

## **SUPERVISOR DECLARATION**

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation)”

Signature :.....

Supervisor :.....

Date :.....

**DESIGN AND ANALYSIS OF LOCAL FRUIT'S POLE PICKER**

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**This thesis is submitted as a part of the fulfillment for the  
bestowal of Bachelor in Mechanical Engineering (Design & innovation)  
with honours.**

**Faculty of Mechanical Engineering  
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**MAY 2015**

## DECLARATION

“I hereby declare that the work in this report entitle DESIGN AND ANALYSIS OF LOCAL FRUIT’S POLE PICKER is my own except for summaries and quotations which have been duly acknowledged.”

Signature : .....

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Date : 27/5/2015

## **SPECIAL TO**

### **Mom, Puan Atikah binti Ismail**

A strong and gentle soul who taught me to trust in Allah, believe in hard work and that so much could be done with little. Thank you for guiding me as a person, teaching me that my job in life was to learn, to be happy, and to know and understand myself; only then could I know and understand others.

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## ABSTRACT

Fruit pole picker has been widely used in most country in order to pluck the fruit. Current pole picker comes in different method and mechanism of handling and operation which is some is too complex to be handled by single user. Thus, the main purpose of this project is to design a local fruit picker that is reliable and easily used by most homeowners or in small farm. This project primarily focus on development of fruit pole picker with consideration of several factors such as ergonomics, weight, safety, operation, output power, cost and etc. The fruit pole picker in this project is focusing on plucking the local fruit from *Meliaceae* family of *Lansium spp.* fruit such as dokong, langsung and duku which is become an important new economic crop in Malaysia and there is no specific tools has been designed to pluck this fruit. Designing and modelling a fruit pole picker are important for the development of pole picker itself. From the existing pole picker in the market, there are so many problems that can be improved. Redesign of existing fruit pole picker is a good solution to ensure the pole picker has a perfect design and better specification. After redesign the pole picker, the analysis is essential to ensure the pole picker is safe and good enough to fabricate.

## ABSTRAK

Galah pemetik buah telah digunakan secara meluas di kebanyakan negara untuk memetik buah. Galah pemetik buah yang sedia ada datang dalam kaedah dan mekanisme pengendalian yang berbeza dimana sesetengah galah pemetik buah terlalu kompleks untuk dikendalikan oleh seorang pengguna. Oleh itu, tujuan utama projek ini adalah untuk merekabentuk galah pemetik buah-buahan tempatan yang mudah digunakan oleh kebanyakan pemilik rumah atau ladang kecil. Projek ini memberikan tumpuan kepada pembangunan galah pemetik buah dengan mengambil kira beberapa faktor seperti ergonomik, berat, keselamatan, operasi, kuasa output, kos dan lain-lain lagi. Dalam projek ini, galah pemetik buah menumpukan kepada buah-buahan tempatan daripada keluarga *Meliaceae* iaitu *Lansium spp.* seperti buah dokong, langsung dan duku yang menjadi ekonomi tanaman baru yang penting di Malaysia dan tiada alat khusus yang dibina untuk memetik buah ini. Merekabentuk dan memodelkan galah pemetik buah ini adalah penting untuk pembangunan galah pemetik buah itu sendiri. Daripada galah pemetik buah yang sedia ada di pasaran, terdapat banyak masalah yang boleh diperbaiki. Merekabentuk semula galah pemetik buah yang sedia ada adalah penyelesaian yang baik untuk memastikan galah pemetik buah mempunyai reka bentuk yang sempurna dan spesifikasi yang lebih baik. Selepas merekabentuk semula galah pemetik buah, analisis adalah penting untuk memastikan galah pemetik buah selamat and baik untuk dipasang.

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## LIST OF ABBREVIATIONS

HOQ	-	House of Quality
PDS	-	Product Design Specification
WDM	-	Weight Decision Matrix
CAD	-	Computer Aided Drawing
CATIA	-	Computer Aided Three Dimensional Interactive Application
BOM	-	Bill of Material
FEA	-	Finite Element Analysis
PSM	-	Projek Sarjana Muda
FPP	-	Fruit Pole Picker

## CHAPTER I

### INTRODUCTION

#### 1.1 BACKGROUND

Malaysia is a country rich with varieties of local fruit such as *rambutan*, *durian*, mangosteen and *dokong*. Usually the homeowner or owner of a small farm retrieve the fruit by using homemade fruit pole picker climb on to a ladder and pick each fruit by hand. Certain types of fruit may be left to fall itself, but for the most species of local fruit, they must plucked or picked when they start to ripening to avoid the fruit dropping to the ground and creating a mess.

