PROFILING DESIGN PREFERENCES USING BEZIER CURVE TOWARDS KANSEI ENGINEERING

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2017

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This report is submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

by

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2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Tajuk: **PROFILING DESIGN PREFERENCES USING BEZIER CURVE TOWARDS KANSEI ENGINEERING**

Sesi Pengajian: **2016/2017 Semester 2**

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This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.).
The member of the supervisory committee is as follow:

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ABSTRAK

Dalam pasaran hari ini, pelanggan bukan sahaja membeli produk yang hanya memenuhi keperluan fungsian, tetapi produk yang boleh memenuhi keperluan afektif mereka. Walaubagaimanapun, pereka menghadapi kesukaran dalam menganggarkan dan meningkatkan perasaan pelanggan kerana tidak ada kaedah yang sesuai untuk berbuat demikian. Botol air minumam yang boleh diguna semula telah dipilih sebagai objek kajian dalam projek ini. Tujuan kajian ini adalah untuk mengenal pasti dan menyiasat perasaan emosi terhadap reka bentuk produk yang berkaitan dengan kepuasan pelanggan dengan menggunakan Kansei Kejuruteraan. Selain itu, pilihan reka bentuk profil dianalisis melalui pendekatan matematik dengan menggunakan persamaan berparameter berdasarkan algoritma De Casteljau pada lengkung Bezier. Terdapat tiga kaji selidik yang penting telah dijalankan iaitu kajian awal, kajian utama dan ujian pasca. Semasa kajian awal, terdapat 10 reka bentuk yang dipilih oleh responden dari 9 kategori botol air sebagai profil reka bentuk pilihan keutamaan. Pada masa yang sama, 5 perkataan Kansei daripada 24 kata-kata Kansei telah dipilih oleh responden untuk mewakili perasaan emosi mereka terhadap reka bentuk botol air. Selepas itu, kajian utama telah dijalankan terhadap 550 responden di Institusi Pengajian Tinggi Melaka. Responden diperlukan untuk mengadar setiap perkataan Kansei yang boleh mewakili perasaan mereka terhadap reka bentuk botol air. Seterusnya, keutamaan Kansei bagi setiap reka bentuk botol air telah ditentukan di segmen yang tertentu berdasarkan lengkung Bezier yang diperolehi. Hasil kajian menunjukkan bahawa reka bentuk profil yang menunjukkan keutamaan 'Simple' pada bahagian bawah botol air, keutamaan 'Moden' adalah sekitar bahagian penutup dan sebelah kanan botol air dan keutamaan 'Tahan Lama' adalah reka bentuk dengan dua mulut dan dilindungi oleh reka bentuk beg tambahan. Untuk mengesahkan data yang didapati dalam kajian utama, ujian pasca telah dijalankan. Keputusan ujian pasca adalah konsisten dengan hasil kajian utama. Ini mewajarkan segmen mewakili keutamaan Kansei terhadap reka bentuk adalah sah.

ABSTRACT

In today's market, customer no longer purchasing products that only satisfy the functional requirements, but those can meet their affective needs like feeling and emotion. However, designers facing difficulties in estimating, reviewing, and enhancing the customers' feeling because there is not suitable method to do so. The reusable water bottle was chosen as the object of study in this project. The purpose of this study is to identify and investigate the emotional feeling towards the product design related to customer satisfaction and preferences using Kansei Engineering. Moreover, the profiling design preferences was analysed through mathematical approach using parametric equation based on De Casteljau's algorithm on Bezier curve. There are three important surveys were conducted which were preliminary survey, main survey and post-test. During preliminary survey, there are 10 designs were chosen by the respondents from 9 categories of water bottle as the most preference design profile. At the same time, 5 Kansei words out of 24 Kansei words were chosen by respondents to represent their emotional feeling towards the water bottle design. After that, the main survey was conducted towards 550 respondents in Melaka, especially in Higher Education Institution. During the main survey, respondents were needed to rate each of the Kansei words that can represent their feelings towards the water bottle design. Next, the Kansei preferences for each water bottle design was determined in which segment based on the Bezier curve obtained. The results showed that the profiling design which showed the 'Simple' preferences is at bottom of the water bottle, 'Modern' preferences is around the cap area and the right side of the water bottle and 'Durable' preferences is design with dual mouth and covered by extra bag design. To validate the data obtain in main survey, post-test was conducted. The post-test results were consistent with the main survey result. This justify the segment represented the Kansei preferences towards the design is valid.

