Faculty of Computer Science and Information Technology

Multi-Screen Thinking Environment for Supporting Inventive Problem Solving

Cyhren a/l Thruvarasu

Bachelor of Computer Science with Honours (Software Engineering) 2019

Multi-Screen Thinking Environment for Supporting Inventive Problem Solving

CYHREN A/L THRUVARASU

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

Faculty of Computer Science and Information Technology

Pemikiran Pelbabgai Skrin untuk Menggalakkan Penyelesaian Masalah

CYHREN A/L THRUVARASU

Projek ini merupakan salah satu keperluan
untuk Ijazah Sarjana Muda Sains Komputer dan
Teknologi Maklumat
(Pengkomputeran Perisian)

Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

THESIS STATUS ENDORSEMENT FORM

TITLE   Multi Screen Thinking Environment for Supporting Inventive Problem Solving

ACADEMIC SESSION: ___Semester 2,2019/2020___

___CYHREN A/L THRUVARASU___
(CAPITAL LETTERS)

hereby agree that this Thesis* shall be kept at the Centre for Academic Information Services, Universiti Malaysia Sarawak, subject to the following terms and conditions:

1. The Thesis is solely owned by Universiti Malaysia Sarawak
2. The Centre for Academic Information Services is given full rights to produce copies for educational purposes only
3. The Centre for Academic Information Services is given full rights to do digitization in order to develop local content database
4. The Centre for Academic Information Services is given full rights to produce copies of this Thesis as part of its exchange item program between Higher Learning Institutions [or for the purpose of interlibrary loan between HLI]
5. ** Please tick (√)

☐ CONFIDENTIAL   (Contains classified information bounded by the OFFICIAL SECRETS ACT 1972)

☐ RESTRICTED   (Contains restricted information as dictated by the body or organization where the research was conducted)

☑ UNRESTRICTED

Validated by

_____
(AUTHOR'S SIGNATURE)

_____
(SUPERVISOR'S SIGNATURE)

Profesor Dr. Narayanan N. Kuluthurnmaiy
Pengarah
Institut Informatik Sosial & Inovasi Teknologi
Universiti Malaysia Sarawak
94300 Kota Samarahan

Permanent Address

569,Lorong Senangin ¼,Taman Senangin, 09000, Kulim, Kedah

Date: __12/08/2020__

Date: 12/8/2020

DECLARATION

I hereby declare that this project and its contents are my original work except for that information which have been cited and quoted are extracted from other sources with the provided reference.

_____

(CYHREN A/L THRUVARASU)   12 AUGUST 2020

ACKNOWLEDGEMENT

Table of Contents

CHAPTER 4: IMPLEMENTATION

CHAPTER 5: TESTING

CHAPTER 6: CONCLUSION AND FUTURE WORKS

List of Figures

List of tables

Abstract

Out of the box thinking is known to produce results in today's era. Many organizations are putting an emphasis on out of the box ideas. More often than not, an individual who is in need of a problem solving tool settles for any one of the fairly inefficient thinking tools available on the internet. A system is proposed and designed to help create a more consistent problem solving environment for this Final Year Project 1. The methodology used in this proposed system is the Rapid Application Development (RAD). A literature review with three reviewed systems is conducted to obtain a better understanding of the proposed system. The requirements will be gathered through observation and reviewed system in requirement analysis phase. In system design phase, context diagram, Data Flow Diagram for Level 0 and Level 1, Entity Relationship Diagram, and user interface design for the web-based system were drawn. In the end of Final Year Project 1, the idea and design of proposed system is identified. The implementation and testing phase of proposed system has been defined in Final Year Project 2 based on the requirement analysis and system design stated earlier. This project can be a useful tool for students and researches alike in assisting them with inventive problem solving. In addition, this project has a lower learning curve compared to the existing systems.

