



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and development of a Hand-Arm support : Lifting wheelbarrow and loading banana fruit into the wheelbarrow

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

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Lifting wheelbarrow and loading banana fruit into the wheelbarrow

SESI PENGAJIAN: 2015/16 Semester 1

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Date : 29st MAY 2015

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree in Bachelor Degree in manufacturing Engineering Technology (Product Design)(Hons.). The member of the supervisory committee is as follow:

(Signature of Supervisor)

.....

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ABSTRAK

Tangan sangat penting bagi manusia. Tanpa tangan manusia tidak boleh melakukan kerja mereka seperti biasa. Setiap kerja ada menggunakan pergerakan tangan. Dengan itu, factor risiko akan memberi kesan kepada tangan manusia. Faktor risiko yang berlaku kepada tangan manusia boleh mengakibatkan kecederaan di tangan dan boleh mengganggu kehidupan manusia..

ABSTRACT

Arm is very important to human. Without arm, human cannot do their daily job properly. Every job have their own task using. The work may resulted to the risk factor to the human arm. The risk factor happen to human arm can lead to arm injury. Today in current market, no arm support is build for the farmer and banana's worker doing their job. The existing arm support in current market not focus on farmer. This project will develop arm support for the bananas worker doing their work of lifting and loading bananas fruit into the wheelbarrow. The development 3D model is used CAD Software and the fabricating is used 3D printer machine. The development of this arm support will help the bananas worker doing their job.

DEDICATION

Specially dedicated to my family, PSM's supervisor, PSM examiner panels and friends.

ACKNOWLEDGEMENT

Firstly, Thanks to Allah s.w.t. because let me live until now to complete this Bachelor's Degree Project for 1 semester.

Thanks to my parents and family for their support in making this report.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

mm	=	millimeter
cm	=	centimeter
m	=	meter
kg	=	kilogram
N	=	newton
in	=	inchi
lb	=	pound
ft	=	feet

CHAPTER 1

INTRODUCTION

1.1 Background

In human body anatomy, arm is a part of human body. Arm have several part that combine together as a perfect mechanism for people to do their daily life routine. From the shoulder to the finger have the different mechanism of movement and its own degree of freedom (D.O.F).

The use of arm is not limited every day. Every job have their own task using hand such as typing, lifting load, writing, painting and others. The work may resulted to the risk factor to the human arm. The risk factor happens to human arm including vibration, static postures, repetition, force, contact stress, cold temperature and awkward posture.

The risk factor can make human arm to injury. The example of the injury to the arm is related to the musculoskeletal disorder (MSD), carpal tunnel and bone fracture. The factor of ages also can bring to the injury.

So, the ergonomic study responsible to fit the job to the human capabilities. In this case, the study will develop an arm support for the task lifting the wheelbarrow and loading banana fruit inside the wheelbarrow. The loading of banana fruit need to use high force because the fruit is heavy. So, with the design development the task will be easily handle and no need high force to lift the fruit and wheelbarrow. The arm support will help to support the weight of human arm, banana fruit and the wheelbarrow. Then, the risk factor will be reduce and the probability of injury will decrease.

1.2 Problem Statement

Problem statement of this project is:

Nowadays, some hand-arm support are made. The arm support is focus only for disable people. It is hard to find the arm support for the other used especially for the lifting wheelbarrow and loading banana fruit in the wheelbarrow

The movement of the arm support in today market have the limitation of work and movement and make it hard to use. People who wear it will feel a little bit more uncomfortable because it limits the range of the arm movement.

1.3 Objectives of Project

The objective of the this study of a Hand-Arm support : Lifting wheelbarrow and loading banana fruit into the wheelbarrow is :

1. To design and fabricate prototype of a design concept of hand arm support for a farming worker to carry bananas with a wheelbarrow using concept selection method.
2. To develop the 3D model of the arm support using a 3D CAD software suitable for farming worker to carry bananas with a wheelbarrow.

1.4 Scope of Project

The work scope of this project is to develop a design concept of hand arm support for banana worker to lift wheelbarrow and loading banana fruit in the wheelbarrow. During this project, the SolidWorks software is used to make the design concept. The analysis of the design also make using SimulationXpress Analysis Wizard in SolidWorks software. The design also will be fabricate. The fabricating process will be done using appropriate manufacturing process.

