarchical information in a way to make it easy for users to visualized and understand the information presented. Users could also control the structure of the data in a manner way.

CHAPTER 3

METHODOLOGY

3.1 Overview

In this section, the project methodology will be discussed in three aspects which are the overview of this section, procedure identification and the tools used for deploying the system. In the procedure identification part, it would be more into the life cycle that is going to be used for the project while the tools section would briefly explain on the tool that is going to be used throughout the project.

3.2 Procedure identification

The project would be developed based on the Rapid Application Development (RAD) model. The development lifecycle designed by this model is proved to give much faster development and higher-quality results than those achieved with the traditional lifecycle such as Waterfall Model. RAD Model consists of four lifecycle stages which are the Planning, Design, Development, and Testing.

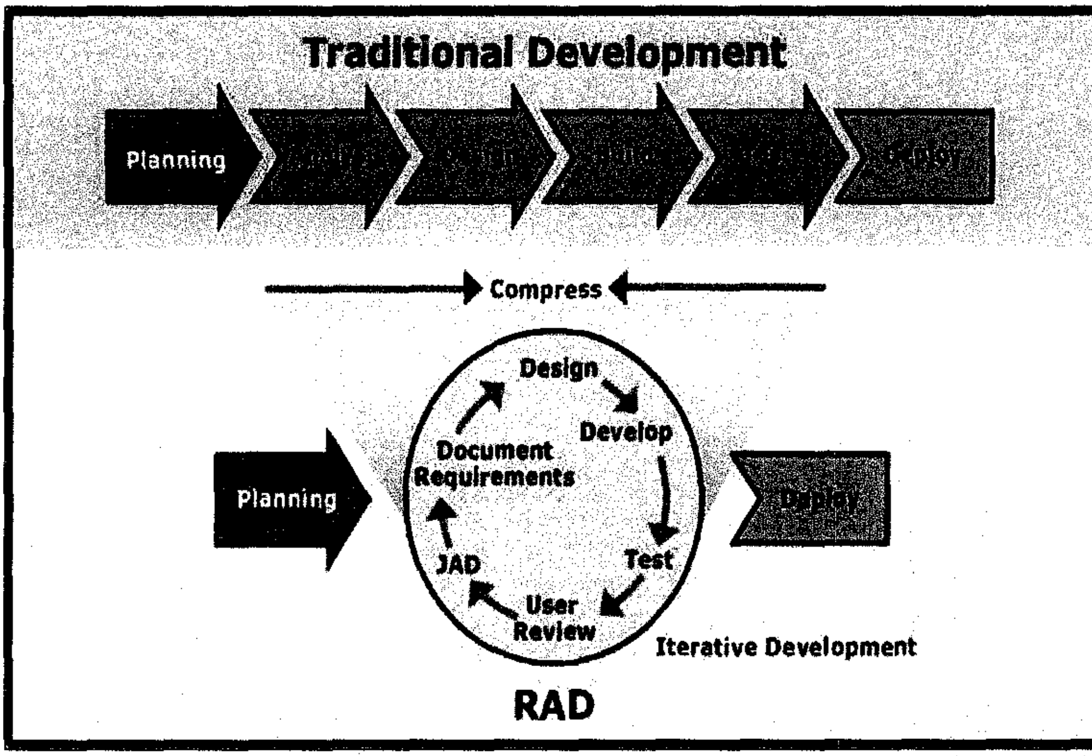


Figure 1: Rapid Application Development (RAD) Model

3.2.1 Planning

During this stage, all the possible requirements need capturing. The data that will be used in this project are the overview of how the alarm management system works at Petronas Penapisan Melaka Sdn Bhd (PPMSB). The data would consist of information captured in the history section each time the alarm triggered and the parameters that caused the alarm to trigger. The examples of the parameters are temperature, pressure, level and flow.

3.2.1.1 Plant Visit

A visit to PPMSB was made in March 2008. The purpose of the visit is to get a better and clear idea of how alarm management system works in PPMSB from the expert perspectives. A semi-constructed interview was conducted with about 10 operators involved in the study. The selection of the operators includes the experienced and less experienced operators. The questions asked were open-ended type of questions. A few possible questions were drafted before the interview session started. Anyhow, as the session moved on, the questions then depended on the situation of the interview session.

3.2.2 Design

The overview of how the alarm management system works would be the basis to come out with a design data that will be used throughout the project. This data would consider all the parameters that would lead to triggering the alarm and also the different types of alarms. Also during this stage, all the assumptions about the tree representation are made. During this stage, the design representation of trees is determined clearly.

3.2.3 Development

During this stage, the data is simulated and at this particular point of time, it could clearly be seen that all the data that triggers alarm and parameters that would lead to the triggering of the alarm would no more be presented in a traditional way. The visualization of the data would indicate the types of alarms which are classified as high priority alarm, medium priority alarm and low priority alarm with the associate time. This information would assist the end users in better handling the alarm management system in the oil refinery.

3.2.4 Testing

This phase is a testing phase. The application put into test by demonstrating it to the experts to get their feedbacks. All the feedbacks would be recorded and improvement would be made to ensure the final end product is relevant to the industry.