Abstrak

Pemikiran "out-of-the-box" diketahui menghasilkan idea yang bagus pada zaman ini. Banyak organisasi menekankan pemikiran ini. Seringkali, individu yang memerlukan alat penyelesaian masalah mengunakkan salah satu alat pemikiran yang tidak cekap yang diperoleh daripada internet. Satu sistem dicadang dan direka untuk membantu mewujudkan persekitaran penyelesaian masalah yang lebih konsisten untuk Projek Tahun Akhir 1. Metodologi yang digunakan dalam sistem yang dicadangkan ini ialah Pembangunan Aplikasi Rapid (RAD). Kajian sastera dengan tiga sistem kajian dilakukan untuk mendapatkan pemahaman yang lebih baik mengenai sistem yang dicadangkan. Keperluan akan dikumpulkan melalui sistem pemerhatian dan kajian semula dalam fasa analisis keperluan. Dalam fasa reka bentuk sistem, gambarajah konteks, Rajah Aliran Data untuk Tahap 0 dan Tahap 1, Rajah Hubungan Entiti, dan reka bentuk antara muka pengguna untuk sistem berasaskan web telah disediakan. Pada akhir Projek Tahun 1, idea dan reka bentuk sistem yang dicadangkan dikenalpasti. Tahap pelaksanaan dan pengujian sistem cadangan telah ditakrifkan dalam Projek Tahun Kedua 2 berdasarkan analisis keperluan dan reka bentuk sistem yang dinyatakan sebelum ini. Projek ini boleh menjadi alat yang berguna untuk pelajar dan penyelidik untuk membantu mereka dengan menyelesaikan masalah inventif. Di samping itu, projek ini mempunyai lengkung pembelajaran yang lebih rendah berbanding dengan sistem sedia ada.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

There is no doubt that the technological breakthroughs of the 21st century's first two d ecades have revolutionized everyday lives of people dramatically. Streaming services, connected devices, digital books are starting to replace conventional books, television, radio and landline phones. Technology has and will continue to play a huge part in the development of various nations. These constant improvements are the product of brainstorming and think tanks working to solve an existing solution or coming up with new ways to ease daily life tasks.

All these new improvement, upgrades, and inventions are fueled partly by creativity and the need for innovation. Generally speaking, creativity is differentiated from innovation, where the latter focuses on execution. Teresa Amabile and Pratt (2016) defines creativity as production of novel and useful ideas and innovation as implementation of creative ideas. According to the Organisation for Economic Co-operation and Development (OECD) and Eurostat, "innovation is more than a new idea or an invention. An innovation requires implementation, either by being put into active use or by being made available for use by other parties, firms, individuals or organisations" (OECD/Eurostat,2018).

In *Art of Thought* (Wallas.G,1926), the author suggested creative insights could be explained by a process consisting of five phases. The first phase, preparation is when the individual focuses on the problem and explores its dimensions (Barry *et al*., 2010). There are tools that help induce creativity to solve a problem. Some of them are the Pareto chart, the 5 Whys, the Fishbone Diagram, and a few more. These tools however usually only show a limited view which can prove to be not as helpful in solving said problem. One of the more productive tools is TRIZ or "the theory of inventive problem solving" (Barry *et al*., 2010) (Sheng *et al*., 2010).

TRIZ or as it's known in Russian, *Teoriya Resheniya Izobretatalskikh Zadatch* is a problem-solving methodology that focuses on efficiency, effectiveness, and creativeness. Integrated with a research element, this project aims to develop an environment that uses the TRIZ principles. This method of problem solving was developed by a Soviet inventor, Genrich Altshuller when after extensively researching thousands of patents, he found that almost all of them applied the same inventive principles (Vidal *et al*., 2015).

1.2 PROBLEM STATEMENT

The 21st century looks to a more holistic approach when presented with a problem. Companies all around the world are trying to come up with solutions that would help customers and themselves. Often times ideas do not get to the implementation phase because they seem far-fetched. Some ideas on the other hand ends up in a pile of unwanted ideas until someone stumbles upon it some other time and works on it and makes it usable, implementable. Certain individuals who have identified a problem might find it hard to go about it. Innovation is still being treated as a black box (Salamatov, 1999). TRIZ experts have demonstrated innovation can be systematically developed and nurtured (Silverstein *et al*.,2008). Current computer science models, methodology is not exactly directed at innovation lifecycles. The models usually follow a rigid process that emphasizes on development and implementation. There is a need for a platform that supports the innovation lifecycle, in the creation, the managing, and the sharing of ideas. TRIZ has shown to be powerful tool in creative problem solving and innovation. It is being used by leading industries such as NASA, Siemens, General Motors, Procter & Gamble, Schneider Electric, BMW, Apple and many others (Poskela, Posch). There are 30 over TRIZ tools of which the 9 window tool has been used in the past to help inventors overcome challenges beyond dimensions. With a system that can store, retrieve, and help give a different view of the

problem, ideas can get implemented quicker and in turn benefit everyone involved.

