IMPROVEMENT OF HYGIENIC URINAL SYSTEM USING INTEGRATED APPROACH

Submitted in accordance with the requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

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I hereby, declared this report entitled “Improvement of Hygienic Urinal System Using Integrated Approach” is the result of my own research except as cited in references.

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APPROVAL

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

……..

(PM Dr. Hambali bin Arep @ Ariff)

ABSTRAK

Kajian ini memaparkan kaedah memperbaiki sistem urin bersih yang sedia ada dengan menggunakan pendekatan bersepadu. Oleh itu, pelbagai aktiviti reka bentuk telah terlibat dalam merekabentuk dan menyusun produk yang dicadangkan. Tujuan penyelidikan ini adalah untuk merekabentuk dan mencetak sistem urin bersih baru untuk menyelesaikan masalah orang yang mengalami kesukaran mengakses tandas. Proses reka bentuk adalah berdasarkan kaedah bersepadu atau pendekatan *Pugh* yang merangkumi pelbagai aktiviti reka bentuk seperti penyiasatan pasaran, penjanaan konsep, pemilihan konsep, reka bentuk terperinci dan konsep prototaip pantas. Mengenal pasti produk serupa yang sedia ada telah dijalankan untuk membayangkan dan menghasilkan idea untuk memperbaiki produk terdahulu. Proses Hierarki Analisis (AHP) dan Teknik Pesanan Keutamaan oleh Kesamaan kepada Penyelesaian Ideal (TOPSIS) telah digunakan untuk menentukan konsep reka bentuk terbaik semasa proses pemilihan pada peringkat reka bentuk konseptual. 3D model dan reka bentuk dijalankan menggunakan *SolidWorks* pada peringkat reka bentuk terperinci dan akhirnya reka bentuk yang dicadangkan direka dengan menggunakan pencetak 3D. Penambahbaikan sistem urin bersih dari reka bentuk yang sedia ada kepada reka bentuk yang dicadangkan menunjukkan bahawa 41% adalah peningkatan tertinggi dalam jumlah bahagian sistem urin bersih Hasilnya menunjukkan reka bentuk baru yang dicadangkan mampu menahan daya impak maksimum (195.042N) sebelum retak atau patah yang lebih baik daripada reka bentuk sebelumnya. Keputusan juga menunjukkan bahawa ketinggian maksimum untuk melindungi bahagian utama (perumahan) reka bentuk baru yang dicadangkan dari retak adalah 4.82 m yang lebih baik daripada reka bentuk terdahulu. Sebagai kesimpulan, reka bentuk baru sistem urin bersih yang dicadangkan jauh lebih baik dari segi fungsinya dan prestasi berbanding reka bentuk terdahulu.

ABSTRACT

This research presented the method of improving the existing hygienic urinal system using the integrated approach. Thus, various design activities have been involved in designing and fabricating the proposed product. The aim of this research is to design and fabricate a new hygienic urinal system for solving the person who has difficulty accessing the toilet. The design process is based on the integrated method or Pugh's approach which includes various design activities such as market investigation, concept generation, concept selection, detail design and rapid prototyping concept. Investigating the existing similar product was carried out in order to ideate and generate the idea to improve the previous product. Analytical Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) were employed to decide the best design concept during the selection process at the conceptual design stage. 3D modelling and design analysis were conducted using SolidWorks at the detail design stage and finally, the best-proposed design was fabricated using a 3D printer. The improvement of the hygienic urinal system from the existing design to the proposed design showed that the 41% is the highest improvement in the total number of parts of the hygienic urinal system. The result showed that the proposed new design able to withstand the maximum impact force (195.042N) before it was cracked or fractured which is better than the previous design. The results also revealed that the maximum height to protect the main part (housing) of the proposed new design from cracking was 4.82 m which is better than the existing design. In conclusion, the proposed new design of the hygienic urinal system is much better in terms of its functionality and performance compared to the existing design.

DEDICATION

Special dedication to my beloved family especially my father (Abdul Halim bin Ismail), my mother (Fauziah binti Hashim) and my supervisor (AP. Dr. Hambali bin Arep@Ariff) for every support, guidance, concern, understanding and patient. Thanks for everything. I would like to say thanks too to all my fellow friends. Without all your supports, the work and success will never be achieved.

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FUD	-	Female Urinal Device
RP		Rapid Prototyping
FDM		Fused Deposition Machining
PDS	-	Product Design Specification
CAD	-	Computer-Aided Design
3D	-	3 Dimensional
FEA	-	Finite Elements Analysis
FDM	-	Fused Deposition Modelling
STL	-	Standard Template Library
FEA		Finite Elements Analysis
AHP		Analytic Hierarchy Process
TOPSIS		Technique for Order of Preference by Similarity to Ideal Solution
PLA		Polylactic Acid

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE RESEARCH

Nowadays, the demand for social care service is increasing as the world also grew rapidly in development and technologies. Social care is the service that is supportive and helps the people either in person or practically to enable them to live as independent life as they can. The social care does not provide only the medical care, but it includes countless social care service with health services in providing the nursing service (Hamimatulakman & Noralfishah, 2016). There has been a major reorganization of health care services since 1957 in Malaysia. The health care service in Malaysia is always changing towards excellent service as opposed to illness service due to the increase of the elderly population. One of the problems for the elderly is the facilities in accessing the toilet.

