DESIGN AND SIMULATION OF CAM OPERATED IRIS MECHANISM

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DECLARATION

I declared that this project report entitled “Design and Simulation of Cam Operated Iris Mechanism” is the result of my own work except as cited in the references

Signature : ……..

Name : SYAHRONI BIN HUSAIN

Date : 11 JANUARY 2021

APPROVAL

I have checked this report and the report can now be submitted to JK-PSM to be delivered back to supervisor and to the second examiner.

Signature : ……..

Supervisor's Name :Dr. MOHD. NIZAM BIN SUDIN

Date : ……..

DEDICATION

To my beloved families whom always be a guiding light and support in all aspect in my life. To every person that always help me in learning process throughout the years.

ABSTRACT

Iris mechanism have been applied in multiple field in the engineering scope of studies and manufacturing. The mechanism structure consists of an opening at the centre of its mechanism and combine with multiple part that will encase it structure together. The problem statements start with the demand to create a food making machine that can encrust or cut the dough which in turn will make a food called “kuih cucur badak”. The design and mechanism for this cutting process were dictated to have an iris mechanism. This project objective is to design and simulate the cam operated iris mechanism. The simulation of this structure also was executed to fully understand the stress or any loading that happened during the motion of the mechanism works. The first step of this project is to gain as much references and sources that can be obtain to grasp the idea and the basic principle of each mechanism. This established the basic flow for the methodological process to be performed by the researcher. The detail calculation for the crucial part such as the blade for iris mechanism, linkages and the cam profile were conducted to established the design sketch. The cam also used the Simple Harmonic Motion (SHM) for its motion schemes. The design process also was performed in this project to make sure the design keeps up with the basic flow of design processes. Modelling the design sketch are made after basic design have been made and the last step is to simulate the whole structure inside the Computer-Aided Design (CAD) software which is Solidwork. Motion study were used to simulate the mechanism movement and its stresses during those motion. Tabulated data were made to understand the stresses that occurs on the components. The result of this study is to create a fully functional mechanism which consist of iris mechanism, linkages and its cam-follower components. The result of the simulation is used and discussed heavily on how the stresses work based on the motion of the mechanism.

Keyword: *iris mechanism, linkages, cam-follower mechanism, simple harmonic motion, design, simulation, computer-aided design*

ABSTRAK

Mekanisme iris telah diterapkan dalam pelbagai bidang dalam skop kajian dan pembuatan kejuruteraan. Struktur mekanisme ini terdiri daripada pembukaan di tengah-tengah mekanismenya dan bergabung dengan beberapa bahagian yang akan merangkumi strukturnya bersama. Penyata permasalahan bermula dengan permintaan untuk membuat mesin membuat makanan yang dapat menutup atau memotong adunan untuk proses pemotongan makanan yang pada akhir proses tersebut akan membuat makanan atau kuih yang dikenali sebagai "kuih cucur badak". Reka bentuk dan mekanisme untuk proses pemotongan ini ditentukan untuk memiliki mekanisme iris. Objektif projek ini adalah mereka bentuk dan membuat simulasi terhadap mekanisme iris yang digerak dan dipacu oleh sesondol. Simulasi struktur ini juga dilaksanakan untuk memahami tekanan atau beban yang berlaku semasa pergerakan mekanisme berfungsi. Langkah pertama projek ini adalah memperoleh seberapa banyak rujukan dan sumber yang dapat diperoleh untuk memahami idea dan prinsip asas setiap mekanisme. Dengan cara ini, ia dapat menetapkan aliran asas untuk proses metodologi yang akan dilakukan oleh pengkaji. Pengiraan terperinci untuk bahagian penting seperti pisau untuk mekanisme iris dan profil sesondol dilakukan untuk membuat lakaran reka bentuk struktur. sesondol juga menggunakan Simple Harmonic Motion (SHM) untuk skema gerakannya. Proses reka bentuk juga dilakukan dalam projek ini untuk memastikan reka bentuk sesuai dengan aliran asas proses reka bentuk. Model lakaran reka bentuk dibuat setelah reka bentuk asas dibuat dan langkah terakhir adalah mensimulasikan keseluruhan struktur di dalam perisian Computer-Aided Design (CAD) iaitu Solidwork. Kajian gerakan digunakan untuk mensimulasikan pergerakan mekanisme dan tekanannya semasa pergerakan tersebut berlaku. Data berjadual dibuat untuk memahami tekanan yang berlaku pada komponen. Hasil daripada kajian ini adalah untuk mewujudkan mekanisme berfungsi sepenuhnya yang terdiri daripada mekanisme iris, jalinan penghubung dan komponen sesondol-pengikut sesondolnya. Hasil simulasi akan digunakan dan dibincangkan secara terperinci mengenai bagaimana tekanan berfungsi berdasarkan pergerakan mekanisme.