Thus, the purpose of this project is to design and analysis of local fruit picker with mechanical design knowledge in order to maintain the quality and quantity of the fruits. The common fruit pole picker has a pair of cutting tool such as scissors with a stationary and movable member join together to cut the fruit stem there between.

There are several adjustments that have been made to current fruit picker in the market. In this study, the new concept design of fruit picker is fabricated and analyzed to ensure it meets the customer requirement. This project requires mechanical skills and knowledge to be applied such as drilling, grinding and others. The title of this project is 'Design and Analysis of Local Fruit Pole Picker' with specifications including stress analysis, type of material used and cost. Several tests



are conducted in order to verify the design and to increase the performance of this fruit picker.

## **1.2 PROBLEM STATEMENT**

Nowadays, there are many alternative to collect the ripen fruit from the trees. One of the popular methods is by using the fruit picker. Current fruit picker comes in different method and mechanism of handling and operation which is some of them is too complex to be handled by single person. Unfortunately, there still some problem faced by user such as difficulties to pick fruit at the unreachable and hidden area because it cannot be maneuvered between the bushes. Fruit picker at the market has limited capability or function to pick certain type of fruits. Besides that, current fruit picker cannot ensure the quality of picked fruit especially for fruit that easily loose from their benches which can cause obvious permanent fruit damage.

Smaller pole picker have also been proposed since the common pole picket in the market seems too bulky and have certain disadvantages in terms of weight and storage. Even though most of the pole pickers are able to separate the fruit from the stem, some of them are failing to separate between ripe and unripe fruit which will cause waste.

## **1.3 OBJECTIVE**

To done this project successfully, there are several objectives are targeted to achieve the project goals.

- i. To study the problem and identify the solution with current fruits picker terms of safety, ergonomic and cost.
- ii. To design a local fruit pole picker that is reliable and easily used by most homeowners or small farm.

- iii. To perform the stress analysis on the design in order to make comparison with the existing fruit pole picker in the market.

#### 1.4 SCOPE

Based on project objectives, there are four scopes that have been narrowed down and identified which are:

- i. To study the advantages and disadvantages of existing fruit pole picker in the market and suggest the solution to the previous design.
- ii. To propose the conceptual design with suitable mechanism in order to develop the efficient cutting mechanism to cut the fruit stem.
- iii. To develop the fruit pole picker that is ergonomic, safe and easy use by reducing the weight and simple enough to be hand held and manually operated by a person.
- iv. To perform stress analysis on final design by using engineering software such as CATIA V5R20 and CATIA structural analysis in order to determine the maximum force to be applied and maximum stress can be withstand by a pole picker .

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 INTRODUCTION

This chapter is divided into seven sections which the first section are focusing on the characteristic of *Meliaceae* family of *Lansium spp.* fruit such as dokong, langsung and duku, second section focusing on the existing fruit picker in market with the research patent, the third section focusing on review of existing product, the fourth section focusing on the project design requirement, the fifth section focusing on design concept consideration and the last section focusing on design criteria of fruit pole picker. In order to identify the effective ways to plucking the fruit, the characteristic of the fruit such as the color, chemical composition, harvesting index, weight of the fruit should be studied and understood. For the existing product and research patent section, the method used and the disadvantages for every product will be determined and explain in this chapter.

#### 2.2 *LANSIUM SPP.*

This section is focusing on the generality of *Lansium spp.*, the development of *Lansium spp* fruit and flower, factor and condition for harvest and the characteristic

of *Lansium spp* tree. These aspects need to be study in order to identify the suitable design concept to retrieve the *Lansium spp* fruit.

### 2.2.1 Generality of *Lansium spp*.

There are three important cultivars of *Lansium spp* which are dokong, langsung and duku. According to Yunus et al (1998), the identification among these cultivars is nearly the same thus make it difficult to growers to classify based on their morphological appearance *Lansium spp* has almost seedless fruits with a brittle skin and size of 30 to 60 mm in diameter. The skin of young fruit is pale green and, when it starts to ripening it turns yellow with some brown spots while its sap is no longer sticky. The green seed is covered with white translucent pulp. Recently, many researchers and growers have shown interest in plantation of *Lansium spp* fruit as a new important economic crop that is gaining popularity in Malaysia. Some information on colour and composition of dokong are reported by Yunus et al (1998). According to Yunus et al (1998), the best indicator for determining the maturation of dokong is the change in their colour since the degree of yellowness at different stages is easy to recognize. Norlia (1997) state that dokong fruit start to develop yellow colour about 87 days after fruit set and Yunus et al (1998) state that dokong can be harvested 11-17 days after that stage. Figure 2.1 shows that the *Lansium spp* fruit.