{Only phase 3.2.1, 3.2.2 and 3.2.3 are carried out in this project }

3.3 Tools Required

- Context Free Art

  Context Free Art is actually a program that generates images from written instructions called a grammar. The developer of the program, Chris Coyne had created a small language for design grammars called CFDG. According to him, these grammars are sets of non-deterministic rules to produce images. The images produced are surprisingly beautiful, even from very simple grammars. Context Free is a full graphical environment for editing, rendering, and exploring CFDG design grammars [12]. And most importantly, this program is free to be downloaded from Context Free Art websites: www.contextfreeart.org.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Result of the Plant Visit

With reference to the plant visit described in 3.2.1.1, the interview sessions were recorded using few recorders. From the interview sessions, few things were captured. As from the experience of the operators, the frequency of the alarms going off in a day would depend on the unit and also the parameter's setting of the equipments. Activities in that specific unit would also affect the frequency of the alarm going off in a day. If the unit conducts a lot of activities, then the alarm would trigger quite a lot. In a day, approximately 5000 of alarms triggered. Due to several operators from different unit, there are several parameters that would lead to triggering the alarm. Among the parameters are temperature, level, flow and pressure.

Besides that, the operators generally classified the alarm into three types. The first type is the high priority alarm, the medium priority alarm and also the low priority alarm. The frequent alarm is the low priority alarm. According to the operators, when they need to address the low priority alarm, they just acknowledge and yet no action being taken. The operators also clarified that in the industry, to better group the inputs, instead of using Very High or Very Low input, they use Low-Low (LL) to represent a very low input and High-High (HH) to represent a very high input.

4.1.2 Data Analysis

Based on some of the information that captured during the interview sessions, some sample data were developed.

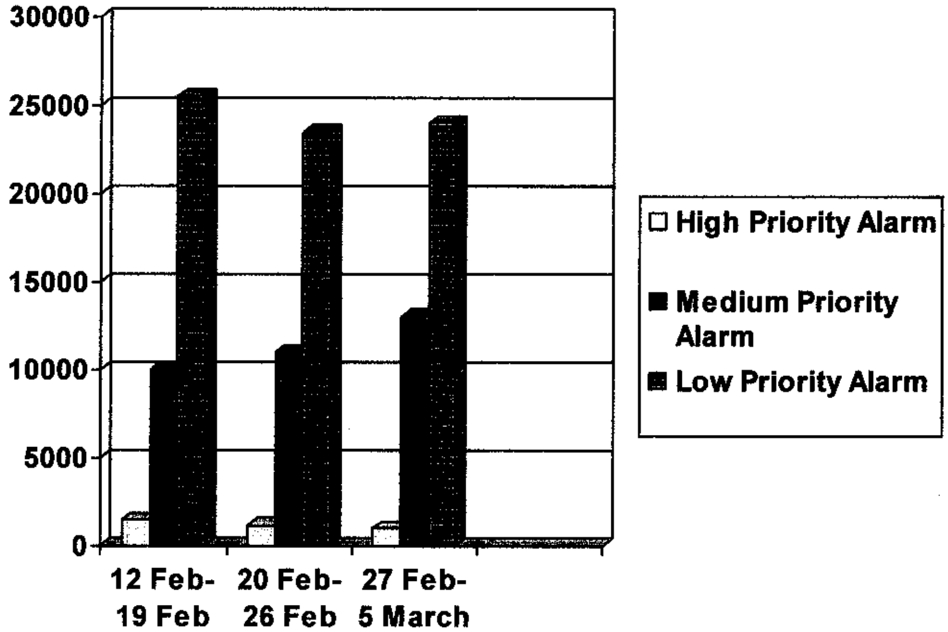


Figure 2: Amount alarm triggered in a week from 12 February 2008 to 5 March 2008 in Crude Distillation Unit (CDU)

The bar chart in Figure 2 shows the amount of alarm triggered in a week starting from 12 February to 5 March 2008. From the bar chart, it could be seen clearly that it is most likely for the low priority alarm to trigger most frequent compared to other types of alarm. While the high priority alarms not trigger that frequent.

In a week, approximately 35,000 of different kind of alarms triggered with the low priority alarm triggered the often.

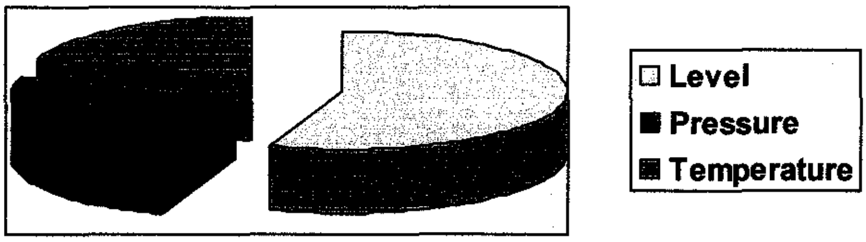


Figure 3: The parameters that lead to occurrence of abnormal situations in February 2008

From the pie chart in Figure 3, it is obvious that level is the dominant factor that leads to the occurrence of abnormal situations that can cause alarms to trigger.

Since this information is just a sample data, it does not focus to any unit, it is always need to be remembered that the parameters might always be different ranging from one unit to another unit. This is because each unit serve different task.

The purpose of presenting the data collected from the interview sessions into Bar Chart and Pie Chart is to have a better view of the data. This would help further in understanding the information of how the alarms are handled in the plant. The whole process might be complicated to be understood, but for the first phase of the study; it would be good if the surface of the process can be understood.

