CONCEPTUAL DESIGN OF SELF-ORGANISED USB CHARGER CABLE BY USING TRIZ METHOD

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Bachelor of Manufacturing Engineering Technology (Product Design) with Honours

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in fulfillment of the requirements for the degree of
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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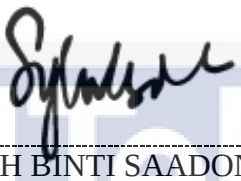
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this thesis entitled “Conceptual Design Of Self-Organised USB Charger Cable By Using TRIZ Method” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (Product Design) with Honours.

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Date : 25/01/2023

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DEDICATION

This thesis is dedicated to my mother, Nor Azizah Binti Atan, who has been a constant source of support and encouragement during my struggles in finishing this thesis. I am truly thankful for having you in my life. Besides, this work is also dedicated to my supervisor, Ts. Dr. Syahibudil Ikhwan Bin Abdul Kudus, Mr. Febrian Bin Idral, that has been guiding me throughout the whole journey of completing this. I also would like to dedicate this thesis to Allah almighty for the strength and health that have been given. Also, to my dearest little sister who have been encouraging and believe me into finishing my engineering degree.

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ABSTRACT

This study introduces Conceptual Design of Self-Organised USB Charger Cable by using Inventive Problem Solving (TRIZ) as a solution to the problem of clean and neat workspace. This study aims to establish and determine the ideal component conceptual design based on product design criteria, with a focus on the ideal solution to retain the length of the charger cable when in use. This problem occurs when the user had difficulty in maintaining clean and neat workspace. Inventive principles were solved using the TRIZ contradiction matrix and 40 engineering instruments. This research aims to study and analyse design solution of self-organised USB Charger Cable by using TRIZ method. TRIZ technique is effective in assisting in outlining issues with organised solutions, in addition to having the capacity to provide unique ideas and solutions. Few design methods were used during the design and fabrication process such as TRIZ Inventive Principle. Self-organised USB Cable is a built-in charger cable that has space to store the cable by rolling or keeping it in depending on the findings and the final design concept. This method of TRIZ have been used to make new design and concept for the self- Organised cable organiser. 39 Engineering Parameters were included in the study. Besides, to design and fabricate a self-organised USB Cable organiser prototype. Concept generation by using TRIZ 39 Engineering Parameters Method, and weighted rating evaluation method are implemented to build a self-organised USB Charger Cable. In order to construct a solution for the contradiction, a number of general solutions, such as taking out, self-service, segmentation and parameter changes, were picked based on the TRIZ 40 innovative principles. The design of the finalised self-organised USB Charger Cable was designed by using SOLIDWORKS. This study recommend that System Usability Scale consists of 3 main categories, which is Usability, Applicability and Effectiveness. A usability test will be conducted to gather user feedback on the self-organized USB charger cable prototype. Concept design 6 is selected according to the Weighted Rating Evaluation Method results. Based on the result of System Usability Scale, it shows that 84.2% had positive perception toward the design of the prototype and this indicated the conceptual design are relevant for users.