1.3 OBJECTIVES

The main aim of this project is to propose a solution for better problem solving using the TRIZ principles. The objectives of this project are as follows:

1. To study the existing different problem solving techniques and compare them with TRIZ methods

2. To design an environment that stimulates the capture, organization, representation and storing of ideas for retrieval.

3. To have a database that stores and retrieves the ideas for future use and refinements or improvements.

1.4 METHODOLOGY

The theoretical analysis of the methods to be used when conducting a research or developing a system is the methodology. The Rapid Application Development (RAD) will be good guideline to follow in order to make sure all the requirements are fulfilled. This approach suggests a few steps involving the development team and clients/users, leading to quicker technology acquisition (Geambasu *et al.*, 2011). There usually are five major phases in RAD.
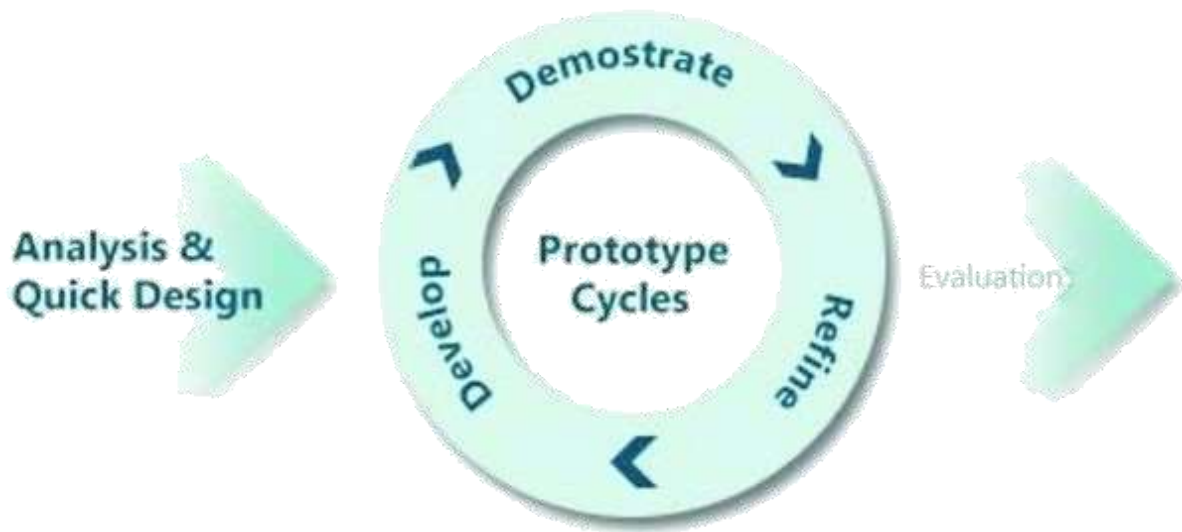
Figure 1.1. RAD life cycle (Adapted from Abd Ghadas *et al*, 2015:23)

In the evaluation phase, the goals of this system is to be determined. Identifying the target users is important to make sure the requirements are being fulfilled. The specific needs of certain users should also be taken into consideration to ease the implementation process.

During analysis, similar thinking systems are reviewed and compared to assess the strength and weaknesses of each system. The requirements of the system are also collected from the target users by interviewing them, handing out questionnaires, and others.

In the design phase, a prototype is created which is just the basic layout and the navigation flow of the proposed system. The data dictionary, the Data Flow Diagram(DFD), the Entity Relations Diagram(ERD) should be developed.

The actual building of the system is done during the implementation phase. The suitable programming language should be chosen to deliver the best version of the system. The database should work well with the system.

The testing phase is essential to check the accuracy of the system. All requirements are to be met before the final version of the system goes online.

1.5 SCOPE

The scope of this project is mainly concentrating on the TRIZ principles which is used to aid users in inventive thinking. Besides that, this research also focuses on the other applications of the TRIZ principles. The two primary target audience of this system are the students and the administrator of the program.

I.   Students

The students would be able to login into the system using their registered credentials. They register into the system by completing the required details. Upon logging in they will be able to view their saved template to update or just view it. They can also create a new template and start filling in the details needed.