Table 1: The types of alarms and actions to be taken when addressing the alarms respectively

Types of Alarms	Action
Low Alarm	-Acknowledge -Keep to silent and no action being taken
High Alarm	-Give attention by figuring out what actually happening at the plant. - Technical people at plant would go and check the condition.
Emergency Alarm	-Make decision on what action should be taken quickly -Take action as quick as possible

Referring to Table 1, it shows the three types of alarms in oil refinery and also the actions need to be taken by the operators at the control room when managing the alarms. From the table it is known that when handling the high priority type of alarm, operators need to do decision on actions need to be taken in order for the conditions to not get worse. As the conditions get worse, it would absolutely put the plant in such a critical condition.

4.2 Conceptual Design

The analysis part as described in Section 4.1.2 could be used as the design requirement for the simulation of the data. A few assumptions are made to better associate the simulation data with the actual situations in the oil refinery.

Among the assumptions made are that equipments have the same set of parameter's setting. Besides that, it is also assumed that each tray will have three different kinds of sensors which are the temperature sensor, level sensor and pressure sensor. Refer to Figure 4.

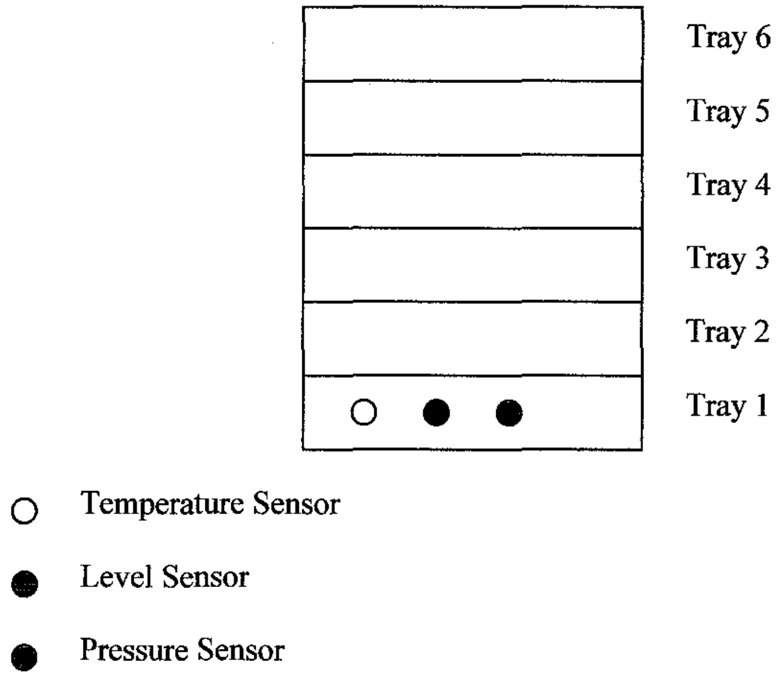


Figure 4: One of the Columns for Crude Distillation Unit (CDU)

Moreover, the indication of new branch signifies that action must be taken at that particular point of time. The right branch signifies input HH, and left branch signifies input LL While the indicator shows red color in main branch signifies input LL and if indicator shows red color in small branches either it is left or right branch, it would signifies the input HH.

Apart from that, if it happens to be a few readings in one parameter, it indicates that the readings come from a few number of trays. Anyhow, the project is not being able to determine the tray number. If the branch stops growing, it is caused by the action has been taking at that particular time. It is also being assumed that the main branch is the input of the upper tray since this tray produce prime products. Last but not least, the combinations of the main branches for all the three parameters are considered as the output.

4.2.1 Applying the CFG

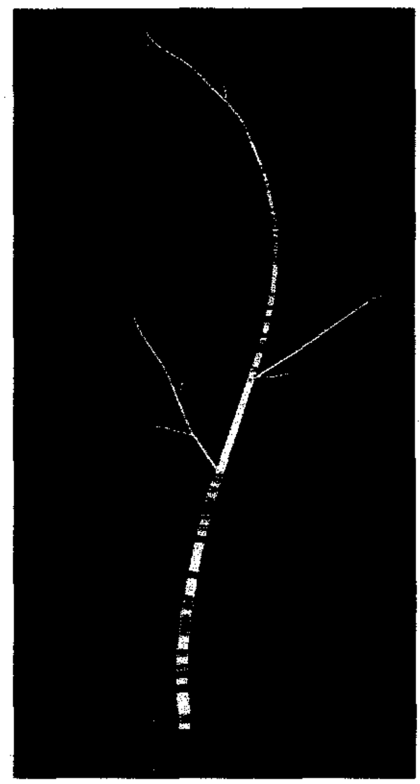
Context Free Grammars (CFG)	Simulation
Rule 1 : S → FOREST Rule 2 : FOREST → SEED Rule 3 : SEED → BRANCH FORK Rule 4 : BRANCH → RIGHT BRANCH LEFT BRANCH Rule 5 : RIGHT BRANCH → FORK BLOCK Rule 6 : LEFT BRANCH → FORK BLOCK Rule 7 : FORK → BRANCH Rule 8 : BLOCK → SQUARE	

Figure 4: Context Free Grammars rules and the simulation

Figure 4 above shows all the rules constructed from Context Free Grammar (CFG) and the associate simulation. A context-free grammar (CFG) can be defined as a set of recursive rewriting rules (or productions) used to generate patterns of strings. [13]

A CFG is actually consists of a few components. As stated in [14], there are three basic components of CFG. The first one is the terminal symbol in which are the symbol to construct parts of tree that will make up the whole tree. The second one is called the nonterminals, the one in which is S, the start symbol. While the third one is called the productions of the form:-one nonterminal finite string of terminals and/or nonterminals and/or the empty string. One of these productions must have S on its left side.