The urinal device is one of the best options to help the elderly to overcome the problems to go to the toilet. This research relates to urinal devices and more specifically to the personal urinal that can be used by both male and female users. Over the years, the urinal system for males have constant standard configuration because of the ease with which urine discharged from the penis can be effectively completely hold. There are some innovations in size, configuration and angular orientation of the component have been done but the

function of each components is still the same with substantially the same continuing efficiency (Knight, 1982).

Until now, there are not many people know about the product of urinal system that is easy, effectively and efficiently usable by both male and female users. According to some institutions, such as hospitals, convalescent homes, nursing homes, and homes for a long time have a continuing need to separate urinals for males and females. The lack of a presently available and commercially satisfactory in the market about the universal urinal for both male and female users requires that these institutions expend the high cost of purchasing and storing two types of urinals. Such additional expense adds to the ever-increasing costs of personal health and medical care.

This research presents the development of the hygienically urinal system using the integrated approach. Today, it is well-known that manufacturing is the most important resource for today's wealth-generating process. Manufacturing is an important industry of economic growth in all countries. With the introduction of the concept of Industry 4.0 by Germany, there has recently been a great emphasis on advancing manufacturing technologies around the world. The introduction of the concept of manufacturing systems began with advances in digital computing capability in the 1960s. At that point, some kind of integration started to emerge within manufacturing (Chen, 2017). The product development stages were conducted initially from market investigation until the concept development stage.

Many methods have been built and introduced to assist the designer to select the best design structure of the early phase of the development process. The integrated method or Pugh's method is also well-known methods that use to develop and improve the product's design that needs to be implemented. The Pugh's method includes the customer demands, product design specification, conceptual design, detailed design, manufacture, and sale.

1.2 PROBLEM STATEMENT

For this research, the behavior of the individual's experience and practicing with the toilets environment itself will be focusing on here. The design of the toilet nowadays often includes the design that is very common. They also will see the practical design for use of the disabled person (Waraporn Mamee, et al., 2010). For the use of the Muslims people, it required to use water to complete the use of the toilet (Istinja') and for the cleaning before performing the prayer (ablution or wudu). Besides that, they are permitted to do that without utilizing water. Istinja' is washing the private parts of the body to evacuate the pee or stool. Under specific circumstances, Istinja' could be performed without water. Rocks, stones, torn bits of fabric are admissible to use for cleaning (Hamid et al., 2016). According to a bathroom firm Bathstore survey, a man is using the toilet for one hour and 45 minutes a week (91 hours per year), while women spend their time using the toilet just one hour and 25 minutes a week, meaning that men spend more than 17 hours per year on the toilet compared to women (Killelea, 2014; Sanghad, 2014).

Besides that, there are also problems that caused the average age men or women, or kids cannot run to the bathroom. Either it can be the situation of being stuck in traffic congestion or travel long distances on a highway without any exit for miles and miles. Most of the people who traveling for short or long distances with the car or other automobiles can end up with the traffic congestion. The traffic jam caused mostly men will urinate on the side of the road or else they find themselves in pain or suffering the urge to urinate. The percentage of getting caught in traffic congestion is the highest in the mobile society. The average of the American people travelled is 30,000kn in year the 2006, which is $3/4^{th}$ of the Earth's circumference and more than twice of the average European people (O'Toole, 2010).

It also can be even more difficult for the elderly population to access the toilet. The elderly population needs to have some difficulties go to the toilet due to the health problems such as incontinence, overactive bladder or any other medical disorders. Or the situation

where there are only a few public toilets available, for example, in the public space in the cities or no toilet and running water available. An American Standard's 2008-bathroom Habits survey that consumer toilet frustration and include fixtures that do not flush all the way (19%), appearance (18%), running water (18%) and not conserving water (17%) (American Standard Bathroom Habits Survey, 2008). Lastly, the same problem also happens when the old male or female people performing Hajj. Some of them have problems with their health and face difficulty to go to the toilet and sometimes they need to wait for a long time to get it.

1.3 OBJECTIVES

There are three objectives of this research as follows:

a) To design a new hygienic urinal product for a unisex user using an integrated approach.
b) To improve the proposed design of the hygienic urinal from the existing design.
c) To fabricate and test the functionality of the proposed design.

1.4 SCOPE

The scopes of research are as follows:

a) The market investigation is focused on the existing product for both male and female users.
b) The concept generation is developed for five design concept using SolidWorks software.

c) The concept evaluation is developed using the AHP and TOPSIS method to select the best design concept.
d) The detailed design of the proposed design is developed using the SolidWorks software.
e) The improvement had been made by comparing the existing design and proposed design.
f) The theoretical calculation and simulation are compared using the FEA simulations.

1.5 SIGNIFICANT AND IMPORTANT OF RESEARCH

The development of the hygienically urinal system for use of both male and female will give high benefits to the elderly or other people. It will have a different shape and more improvement to the design concept and development. This research also will improve the existing product in the market and optimize the design product to be more functional and efficient. The development of this product design also will give benefits to some institution such as hospitals, convalescent homes, nursing homes, and social care sector to use it when needed. In addition, it will give benefits to the people who have a problem in accessing the toilet in emergency time.