DEDICATION

For my beloved parents who were always supported me,

Loh Fook Kheong

Lai Lian Chow

For my families and my friends, thanks for your love and care

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who gave me the possibility to complete this thesis. Firstly, I am deeply indebted to my previous supervisor, Mr. Hasoloan Haery Ian Pieter whose sharing his knowledge to help, stimulate suggestions, encouragement and guidance to complete this project. Furthermore, I would like to thank my supervisor, Professor Dr. Chong Kuan Eng to continue support and guide me until the end of this project.

In addition, I would like to thanks to all my colleagues. I want to thanks them for all their help, support, interest and valuable hints in completing my project. Lastly, I would like to give my special thanks to my family whose always patient with full of love and understanding that enabled me to complete this work.

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Con	-	Convenience
Dur	-	Durable
Ergo	-	Ergonomic
KE	-	Kansei Engineering
Mo	-	Modern
PSM	-	Project Sarjana Muda
Sim	-	Simple
SPSS	-	Statistical Package for the Social Science

CHAPTER 1

INTRODUCTION

1.1 Project Background

In the last two decades, the market of consumer products had transformed the company strategy from traditional product-oriented point of view to customer-oriented marketing (Guo *et al*., 2011). Due to the customers are indeed dynamic and 'unfaithful' to distinct product, the strategy through product changes and reduction or discount in product's price are now, old-fashioned and no more suitable in today's market (Hartono *et al.*, 2011). In this case, the companies must therefore have to change the structure of their product by discovering and exploiting top-level creativity and innovation (Brad, 2008).

Due to aforementioned reasons, company need to reformulate their product development strategies by focusing on a unique selling point and proposition in the eyes of customers since the products' performance is not only limited to utility, design, quality and price of product, but also to a name, symbol, design, packaging, and delivery (Grassl,1999). Moreover, because of the product from a wide selection of consumer goods need to be successful in the market, the company should see the customers not only focus on the reasonable and sensible aspects of the product during purchasing, but on symbolic and emotional factors that play as an important role in a purchase decision (Consoli, 2010; Khuong *et al*., 2015; Tan, 2010). In this case, the performance of company which having market orientation is having greater and more gain in business performance related to sales and profit (Kumar *et al*., 2011).

In addition, since the deepest voice of customer or the perceptions of customer should be explored, captured and transferred to the requirements of products that meet the customer expectations (Annique & Cuervo-Cazurra, 2007), the company should not only focus the development of their product on functionality, quality, and usability factors, but also on how their customer purchase the product to fulfil the mental and emotional satisfaction. Based on the customer requirement perspectives, this is due to consumers are, now, no longer purchasing products that only satisfy physical requirements (such as utility and quality), but also those that can meet their affective needs like feeling and emotion (Yan *et al*., 2006). Lai *et al.,* (2005) mentioned that consumer feeling is an aspect of quality since the term "quality" refers to the capability of a product to fulfil customers' requirements and expectations. Therefore, mass customization and personalization are accepted and agree as an important tool for many companies to gain competitive advantages (Jianxin *et al.,* 2006). Moreover, Reimann *et al.,* (2010) argued that aesthetic products seem to trigger certain positive reactions in consumers such as feeling desire to possess the product; willing to pay for the product despite the price; and higher inclination to show off and care for that product.

Furthermore, due to this trend in which many companies had shifted their differentiation efforts from focusing only to the product characteristics to the less noticeable features (which is aesthetics), therefore the successful key factors in engineering industries are in innovation and creativity aspects (Lee *et al.*, 2012) which the designer need to have the ability to see the products from the customer's point of view. According to Huang *et al.,* (2012) designers need to deliver a product design which can satisfies the customers feelings and preferences during the product design process. This is a reason on why the relationship between the customer and the designer need to be close to enable the designer to identify the interaction between customers and product interface (Kachitvichyanukul *et al.,* 2012). Since there are steps involved for the designer to understand the customer from their point of view, the designer need to design products that can evoke positive emotions to trigger the customers' feeling good (Helandera *et al.,* 2013). According to (Desmet, 2012:1), this due to by ignoring these emotions during the design process is a missed opportunity at best for successful product in the eyes of customers.

1.2 Problem Statements

In today's highly competitive environment in marketplace, manufactures had change their production strategy from "product-out" to "market-in" and change the product design concept from manufacturer-oriented to customer-oriented simultaneously (Yan *et al.,* 2006). Nagamachi (2008) defined "product out" as manufacturers making design specification decision from their view during production while "market in" means consider customers' preferences for product development. Since the trend of product development had changed to customer-oriented development, customer feelings play an important role in product development (Huang *et al.,* 2012). Hence, the only way for designers to increase successful product in the market is by considering and utilizing customer preferences and feeling during the process of design. However, designer facing the difficulties in estimating, reviewing, and enhancing the customers' feeling due to the reason of there is not suitable method to do so. In addition, there were different customers in evaluating the same product from different perspectives and no practicable design process is available (Lai *et al.,* 2005).