II. Administrator

The admin would be able to retrieve the saved templates from the database and view them.

1.6 SIGNIFICANT OF PROJECT

The proposed project aims to facilitate the process of problem solving using the TRIZ principles. It is aimed at university students to aid in problem solving and critical thinking development.

1.7 PROJECT SCHEDULE

The project schedule is a timeframe needed to complete the overall proposed final year project throughout first and second semester of the academic year 2019/2020. For this

project, Gantt Chart is used to demonstrate the timeline required for FYP 1 and FYP 2 together with the resources needed. All the documentations of this project are gathered within 5 main chapters. Figures 2 and 3 shows the rough Gantt chart development of the Final Year Project.

Task Name	Days to complete	Start	Finish
Brief project Description	9 days	9/19/2019	9/29/2019
Full Project Proposal	16 days	9/29/2019	10/19/2019
Research on project	4 days	9/29/2019	10/3/2019
Analyse project requirements	4 days	10/4/2019	10/9/2019
Determine outlines and project scope	4 days	10/10/2019	10/15/2019
Determine Methodology	4 days	10/16/2019	10/19/2019
Chapter 1: Introduction	6 days	10/19/2019	10/26/2019
Chapter 2: Literature Review	16 days	10/26/2019	11/16/2019
Review journals and existing analysis	8 days	10/26/2019	11/6/2019
Documentation	8 days	11/7/2019	11/16/2019
Chapter 3: Methodology	17 days	11/16/2019	12/8/2019
Submission of Final report of FYP 1	7 days	12/8/2019	12/15/2019

Figure 1.2. Gantt chart for FYP 1

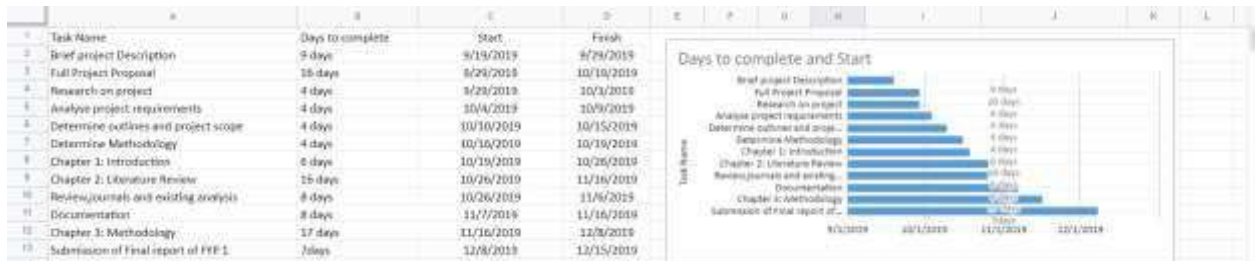| Task Name	Days to complete	Start	Finish
Chapter 4: Implementation	24 days	1/28/2020	2/28/2020
Data Collection	10 days	1/28/2020	2/8/2020
Testing the process	15 days	2/8/2020	2/28/2020
Chapter 5: Result and analysis	19 days	2/28/2020	3/26/2020
Chapter 6: Conclusion and future work	5 days	3/26/2020	3/31/2020
Submission of Final report of FYP 2	12 days	4/1/2020	4/16/2020

Figure 1.3. Gantt chart for FYP 2

1.8 EXPECTED OUTCOME

This system is expected to ease the ability to generate and follow up ideas. The system is also expected to store all the ideas made using the tool and retrieve them at a later time. At this end of the project, a proper thinking tool would be delivered.

1.9 PROJECT OUTLINE

1.9.1 Chapter 1: Introduction

The first part describes the framework of the Multi Screen Thinking Knowledge Based Tool. It talks about the general view and the introduction of the proposed system. The problem statement that immediately follows explains the current limitations and the problems faced by the target audience when dealing with critical thinking. Next, the goals of this proposed system is explained in the objectives. After that, the methodology used in developing this system is briefly explained which is then followed by the scope of the project, the project schedule, and the significance of the project. The expected outcome describes the supposed outcome of the project.

1.9.2 Chapter 2: Literature Review

In this chapter, research and studies will be conducted on existing systems that may have similarities with the proposed system. Resources such as research papers, journals, books, etc. will be used. The functionalities of the existing system will be compared with the proposed system.