In the case of the simulation tree in Figure 4, the terminal symbols are FOREST, SEED, BRANCH, RIGHT BRANCH, LEFT BRANCH, FORK, BLOCK and SQUARE. While for the nonterminals are S, FOREST, SEED, BRANCH, RIGHT BRANCH, LEFT BRANCH, FORK AND BLOCK. For the productions, it is in the form of:-

S → FOREST

FOREST → SEED

SEED → BRANCH FORK

BRANCH → RIGHT BRANCH LEFT BRANCH

RIGHT BRANCH → FORK BLOCK

LEFT BRANCH → FORK BLOCK

FORK → BRANCH

BLOCK → SQUARE

4.2.2 Incorporating the design requirements

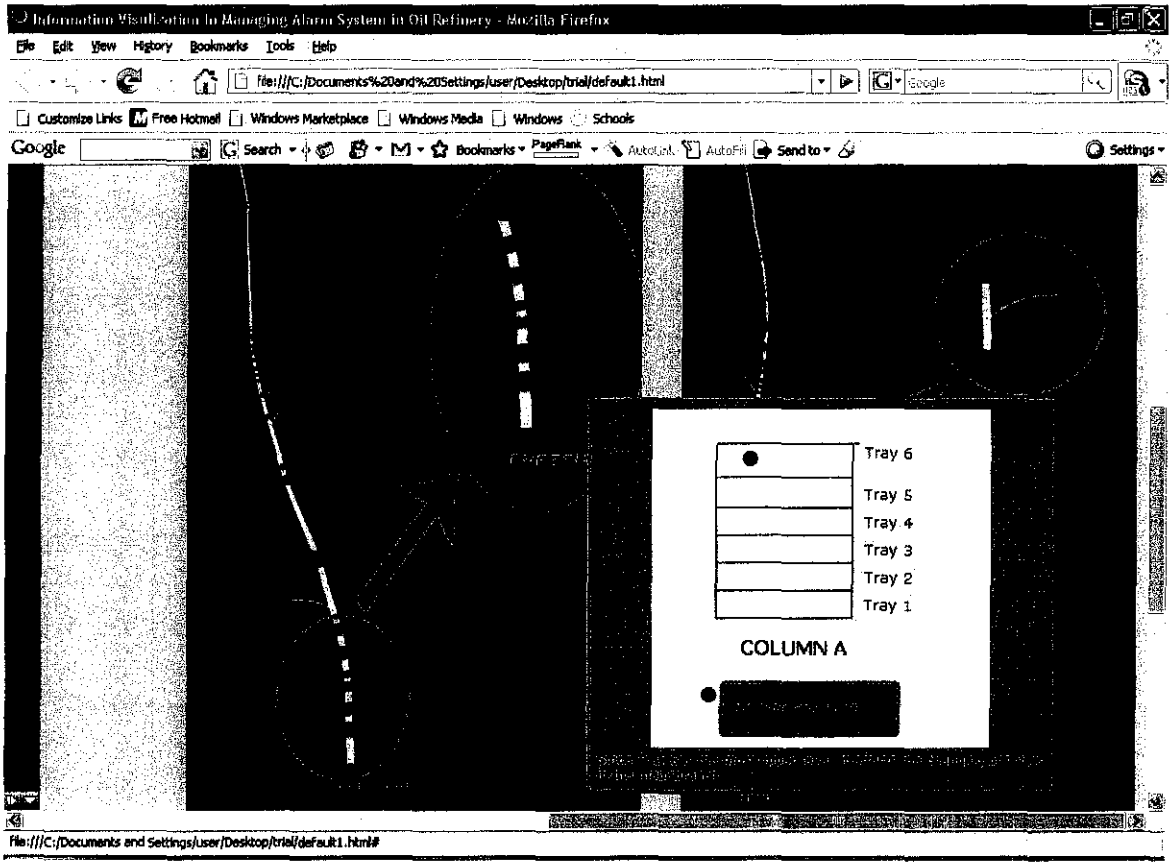


Figure 5: The screenshot for which shows the colors of the main branch changing with associate to time

From the screenshot in the Figure 5, the main branch will change with time. As time changes, the inputs will be changing also. The colors indicates the different inputs. Red color is for the Emergency input, Yellow is for the High input while Green is for the Low input.

When mouse hover on the zoom image, it will displays the illustration of how it would look like for the column and trays when the branch changing its color. For instance, as mentioned in the Assumptions part in Section 4.2, main branch is the input of the upper tray since this tray produce prime products. Thus, in the image, it shows that sensor in Tray 6 will give an input.

