UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REDESIGN OF ASSISTIVE DEVICE FOR BLIND PEOPLE USING CONCEPT OF ENGINEERING DESIGN

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering Technology (Product Design) with Honours

by

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TAJUK: **Redesign Of Assistive Device for Blind People Using Concept Of Engineering Design**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

…….

(MOHD KAMAL BIN MUSA)

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ABSTRAK

Pada era yang semakin canggih ini, terdapat pelbagai alat bantuan dipasarkan dalam pasaran bagi membantu orang buta berjalan seperti orang biasa dan mengelakkan mereka daripada terlanggar halangan sekeliling. Namun, apabila membawa alat bantuan tersebut, ia akan menjadi satu bebanan bagi orang buta jikalau reka bentuk alat bantuan tersebut dicipta secara tidak ergonomik. Pengguna akan rasa tidak selesa apabila membawa alat bantuan dengan mereka. Dengan ini, projek ini akan mencadangkan beberapa reka bentuk bagi menaikkan keselesaan "Smart Vibration System Goggles". Komponen yang sedia ada dalam sistem ini juga akan diubahsuaikan dengan mengekalkan fungsi sistem tersebut. Survey telah dijalankan untuk memahami keperluan dan keinginan reka bentuk cermin mata untuk orang buta. Dengan ini, beberapa lakaran tentang reka bentuk cermin mata telah dicadangkan. Apabila reka bentuk produk dimuktamadkan, model CAD produk tersebut akan dijana dalam SolidWorks. Semua dimensi produk akan ditentu pada masa ini dengan mengambil kira komponen saiz. Selepas itu, produk yang telah siap ubah suai telah diuji oleh 15 responden. Secare keseluruhan, kepuasan reka bentuk produk ini telah meningkat sebanyak 53.33% (dari 20% hingga 73.33%)

Kata Kunci: alat batuan, orang buta, reka bentuk, keselesaan, ubah suai.

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ABSTRACT

Nowadays, there are a lot of assistive products on the market that used to help blind people to guide and prevent to bump into obstacles during their walking. However, when carrying these assistive products, sometimes it would become a burden for visually impaired people as the design of the products is not ergonomics. The users will feel uncomfortable and inconvenience when bringing the assistive device along with them. Thus, this project is conduct to improve the design of the Smart Vibration System inside the goggles so that the users will feel comfortable when wearing on it. The components inside the products will also be modify while remain its functionality. First, a survey has been done among the blind people to understand their needs and wants for the design of goggles. Then several designs idea have been proposed in sketches. Once it is finalized, a CAD model will be generated inside SolidWorks software. All the dimensions will be defined in this stage by considering the system components. Next, the modified product prototype is tested by 15 respondents. As results, the satisfaction of the new design of the goggles has increased from 20% to 73.33%.

Key words: Assistive device, visually impaired, comfortable, modify, satisfaction

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DEDICATION

Every challenging work needs self-efforts as well as guidance of elders, especially those who very close to our heart.

My humble effort I dedicate to my sweet and lovely

Family members

Whose affection, encouragement and prayers of day and night make me able to get such success and honour.

Project supervisor, Encik Kamal Bin Musa

Project co-supervisor, Encik Wan Norhisyam Bin Abd Rashid

Along with all hardworking and respected

Lecturers and friends

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LISTS OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

GPS	=	Global Positioning System
GSM	=	Global System for Mobile communication
RULA	=	Rapid Upper Limb Assessment
CAD	=	Computer Aided Design
STL	=	Stereo Lithography
M	=	Meter

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CHAPTER 1
INTRODUCTION

1.0 Overview

In this chapter, the general idea of this project has been discussed and followed by the problem statement of this project. Next, the aim of this project has been explained clearly and the extent for implementation of this project has been stated.

1.1 Background

Visual Impairment is results from a disease, injury or other conditions that limit vision. According to the research of World Health Organization (WHO) in Prevention of Blindness and Deafness (PBD) Document 2010, 285 million people are estimated to be visually impaired worldwide, which 39 million are blind and 246 have low vision.