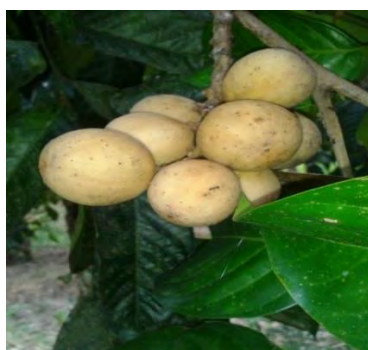


Figure 2.1 *Lansium spp*

### 2.2.2 Development of *Lansium* fruit and flower

The *Lansium spp* tree bears flowers on 1 – 8 inflorescences arising from floral cushions on main branches. Each inflorescence is 15- 2- cm long bearing 20 – 50 hermaphrodite flowers measuring about 6mm across, which develop into nearly spherical shaped fruits. According to Pungtip (2009), the green seed of *Lansium spp* is covered with white translucent pulp and the skin of immature fruit is pale green and, when ripe, its turn yellow with some brown spot while its sap is no longer sticky. Figure 2.2 shows the translucent pulp of *Lansium spp*.



Figure 2.2 The translucent pulp of *Lansium spp*.

(Source: Azman, 2010)

### 2.2.3 Factors and conditions for harvest

According to Pungtip (2009), *Lansium spp* fruits can be harvested about 16 weeks after the bloom of the first flower. At this point, the fruit size reaches about 25 – 35 mm diameter with skin color changing from green to yellow or greyish yellow and pulp becoming translucent and sweet. Another good characteristic of almost all *Lansium spp* is that all the fruit in a bunch ripen simultaneously which facilitates harvesting (Yunus et al 1998).

#### 2.2.4 Characteristic of *Lansium spp* tree.

The *Lansium spp* tree is average in size about 30 metres in height and 75 centimeters in diameter. The tree is tall with densely clustered leaves but with advance of agricultural technology, the *Lansium spp* tree is much shorter nowadays. The leaves are very similar to rambutan fruit trees which are an oval shaped. The trunk grows in irregular manner with the roots showing above the ground and the tree's bark is a greyish in color. Figure 2.3 below shows the example of *Lansium spp* tree in Malaysia.



Figure 2.3 *Lansium spp* tree  
(Source: Simple Malaysian, 2007)

### 2.3 COMPARISON OF CURRENT PRODUCT AND RESEARCH PATTERN

In this section, a detailed look and explanations of all the research pattern and current design of fruit picker from market are selected to make the comparison. The list of pattern is narrowed down to 7 that directly share common ideology with proposed concept design specification. Basically, all the following pattern consist of

a hand pole which is by ‘shearing’ or ‘pulling’ mechanism at the end of the pole in order to separate the fruit from the tree. Many advantages have been notice in order to help in the development of the final concept design. A copy of all pattern discussed is attached in appendixes.

### 2.3.1 Twister fruit picker

This twister fruit picker in Figure 2.4 is a new innovation to quickly, easily and safely pick the fruit. The mechanism involved in this design is rotating mechanism.



Figure 2.4 Twister fruit picker

(Source: Global Products & Development, 2013)

#### Advantages

This design might help the growers to easily and correctly pick fruit with no damage with its durable lightweight engineered reinforced polymer. The slim design allows to target the individual fruit so that can be see what picking. Besides, the pole can be adjustable in order to adapt with the height of fruit.

## Disadvantages

The spring action to rotate the fruit is too strong thus for the weak hand person, not enough tension will be applied when hold the fruit to pull. This design consumed a lot of time since it can only pick one fruit at one time.

### 2.3.2 Pole Fruit Picker

This fruit picker in Figure 2.5 is about 13 foot long consist of static and durable fiberglass pole which perform grab and pull action. This pole picker usually use when fruit is picked from tress instead of off the ground.



Figure 2.5 Pole fruit picker.

(Source: John and Sue Weaver, 2012)

## Advantages

This is the basic design with non-complex mechanism and easy to use. Besides that, it is lightweight and strong enough to pull the fruit. For storage the design of this fruit picker is compact enough to store it. Fruit picked is undamaged