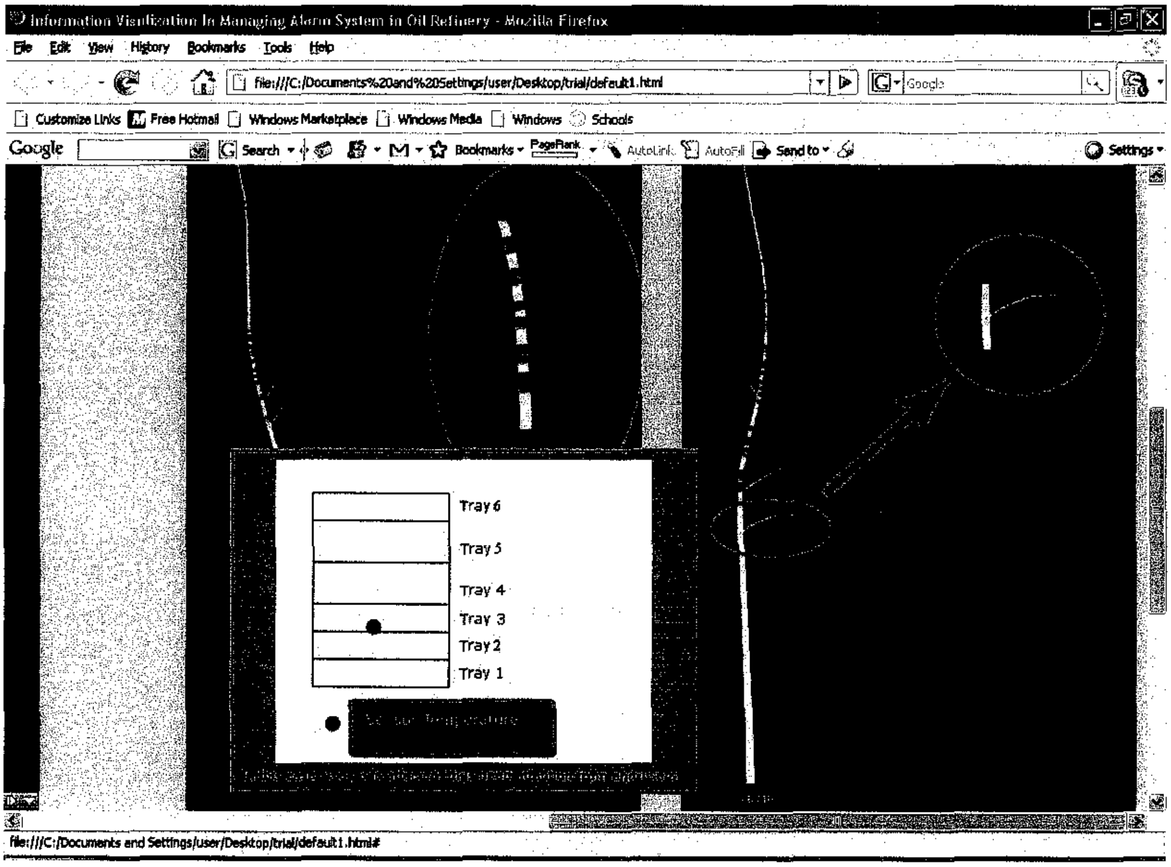


Figure 6: The screenshot which shows the indication of new branch

In Figure 6, the picture shows the indication of new branch at one particular point of time. The zoom image is to make the indication of new branch clearer. From the explanation of Assumptions part in Section 4.2, each new branch indicates that action must be taken at that particular point of time. This is to alert the end-users that it is important to look at the matter.

When mouse hover on the picture, it will shows which tray is affected at that instance point of time. Anyhow, this is only example as the project is actually not being able to detect which tray is affected.

4.2.3 Simplifying the design representation

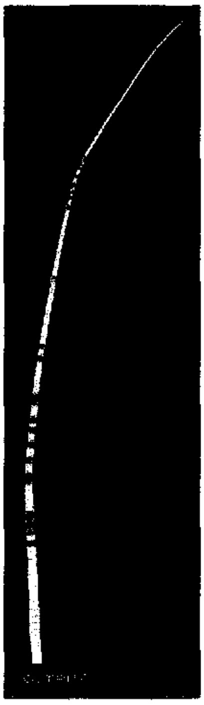


Figure 7: The output as the combinations of all main branches

A finer analysis could be made to improve the final output (referring to Figure 7) of the graphical representation especially on the main branch of the tree. In this project, a set of rules (see Appendix 1) had been developed from the understanding of the overview of how alarm management system works at Petronas Penapisan Melaka (PPMSB).

In the rules, the inputs are being given certain weighted. As shown in Table 2, the weighted is made based on the understanding from the visit and explanation from the operators in Petronas Penapisan Melaka (PPMSB).

Table 2: The inputs and the respective weighted.