1.9.3 Chapter 3: Methodology

The methodology used to develop the proposed system is described in this chapter. The phases are explained in detail for better understanding. The design layout of the system is included to serve as a guide during system development.

1.9.4 Chapter 4: Implementation

Here, the details of the implemented system are discussed in depth. Details such as the description of the proposed system and the screenshots of the User Interface(UI) layouts. The tools used during the implementation is also described.

1.9.5 Chapter 5: Testing

Chapter 5 describes the testing process of the system. Each feature is tested to ensure all the objectives of this system is met. Both functional and non-functional testing is executed here.

1.9.6 Chapter 6: Conclusion and Future Work

Chapter 6 talks about the conclusion of the developed project and discusses future use options. Future work talks about the improvement that can be made to system for further use.

1.10 SUMMARY

Summary talks about the project on whole. It explains briefly about the proposed system, the Multi Screen Thinking Knowledge Based Tool. This tool is a web based system that can be used by almost anyone but for this project's purpose is aimed at students, specifically university students. This system helps the student(user) to view the different dimensions that exist when faced with a problem. This chapter not only explains the problem, but also provides the objectives of the project. The methodology used to develop, the scope, the project significance and the timeline are all included.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Analysing and comparing similar existing systems is one of the crucial steps in developing a system. Each system has its own advantages and disadvantages. Their functions are studied, reviewed, and if possible, improved upon in the proposed system. A dedicated system for creating and storing ideas has not yet been developed so this would be the first of its kind. Hence the comparison can only be done between the tools used to generate the ideas. A simple side-by-side comparison will be made between existing thinking tools and the tool used in the proposed system to get a better view of the functions of the overall system. The aforementioned tools are the Ishikawa diagram, Nominal Group Thinking (NGT), and the Affinity diagram.

2.2 Review of Existing Systems

2.2.1 Ishikawa Diagram

The Ishikawa diagram also goes by "fishbone diagram" or "cause-and-effect diagram". This causal diagram is created by Kaoru Ishikawa to show the causes of a specific event (Ishikawa,1976). The event could be a defect of a product, reasons for delay, or product improvement. Kaoru Ishikawa who made the diagram popular in the 1960s. He pioneered the quality management process in the Kawasaki shipyards and became one of the founding fathers of modern management. A causal diagram is a directed graph that shows the causal relationships between variables in a model. The variables are sometimes also known as nodes. An arrow connects each node to one or more other nodes which it has a causal impact on (Pearl *et al*., 2018).
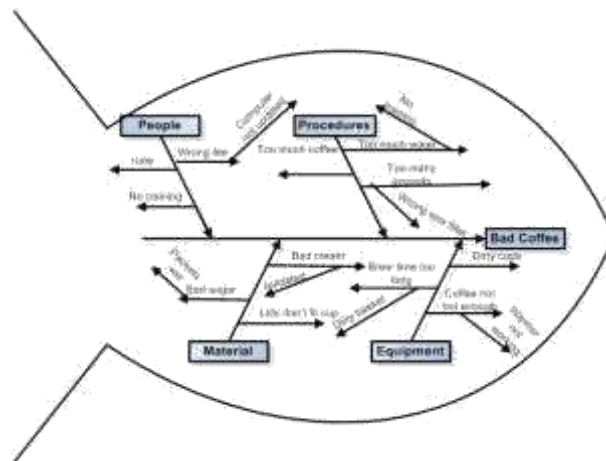
Figure 2.1. Ishikawa Diagram (Source: Kelly Lawless)

The event in question, which in this this case is the defect is shown on the right. That is the "fish's head". The "fishbones", which extend to the left are the causes of the event. The ribs branch off the backbone for major causes and have sub-branches, to as many levels as required to show the root-cause of the event. [1] One of the most famous application of this model is when Mazda Motors used the Ishikawa diagram in the development of their Miata(MX5) sports car. (Frey & Daniel, 1943; Fukuda et al., 2011)

Advantages

- It is a highly visual brainstorming tool which can generate further examples of root causes

- Quickly identify if the same root cause is found multiple times in the same or different causal tree

- Allows one to see all causes at the same time, in parallel

- Good way of visualization for presenting the causes to stakeholders