Keyword: *TRIZ, Conceptual Design, Self-organised USB Charger Cable*

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ABSTRAK

Kajian ini memperkenalkan Reka Bentuk Konsep Kabel Pengecas USB yang Disusun Sendiri dengan menggunakan Penyelesaian Masalah Inventif (TRIZ) sebagai penyelesaian untuk masalah ruang kerja yang bersih dan kemas. Kajian ini bertujuan untuk menetapkan dan menentukan reka bentuk konsep komponen yang ideal berdasarkan kriteria reka bentuk produk, dengan fokus pada penyelesaian yang ideal untuk mengekalkan panjang kabel pengecas semasa digunakan. Masalah ini berlaku apabila pengguna mengalami kesukaran untuk menjaga ruang kerja yang bersih dan kemas. Prinsip inventif diselesaikan menggunakan matriks kontradiksi TRIZ dan 40 instrumen kejuruteraan. Penyelidikan ini bertujuan untuk mengkaji dan menganalisis penyelesaian reka bentuk Kabel Pengecas USB yang disusun sendiri dengan menggunakan kaedah TRIZ. Teknik TRIZ berkesan dalam membantu menguraikan masalah dengan penyelesaian yang teratur, selain memiliki kemampuan untuk memberikan idea dan penyelesaian yang unik. Beberapa kaedah reka bentuk digunakan semasa proses reka bentuk dan fabrikasi seperti TRIZ Inventif Principle. Kabel USB yang diatur sendiri adalah kabel pengecas terbina dalam yang mempunyai ruang untuk menyimpan kabel dengan menggulung atau menyimpannya bergantung pada penemuan dan konsep reka bentuk akhir. Kaedah TRIZ ini telah digunakan untuk membuat reka bentuk dan konsep baru untuk penganjur kabel yang disusun sendiri. 39 Parameter Kejuruteraan dimasukkan dalam kajian. Selain itu, untuk merancang dan membuat prototaip penganjur Kabel USB yang diatur sendiri. Penjanaan konsep dengan menggunakan Kaedah Parameter Kejuruteraan TRIZ 39, dan kaedah penilaian penilaian berwajaran dilaksanakan untuk membina Kabel Pengecas USB yang disusun sendiri. Untuk membina penyelesaian untuk kontradiksi, sejumlah penyelesaian umum, seperti mengambil, layan diri, segmentasi dan perubahan parameter, dipilih berdasarkan prinsip inovatif TRIZ 40. Reka bentuk Kabel Pengecas USB yang disusun sendiri yang telah dirancang dengan menggunakan SOLIDWORKS. Kajian ini mengesyorkan bahawa Skala Kebolehgunaan Sistem terdiri daripada 3 kategori utama, iaitu Kebolehgunaan, Kebolehlaksanaan dan Keberkesanan. Ujian kebolehgunaan akan dilakukan untuk mengumpulkan maklum balas pengguna mengenai prototaip kabel pengecas USB yang disusun sendiri. Reka bentuk konsep 6 dipilih mengikut hasil Kaedah Penilaian Berat Berat. Berdasarkan hasil Skala Kebolehgunaan Sistem, ini menunjukkan bahawa 84.2% mempunyai persepsi positif terhadap reka bentuk prototaip dan ini menunjukkan reka bentuk konseptual relevan untuk pengguna.

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LIST OF SYMBOLS AND ABBREVIATIONS

ARIZ	-	Algorithm of Inventive Problem Solving
PLA	-	Polylactic Acid
3D	-	3 Dimensional
WRM	-	Weighted Rating Method
CD	-	Conceptual Design
FDM	-	Fused Deposition Modelling
PDS	-	Product Design Specification
TRIZ	-	Theory Inventive of Problem Solving
USB	-	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, introduction includes background, problem statement, research objective. Moreover, the scope of research for this project will also be discussed in this chapter.

1.2 Background

An organiser is a device, often with many compartments, used to more effectively arrange goods on a desk, the contents of a closet, etc. Self-organised USB Cable is a built-in charger cable that has space to store the cable by rolling or keeping it in depending on the findings and the final design concept. With the help of Self-organised USB Charger cable, user can keep our place tidy and clean, which also saves a lot of time to pick up each piece of cables.

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Innovation and creativity have always been the driving forces behind initiatives to raise the standard of living for people all around the globe. Humans not only have the capacity to organise their lives and do activities associated with control, but they also have the desire to do so, making the study important. The drive to organise is a characteristic of people. A typical person typically maintains their home neat and clean.

Furthermore, the Theory of Inventive Problem Solving (TRIZ) is an additional strategy that may be used to develop creative and innovative capabilities. The TRIZ approach was developed in the 1940s by a Russian patent engineer by the name of Genrich Altshuller.