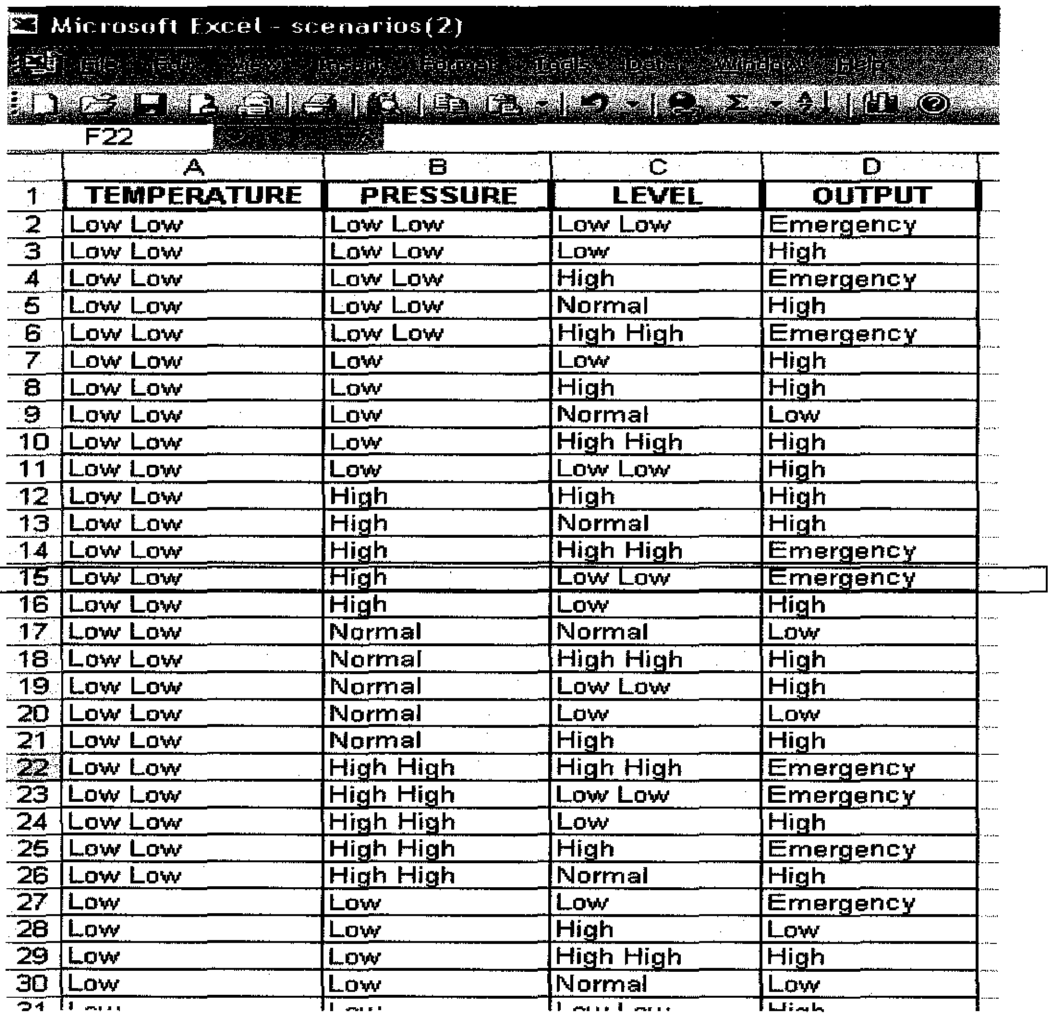
High High	Low Low	High	Low	Normal
3	3	2	1	0

Then, the sum of the weighted is calculated and it would determine the output. While Table 3 shows how to class the output.

Table 3: Class of the output

1-3	4-6	7-9
Low	High	Emergency

It should be highlighted that in this project the rules used are assumed to be valid.



Microsoft Excel - scenarios(2)

	A	B	C	D
1	TEMPERATURE	PRESSURE	LEVEL	OUTPUT
2	Low Low	Low Low	Low Low	Emergency
3	Low Low	Low Low	Low	High
4	Low Low	Low Low	High	Emergency
5	Low Low	Low Low	Normal	High
6	Low Low	Low Low	High High	Emergency
7	Low Low	Low	Low	High
8	Low Low	Low	High	High
9	Low Low	Low	Normal	Low
10	Low Low	Low	High High	High
11	Low Low	Low	Low Low	High
12	Low Low	High	High	High
13	Low Low	High	Normal	High
14	Low Low	High	High High	Emergency
15	Low Low	High	Low Low	Emergency
16	Low Low	High	Low	High
17	Low Low	Normal	Normal	Low
18	Low Low	Normal	High High	High
19	Low Low	Normal	Low Low	High
20	Low Low	Normal	Low	Low
21	Low Low	Normal	High	High
22	Low Low	High High	High High	Emergency
23	Low Low	High High	Low Low	Emergency
24	Low Low	High High	Low	High
25	Low Low	High High	High	Emergency
26	Low Low	High High	Normal	High
27	Low	Low	Low	Emergency
28	Low	Low	High	Low
29	Low	Low	High High	High
30	Low	Low	Normal	Low

Figure 8: Screenshot of the rules and the highlighted scenario.

Figure 8 shows the screenshot of the rules and scenarios that generated from the overview of how alarm management works at Petronas Penapisan Melaka Sdn Bhd (PPMSB). It also shows one of the highlighted scenarios with the associate output.

4.3 Context Free Art as a Simulation Tool

In developing the simulation in Figure 4, Context Free Art has been chosen as the tool. With explanation in Section 3.3, Context Free Art is an attractive tool to generate images from a written set of rules in Context Free Grammars (CFG). There are a lot of images can be generated by the tool, anyhow the project is focusing on using the image of tree to represent the data.