Disability of eyes will bring effects on their normal life as physical movement is one of the biggest challenges for blind people. Normally, visually impaired people used to memorize every structure detail in their house to prevent injury. However, what if a visually impaired people go to new places? The structural obstacles in natural or manmade environments such as trees or stairs will block the mobility of visually impair people. Hence, to ensure the visually impaired people can walk like normal people, a wearable system is developed to help them from bump into obstacles during the walk.

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In existing design, the ultrasonic sensor of the goggles can detect obstacles at a certain distance from users and send vibrate signal to alarm the users. The vibrator will vibrate in different frequency depending on the location of the obstacle and it will be stop within 5 seconds right after the user has stay away or prevent from the obstacles successfully. In case, when the user has lost their way, they can press the button which locate at the box on the existing design. The GPS system will start to detect the longitude of user and transfer to the GSM-Arduino system. When the GSM-Arduino system had received the location of user, it will send his/her location to their guardian through SMS (Short Message Service).

In this project, we propose a newly design of spectacles for blindness people by using the existing smart vibration sensor system as the design of the system. The comfortability and convenience will be the main concern for this design.

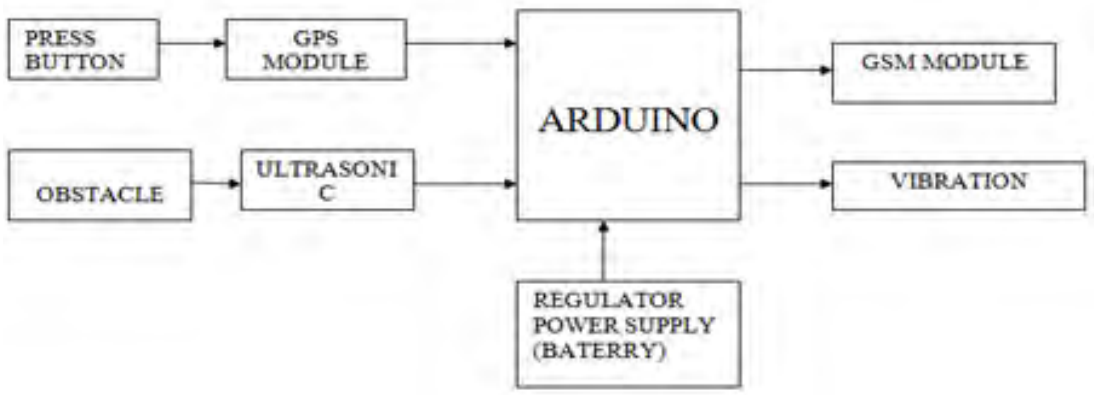

Figure 1.1: The Block Diagram of Smart Vibration System.

1.2 Problem Statement

The function of the smart vibration system is very useful for visually impaired people. However, the current design of the smart goggles doesn't fulfill the principles of ergonomic. In another word, it makes the user feel uncomfortable when wearing on it. The nose pads will bring health effect to users if the goggles are wearing for a long

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duration as the goggle is large in size and heavy. Besides, the battery of the existing system (Rechargeable AA Battery) cannot support the system for a long duration. Most of the component or wiring of the system are also placed outside the goggles and this had definitely affected the appearance of the product. Furthermore, the size of the ultrasonic sensor on the goggles are heavy and large in size. More stress will apply on the user's nose and thus, cause uncomfortable to the user. In addition, the user is required to carry a big box which installs the GPS system and Arduino system during their walk.

Figure 1.2: Original design of smart vibration system

1.3 Objective

The general objective of this project is to increase satisfaction level on new design of smart vibration system ergonomically by:

a) Minimize and simplify the component of the goggles while remain the functionality of the system
b) Analyse the original design of goggles based on the comfortability by using RULA analysis.
c) Prototyping and fabricating the product.

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1.4 Prototyping and fabricating the productScope

In this project, the usability and comfortability is the main concern issues. Thus, the shape will be redesign according to ergonomics and materials will change to light materials. However, the function modification of the existing smart goggles will not be including in this project.