The basic reason on aforementioned problem is due of the companies which having the capability to determine and identify the basic customer requirements of a product (such as ergonomics and usability), but facing a challenge in eliciting the customers' subjective requirements (such as the feeling of satisfaction on a product) (Henson *et al.,* 2006). Moreover, this is due to product development based on customers' preferences have a limitation of time effectiveness since customers' preference will possibly changing over time (Kuang & Jiang, 2009). Hence, manufactures facing a challenge in adapting in this fast changing of customers' preferences. Jiao *et al.,* (2006) asserted that customers' affective needs are hard to be captured, inaccurate and unclear because different linguistic origin from customers, customers' subjective requirement is difficult to translate into verbal descriptions and affective needs are short-lasting emotional states.

In perspective of Mohais *et al.,* (2007), customers in today's market making their purchasing decisions depend highly on subjective criteria compared to the product functionality. This is because of highly competitiveness between manufactures that had made the functionality of the product equivalent and customer is hard to distinguish between them. Therefore, designers need to design a product which can engage customer's emotions and attract customer's attention to differentiate among wide range of products to increase product competitiveness (Jianxin *et al.,* 2006). However, there are different perceptions on

the product from the customers and the designers. Lai *et al*., (2006) stated that consumer depends largely on their perception of product image during making purchasing decision, but designers always considering physical elements of the product during design process. Moreover, designers tend to misinterpret on how the customers will evaluate their product design when the design process only relies on their own assumptions based on their own sensitivity and tacit knowledge (Yanagisawa, 2011). There does not had a suitable common language used by both designers and customers (Desmet *et al*., 2011).

Moreover, Tamaa *et al.,* (2015) stated that attractiveness of a product design plays an important role on customers' purchasing decision which is used to compare to other characteristics of product from competitors. This is due to the design of a product usually provides first impression and the uniqueness to the customer. Industrial designers manipulate product attributes by focusing on customers' preferences for certain shapes, texture, and styles to produce product that can satisfy the customers' expectation (Hsiao *et al.*, 2010). Lai *et al.,* (2005) emphasized that industrial designers will develop certain product based on their subjective experience after they interpret the market analysis from the review of customers' feeling on the product. However, this approach is not appropriate since it is not good scientific methods and procedures for the designer to estimate, review and improve the finished design in order to confirm with the design fulfil customers' expectation. Lee (2012) also agreed that industrial designer always facing difficulties in explaining the logic behind good shape design concepts due to the reason that designer always solved shape-related design problems based on their personal experience, perception and creativeness.

Hence, based on problems aforementioned above, this project will carry out the investigation on Kansei Engineering on how to develop the products used by the product designer in order to transform the feelings of customer into the real design elements during product development. Details about Kansei Engineering on catching the impression of customers for a certain product and translate them to a more detailed product specification will be discussed and analysed in this project. Statistical analysis tool software, that is SPSS, will be employed in this project to analyse and evaluate the questionnaires developed and distributed to the respondents. Moreover, mathematical approach through parametric equation which is involved the De Casteljau's Algorithm to Bezier curve will be exploited in this project for analyzing the designs characteristics' preferences by customer in which they decide the more preferable designs. This approach will be an alternative of assessing and evaluating the actual customer feeling and the target feeling towards the product design.

Water bottle will be chosen as the object of study. Resident in Malaysia need to drink a lot of water to quench their thirsty anytime and anywhere to avoid sickness because of the naturally tropical hot weather in Malaysia. More and more people choose to use reusable water bottle to fill drinking water instead of buying bottled water due to growing concern over the safety, environmental impact, and cost of disposable plastic water bottles. Based on observation, students especially undergraduate students in Higher Education Institutions have their own water bottle to fill the drinking water from the water purifier which prepare by school. However, there is not a significant study on the preferences of the water bottles shape based on the market observation and literature study. Water bottle designer only designs the water bottles based on the designer's preferences and creativity. Hence, the design of the water bottle only can meet the customer's functional requirements but cannot fulfil their affective needs.

1.3 Objectives

This project discusses about an integration of customers' feeling induced to the product based on the profiling design preferences towards the product development using the Kansei Engineering and mathematical approach, which is Bezier curve. Since to fulfil the customers' expectation through the product designed need to be developed based on customer need, therefore the objectives of this project as follows:

i. To identify and determine the emotional feeling towards the product design related to customer satisfaction and preferences using Kansei Engineering.
ii. To investigate and analyse the profiling design preferences through mathematical approach using parametric equation based on De Casteljau's algorithm on Bezier curve.
iii. To evaluate the customers' preferences and satisfaction towards the product design profile.