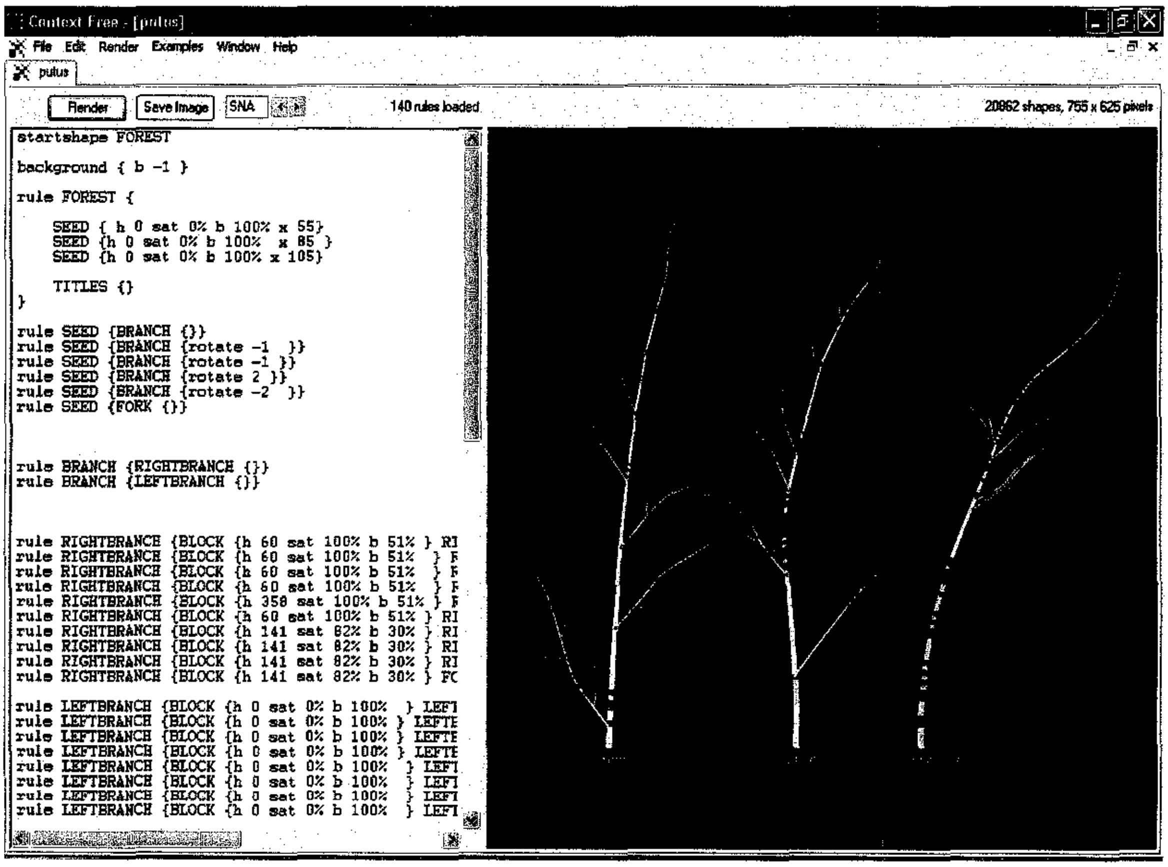


Figure 5: Screenshot of Context Free Art

Figure 5 shows the screenshot of the Context Free Art tool. All the rules are in the left frame while the associate simulation is on the right frame.

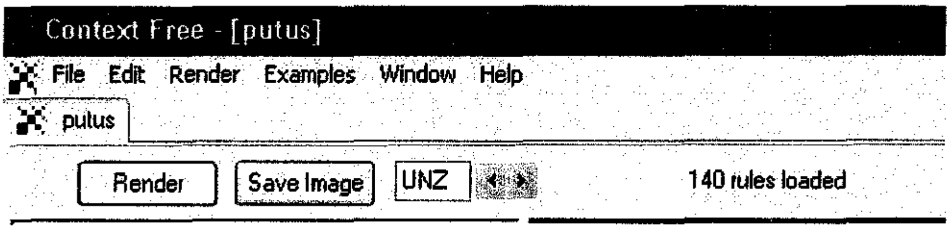


Figure 6: Screenshot saving image

As shown in Figure 6, to save the image, it can be just simply click on the button Save Image. This will save the image produced by the rule. Besides that, this tool also allows the users to Save Movie too. The movies are saved with .mov extension. Thus, it can be played using QuickTime Player.

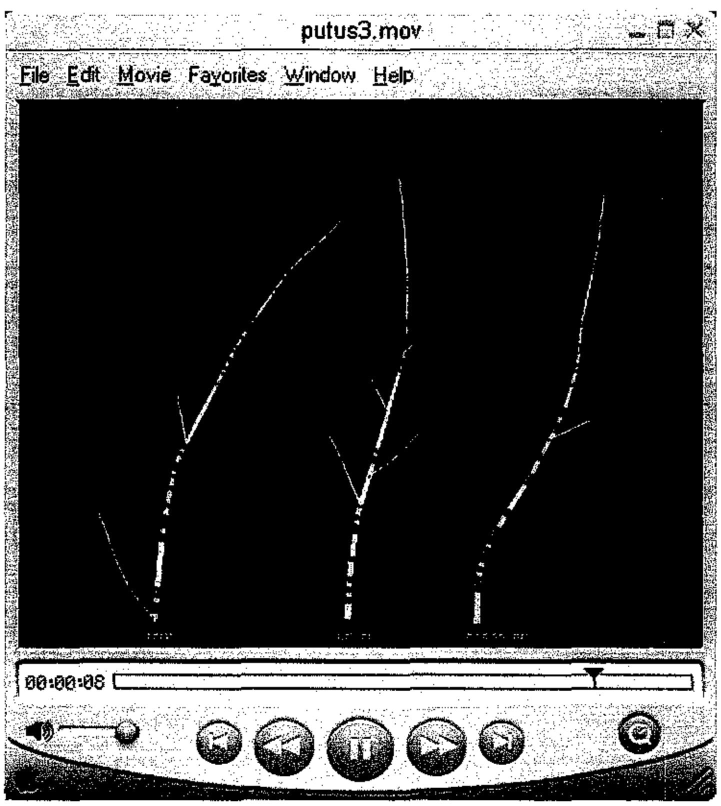


Figure 7: The Movie Produced by Context Free Art display in QuickTime Player

In Figure 7, it shows how the animated simulation tree would be displayed in a movie form. This kind of visual representation would be very much useful to the end-users that handle the alarm management system.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