Its primary objective is to resolve technical contradictions by using a collection of universal solution principles. After doing an analysis of patent applications made by innovators working in a variety of industries, he had the inspiration for the concept. On the basis of his investigation, he arrived to the conclusion that, in general, there are recurring patterns and principles that are employed in the process of generating the patent innovation solution.

Consecutively, he compiled all of the solution principles and gave them the name 40 inventive principles. He also created a matrix to assist the users in identifying the most appropriate solution to be used by mapping the contradiction that occurred within the problem to be solved to the most commonly used 40 solution principles. As the TRIZ approach matured, other solution models were created to assist in the formulation of more inventive solutions. These models include the substance field (Su-field) method, physical contradiction, and the Algorithm of Inventive Problem Solving (ARIZ).

There are a great number of case studies that describe the effective use of the TRIZ technique, particularly in the process of conceptual design creation. (Frillici et al., 2015) proposed using the TRIZ method in order to experience the structured solutions in generating ideas in the conceptual design stage and providing scholars with assistance in generating inventive solutions to the engineering problem. This would be accomplished through the utilisation of the TRIZ method. Using the contradiction matrix and the 40 innovative principles technique developed by TRIZ, (Mansor et al., 2017) come up with the concepts for the self-organised usb charger cable that the TRIZ technique is effective in assisting in outlining issues with organised solutions, in addition to having the capacity to provide unique ideas and solutions.

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1.3 Problem Statement

Based on background research, every device has own charging cables. Every addition of each device may cause messy wire tangling on the charging port. The problems arise when users often encounter the difficulty of organizing the USB charger cable when not in used. At the same time, the user also preferred a solution which is simple to use and retain the actual length of the cable. As a result, a self-organised charger cable can help to eliminate the problem of USB cable management. Hence, this method of TRIZ have been used to make new design and concept for the self-organised cable organiser so that it satisfied the user. When the cable is in used, it is stick together so that it won't tangle and also can be carried around easily or when travelling. Moreover, TRIZ are great tools to solve this problem, 39 parameters or contradiction matrix can be used in order to solve the problems. The problem that are encountered is as follows:

1. Cable tangling due to the shape of the cable.
2. The difficulty of organizing the USB charger cable when not in used.
3. Lack of cable management.
4. It takes a lot of time to organise the cable.

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1.4 Research Objective

The main aim of this research is to design a self-organised USB Charger Cable. Specifically, the objectives are as follows:

a) To study and analyse design solution of self-organised USB Charger Cable by using TRIZ method.

b) To design and fabricate a self-organised USB Cable organiser prototype.

c) Usability Testing of fabricated prototype.

1.5 Scope of Research

The scope of this research are as follows:

- Conceptual Design of self-organised USB charger cable.
- Voice of Customer (VOC) by using Quality Function Deployment.
- Design analysis by using TRIZ Method.
- Decision making by using weighted decision matrix (WDM).
- Fabrication of conceptual prototype.
- Prototype testing.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, literature review includes definition, past research related to the Conceptual Design, USB cable organizer and Theory of Inventive Problem-Solving Technique (TRIZ). Besides, there is Primary Research and Secondary Research that consists of self-observation, online survey.

2.2 Primary Research

Information obtained via primary research is gained by the researcher themselves using self-done research. Primary research is conducted with the intention of obtaining information in order to provide responses to questions that have not previously been asked. Primary research that has been done for this study is self-observation and user survey. Primary research is of the crucial relevance for businesses and other organisations because it enables them to collect information about the requirements of the market from first-hand sources. The results of primary research provide important new information, which is typically used to guide the development of new products and comparable adjustments to organisational policy.

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2.2.1 Self-observation

The users often have trouble in managing the USB charger cord while it is not in use, and they preferred a straightforward solution that maintained the actual cable length. Figure 2.1 below shows un-organised and tangling charger cable.

Figure 2.1: Problem of messy and tangling charger cable when not in use

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