CHAPTER 2

LITERATURE REVIEW

2.1 Product Design and Development

Product development (PD) process is a structure of stage that change a set of input into a set of outputs. For the details of PD process is the sequence of phase that a person make a design and commercialize the product. The product development must follow the product development process. A good development process will make the a good quality of product

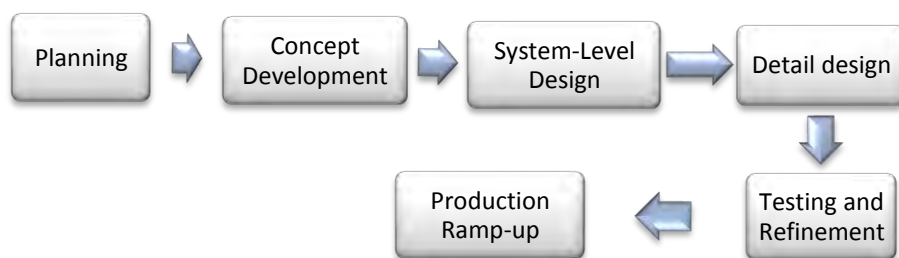




Figure 1: Product development phase
(Source: Savantsimulators.com, "Savant Simulators". Web. 4 Aug. 2015.)

2.2 Benchmark

The method of searching several product that had been in the market and comparing the relation between the products and our concepts is called benchmarking. In particular industry, they always use this method to improve their product. It evaluate the other product with the specification needed. The benchmarking method make the company being well and competitive with other product in order increase their functionality.

Product	Criteria
	<ul style="list-style-type: none"> • lifting heavy objects • stable • held for a long period • Made from springs, pulleys, servo motors
	<ul style="list-style-type: none"> • Comfortable handle. <p>The stabilizer is made of high-strength and lightweight Alloy</p> <ul style="list-style-type: none"> • Can be extended more features and functions. • Easy to install and uninstall.

2.3 Ergonomics

Ergonomic is all about human and their job [1]. Ergonomic is a study about human behaviour, psychological and physiological abilities and their limits. The expertise in this job usually will create a new work environment's or change published work situation refer to the studies of the human limitation and abilities. The job demand must not exceeded the human abilities and limitation.

Exposed to the work stresses that can give effect to the safety and give a safe and productive work condition and finally to make sure the work is done successfully. The application of ergonomic must fit the product, task and environments to a person and not push the human to suit the work. To make sure the job is fit to human, ergonomist must consider the job design, the workplace and the worker. The ergonomic study is a wide study about the working place that will give effect to the comfortable and healthier worker. It is the study about chair design, footwear, machine design, tool design, workstation design repetitive motion, heavy lifting, vibration, temperature, noise and lighting. Factor like shift work, rest time and meal time is under the job design. All the factor can cause the injury or problem about nerve, tendons and muscles and all the problem can create a musculoskeletal disorders (MSD). MSD are injuries of soft tissues (cartilage, joints, ligaments, tendons and muscles) and nervous system. The MSD can affect the surround of tissues, tendon sheaths and nerves. It is commonly involve the arm and backs. 90 percent of disabled old workers have MSD. All the statement above is explaining how important is ergonomic to prevent MSD disorder and how to fit the work condition to the human condition and ability.

2.4 Ergonomic Risk Factor

Since a long time ago, workplace is design to move the product and support the machine effectively. Employer not gives full attention to fit the job to the human since human are adaptable at that time. When injuries caused by repetitive motion, excessive force and awkward postures is growing, ergonomics has become an important factor in the safety of the workplace. Risk and risk factors are same scope used in ergonomics literature. Risk is means how many accident or injury happen in a given exposure time [2]. Injury risk can be looked as very low probability but extremely high consequence such as multiple fatal occur or higher probability but less worst impact like worker slipping and tripping. Risk is also coincidence with the work settings. Risk give a probability for any injury. A worker also have probability to not have any injury during risk exposure. If the injury not occur in a situation, it does not mean the risk is not appear. Risk factors also can define as the conditions that increase the injury of musculoskeletal system. Risk factor exposures and the level of musculoskeletal injury risk is not easy to defined by their relation. Biomechanical exposures, psychosocial stressors and individual risk factors are the three categories of risk factor. Bad designed workplaces and biomechanical exposures like repetitive motion, high forces and abnormalities from neutral body posture is all under biomechanical exposures. Psychosocial stressors at work include factors such as low job control, time pressure, high workplaces stress, and low social support.

2.5 Musculoskeletal System

Musculoskeletal system gives shape, movement, and stability to the human posture. It includes of the body's bones, muscles, tendons, ligaments, joints, cartilage, and other connective tissue. "Connective tissue" is the tissue that supports and hold tissues and organs together. The main content are collagens and elastic fibers. Collagens and fibers are made up from different type of proteins. The musculoskeletal system will make many changes due to the increasing of the human age.