For conclusion, the parameters that would lead to the occurrence of abnormal situations will be figured out and study. This is because all the parameters must be in normal situations, and if not it would lead to the triggering of the alarms in the oil refinery. Then a simulation program will be developed using the overview of data from Petronas Penapisan Melaka (PPMSB). This program will be dealing with the alarm management system which is available at the plant. Overall, this project aims to show how data that deals with alarm system could be represented visually. It is also to show an approach in choosing appropriate simulation tool for assisting the operators in the oil refinery for better view of data.

5.2 Recommendations

The rules are generated and the rules are used to develop the design prototype. The prototype shows how the data that deal with alarms in oil refinery could be presented in a more presentable manner. A few assumptions are made to better relate the prototype with the situations in the real world. The real programming is to be developed in the future using the basic ideas figured out in this project.

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APPENDICES

Appendix-1 Rules of Scenarios of Alarm Patterns

TEMPERATURE	PRESSURE	LEVEL	OUTPUT
Low low	Low low	Low low	Emergency
Low low	Low low	Low	High
Low low	Low low	High	Emergency
Low low	Low low	Normal	High
Low low	Low low	High high	Emergency
Low low	Low	Low	High
Low low	Low	High	High
Low low	Low	Normal	Low
Low low	Low	High high	High
Low low	Low	Low low	High
Low low	High	High	High
Low low	High	Normal	High
Low low	High	High high	Emergency
Low low	High	Low low	Emergency
Low low	High	Low	High
Low low	Normal	Normal	Low
Low low	Normal	High high	High
Low low	Normal	Low low	High
Low low	Normal	Low	Low
Low low	Normal	High	High
Low low	High high	High high	Emergency
Low low	High high	Low low	Emergency
Low low	High high	Low	High
Low low	High high	High	Emergency
Low low	High high	Normal	High
Low	Low	Low	Emergency
Low	Low	High	Low
Low	Low	High high	High
Low	Low	Normal	Low
Low	Low	Low low	High
Low	High	Low	High
Low	High	High high	High
Low	High	Normal	Low
Low	High	High	High
Low	High	Low low	High
Low	High high	High high	High
Low	High high	Low	High
Low	High high	High	High
Low	High high	Normal	Low

Low	High high	Low low	High
Low	Normal	Low	Low
Low	Normal	High	Low
Low	Normal	High high	Low
Low	Normal	Normal	Low
Low	Normal	Low low	Low
Low	Low low	Low low	High
Low	Low low	Low	High
Low	Low low	High	High
Low	Low low	High high	High
Low	Low low	Normal	Low
High	High	High	Emergency
High	High	Low	High
High	High	High high	High
High	High	Normal	Low
High	High	Low low	High
High	Low	Low	Low
High	Low	High	High
High	Low	High high	High
High	Low	Normal	Low
High	Low	Low low	High
High	High high	High high	Emergency
High	High high	Low	High
High	High high	High	High
High	High high	Normal	High
High	High high	Low low	Emergency
High	Normal	Normal	Low
High	Normal	Low	Low
High	Normal	High	Low
High	Normal	High high	High
High	Normal	Low low	High
High	Low low	Low low	Emergency
High	Low low	Normal	High
High	Low low	Low	High
High	Low low	High	High
High	Low low	High high	Emergency
High high	High high	High high	Emergency
High high	High high	Low	High
High high	High high	High	Emergency
High high	High high	Normal	High
High high	High high	Low low	Emergency
High high	Low	Low	High
High high	Low	High	High
High high	Low	High high	High
High high	Low	Normal	Low
High high	Low	Low low	High
High high	High	High	High
High high	High	Low	High
High high	High	High high	Emergency

High high	High	Normal	High
High high	High	Low low	Emergency
High high	Normal	Normal	Low
High high	Normal	Low	Low
High high	Normal	High	High
High high	Normal	High high	High
High high	Normal	Low low	High
High high	Low low	Low low	Emergency
High high	Low low	Normal	High
High high	Low low	Low	High
High high	Low low	High	Emergency
High high	Low low	High high	Emergency
Normal	Normal	Normal	Normal
Normal	Normal	Low	Low
Normal	Normal	High	Low
Normal	Normal	High high	Low
Normal	Normal	Low low	Low
Normal	Low	Low	Low
Normal	Low	High	Low
Normal	Low	High high	Low
Normal	Low	Normal	Low
Normal	Low	Low low	Low
Normal	High	High	Low
Normal	High	Low	Low
Normal	High	High high	High
Normal	High	Normal	Low
Normal	High	Low low	High
Normal	High high	High high	High
Normal	High high	Low	Low
Normal	High high	High	High
Normal	High high	Normal	Low
Normal	High high	Low low	High
Normal	Low low	Low low	High
Normal	Low low	High high	High
Normal	Low low	Low	Low
Normal	Low low	High	High
Normal	Low low	Normal	Low