All the components in the system such as vibrator, sensor and battery will be simplifying together to obtain the smaller size of the goggles and maintain in light weight. Type of battery of the system will also upgrade to larger capacity while remain in smaller size and lighter weight so that the system can last longer after recharge while easy to carry. All the wires that expose outside the product which will affect exterior design will be combine as one wire to bring convenience and comfortability to users when wearing the goggles. For the ultrasonic sensor, the range finder system is cover from 0 to 0.8 meter. The rationale behind this is because ultrasonic sensor has better range detection compare to infrared sensor. The GSM and GPS inside the system also provide safety instruction to user as it can help to contact their guardians and Arduino is the core or master for this system as it controls the entire system in this project. The size of box that contain both Arduino, GSM and GPS in existing design will also be reduce to increase the portability.

The CAD software that choose for this project is SolidWorks. Analysis such as RULA analysis inside CATIA software will be done to test the sustainability of the redesign product.

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CHAPTER 2
LITERATURE REVIEW

2.0 Overview

This chapter discuss all the summaries and reviews of the researches that related to this project.

2.1 Design

2.1.1 Product Design

To get more refine only as the design process moves toward its goal, highly involve, often ill-defined, complex and iterative process, and the needs and specifications of the required artifact are the important criteria inside the product design. An effective computer support tool that helps the designer make better-informed decisions that requires efficient knowledge to represent schemes. There is a virtual explosion in the amount of raw data available to the designer, and knowledge representation is critical in order to sift through this data and make sense of it in the world nowadays.

In order to shrunk product development time through the use of simultaneous and collaborative design processes, stay competitive is a must for a company. To

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achieve these, effective transfer of knowledge between teams are important. Higher impact in terms of energy, cost, and sustainability are the awareness that need to pay attention on it when decisions are making early in the design process. It results in the need to project knowledge typically required in the later stages of design to the earlier stages (Chandrasegaran, et al., 2013).

However, Michael, K, and Mariëlle (2013) have different view on product design. They state that there are many important implications after products are manufactured. There remains a range of additional design decisions although the product is being developed. These additional design decisions include package design, also with those that are indirect consequences of earlier decisions, such as pricing. Customers' interest will be addressed in mass customization, willingness to pay, level of differentiation, and package design due to the research on product design's role in commercialization.

Alsyoufl, Al-Alami1 and Saidam (2015) have the same view that product design can be describe as a device to inspire innovation and altered the change of system. A continual and dynamic process which has no beginning and no end is used to describe the product design and improvement. Both products and processes are in a constant state of flux and a complex pathway which involves of feedback loops are followed by improvement process. Defining system requirements, as determined by stakeholders' needs (e.g. owners or operators, original equipment manufacturers (OEMs), service providers) should be done early in the conceptual design phase as this is a very important attempt effort when starting the product design and development. Some important criteria such as new environmental constraints, the constant mutation of the product, and to drive and realize such products and processes the continuous needs of specialist employees must be figure out and deal with it before a designer start the product design and improvement process.

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2.1.2 Design Concept

According to Graening and Sendhoff (2014), design concepts can used to define as an abstract representation of a class of designs sharing an analogous characteristic that map to approximately equivalent design qualities. Design concept must be generalizing from individual design solutions, the identification and representation of design concepts to classify designs with respects to shape and quality. It can lead to a structuring of the design domain, based on which design concepts can be used, the engineers will be supported by algorithmic identification of concepts when processing large amounts of design data.

Chiu and Salustri (2014) also have similar view that the term design concept is often used. In fact, it only several definitions provided. Despite the desultory definition for concept, the design process is usually more rely to concepts. For example, brainstorming and generating multiple design concepts, and subsequently identifying design concepts for concept selection, evaluation and development, etc. As concepts play a central role in human cognition, concepts and concept formation are of particular interest in psychology. Interest in other fields such as archaeology, bioinformatics and education are also including as one of the concepts and concept identification.

2.1.3 Design Problem

Tong and Sriram (cited in Chandrasegaran et al., 2013) states that design can be describing as a process that meets certain performance criteria and resource limitations by constructing a description of an artifact, process, or instrument that satisfies a (possibly informal) functional specification. It is realizable, and satisfies to certain criteria such as simplicity, testability, manufacturability, and reusability. In the other hand, design can also be differentiating as a process that involves mapping a specify function onto a realizable physical structure. It is found that mapping between function and structure is often complex. A complex organization of a large number of

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