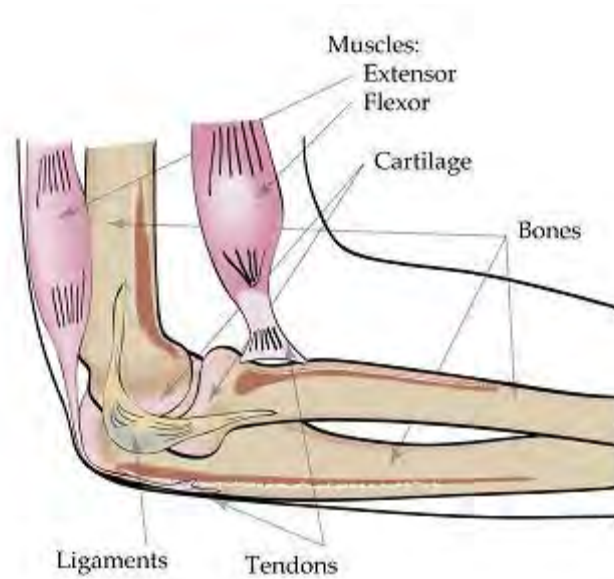


Figure 2.2 : Musculoskeletal system

Source : (https://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_biomed/cub_biomed_lesson02.xml)

2.5.1 Bones

Bone is strong but it will frequently change tissue that has several tasks. It will give stiff structure to the human body and bones also act as a protection to the human internal organs. It is the place that contain bone marrow. Bone marrow is the place the blood cell is produce. Bone's function also to constant the body's tank of calcium.

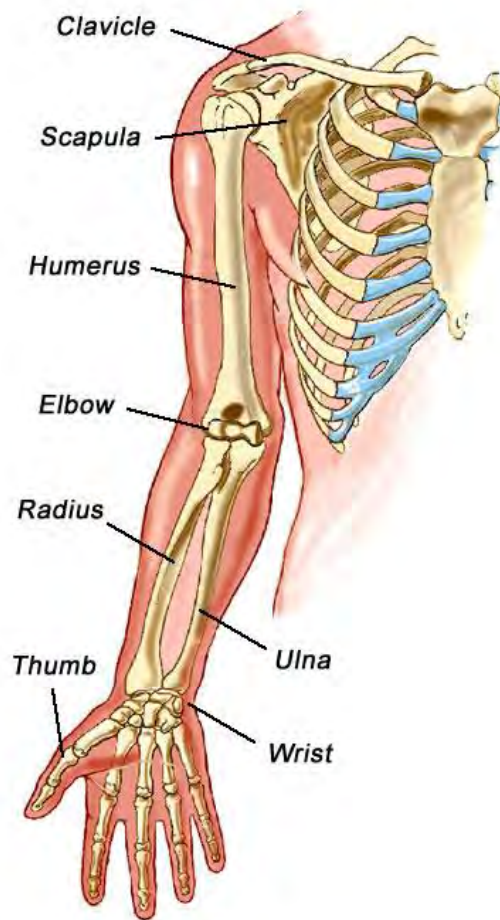


Figure 3.2 : Arm bones

Source : (<http://pixshark.com/upper-limb-skeletal-anatomy.htm>)

Bones have two shapes:

- Flat (the plates of the skull and the backbones)
- Tubular (The thighbones and arm bones)

All bones basically have the same structure. The hard outer part contains many of proteins, like collagens, and hydroxyapatite, which is made from major of calcium and other minerals. The inner part of bones is softer and not as much of dense than the outer part but still helping to strength the bone.

2.5.2 Muscles

Basically muscle have three type:

- Skeletal
- Smooth
- Cardiac (heart)

Skeletal and smooth muscle are part of the musculoskeletal system. People always think skeletal muscle is called muscle, muscle that can be contract to make movement of human body. Skeletal muscles contains many of contractile fibers that are arrange in similar form, and look like stripes under the microscope view. Skeletal muscles different in their velocity of contraction. It responsible to the human body posture and body movement, it connected to bones and organized in opposing groups around joints. When muscles bend the elbow (biceps) countered by muscles that straighten the triceps. So, the movement become balance and smooth, then can prevent from injury of musculoskeletal system. Brain control the skeletal muscle and only move with human mind conscious. By exercise, the size and strength of skeletal will be maintain and increase [3].