Kata kunci: *mekanisme iris, jalinan penghubung, mekanisme sesondol, gerakan harmonik sederhana, reka bentuk, simulasi, reka bentuk bantuan-berkomputer*

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LIST OF ABBREVIATIONS

CAD	Computer Aided Design
SHM	Simple Harmonic Motion
FEA	Finite Element Analysis

LIST OF SYMBOLS

θ	=	Angle
r	=	Radius of Circle
t	=	Time Taken
T	=	Period
H	=	Height

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Iris mechanism is a structure that were design with an opening at it center and quite unique to begin with. The opening at the center of the structure serve as a multitude of functionality based on its purpose of usage. Iris mechanism sometimes called as iris diaphragm were one of the fundamental components in the optical systems related industries as this industry were the pioneer of the iris-shape design structure. The design can be traced to the other industries such as the design of opening of heat exchanger in thermal reactor, structure of opening in water sprinkler, and also in ink-jet printing mechanism and many more. They have a similar mechanism but slightly different approach for the opening at the center of the iris mechanism. Other industries beside photographic sector made a significant advancement in the iris overall design and its functionality (Langenbergh et al., 2015).

The opening of the iris mechanism usually has a moving part which were called as blades and the opening of the mechanism influence by the position and movements of this part. Syms et al. (2004), conclude that by increasing the number of blades will affect in much more circular shape of the opening. The shape of the blades also plays a major role in opening of the iris mechanism as for a curved edge blade will result in the opening also become more circular. The structure that holds this blade for the opening can be varied and it heavily depend on the complexity of the design.

Highly sophisticated design has much more components or parts to hold the blades and these parts act as a housing for the blades. The overall structure then called as iris mechanism

or iris diaphragm. Some variation of the mechanism is called as translational iris mechanism, sliding iris mechanism and the camera-like aperture (Pieter &Tom, 2017). These variations on the mechanism serve specific purpose for their creation and design but the popular design that were still widely used is the camera-like aperture.

This report is focused on the design and functionality of iris mechanism specifically in the food industries as the design is referred to a mechanism which will cut a section of dough to make a certain type of food. It still using the basic design which is the camera-like aperture but with much simpler and understandable design. The behavior of this design mechanism will be simulated to analyze and conclude whether the design that already made serve it purpose which is cutting a dough. The term used for cutting the dough to specified form is called encrusting or forming. This term is unofficially used in the food industries as the term may not have a significant and important points toward academic research study and report journal as it only come out from the manual book of the machines or its advertisement.

1.2 Problem Statement

The food manufacturing company is a big player in the generation of the economy and thus making it one of the important sectors. The machine that were created and fabricated by the machine development companies for food manufacturer can be in multiple design and based on its purpose or functionality. Certain food manufacturing companies that focus on creating a specific food which is *kuih cucur badak* still using the traditional methods to make the food and demand the production of food manufacturing machine in which not only cheap but also reliable. This demand to create a food manufacturing machine that were custom-made create an opportunity for the designer and engineer to work together to make a fully functional design and fabrication of the machine.

The mechanism that were chosen is iris mechanism which used to specifically cut the dough for the production process of *kuih cucur badak*. The operated iris mechanism can be installed in the system of the dough cutting machine to allow a smooth and thorough cutting of dough. The cam structure and configuration of linkage dictate the motion and kinematics of the iris mechanism.

The configuration design for the linkage and cam structure were not definitively explained in details for the modelling process in Solidwork. The only structure that were acquired were iris mechanism. The given specification not enough to design the model of whole cam operated mechanism. researcher need to studies on how exactly the iris mechanism will work based on the attachment of linkage and cam. The design that will be made by the research will heavily dependent on the iris mechanism specification that were acquired.

The cam operated iris mechanism is lack of validation in term of simulation and kinematics. It also lacks of analysis and understanding of cam operated iris mechanism made for dough cutting process. The lack of understanding and analysis of the cam operated iris mechanism will make the mechanism lost its basic principle in legitimate design process. The process to simulate the design were the pinnacle to further establish and prove that the design was perfectly working and were backed up with rock solid validation. This bring forth the aim of this research study which is to design and simulate the cam operated iris mechanism.

1.3 Objectives

The objective of this project is;

a) To design cam operated iris mechanism based on the given specification.

b) To investigate the kinematics and simulation of cam operated iris mechanism using Solidwork motion software.

1.4 Scope of Project

This project is solely using the help of software tool to generate and analyze the result of the study which is SOLIDWORK 2018. The main purpose is to design or model the mechanism and simulate the mechanism. The other industries design of iris mechanism has complicated and much more advance design as mainly due to the capacity and capability of its usedness. The end result is to determine whether the simulation of the iris mechanism is behave as expected and can be fully functional to be produce and fabricated. Detail flow of design the structure model of iris mechanism, linkage and cam mechanism and its individual simulation were the focus of this project before the fabrication process were conducted.

1.5 General Methodology

The steps need to be address to achieve the objective of this project are:

1. Literature review

   Any reports, journals, books and online sources will be used as a major reference for this project.

2. 3D modelling

   The design of the iris mechanism will be made in the Solidwork 2018 software based on the specification that have been given earlier. For this report, the modelling will be made for the iris mechanism with the attachment of the cam system and linkages.

3. 3D simulation

   After the modelling have been made and set, the simulation procedure will be enacted to test the subject in specified and control parameter. The simulation will be tested inside the Solidwork 2018 software. This step will be the crucial part as it acts as a benchmark whether the iris mechanism is working or not.

4. Analysis

   Analysis then will be made based on the result that have been gain from the simulation. Any graph, data and visual condition of the mechanism will help to finalize the working parameter of the structure.

5. Report writing

   Full report of the study will be made at the end of this project.

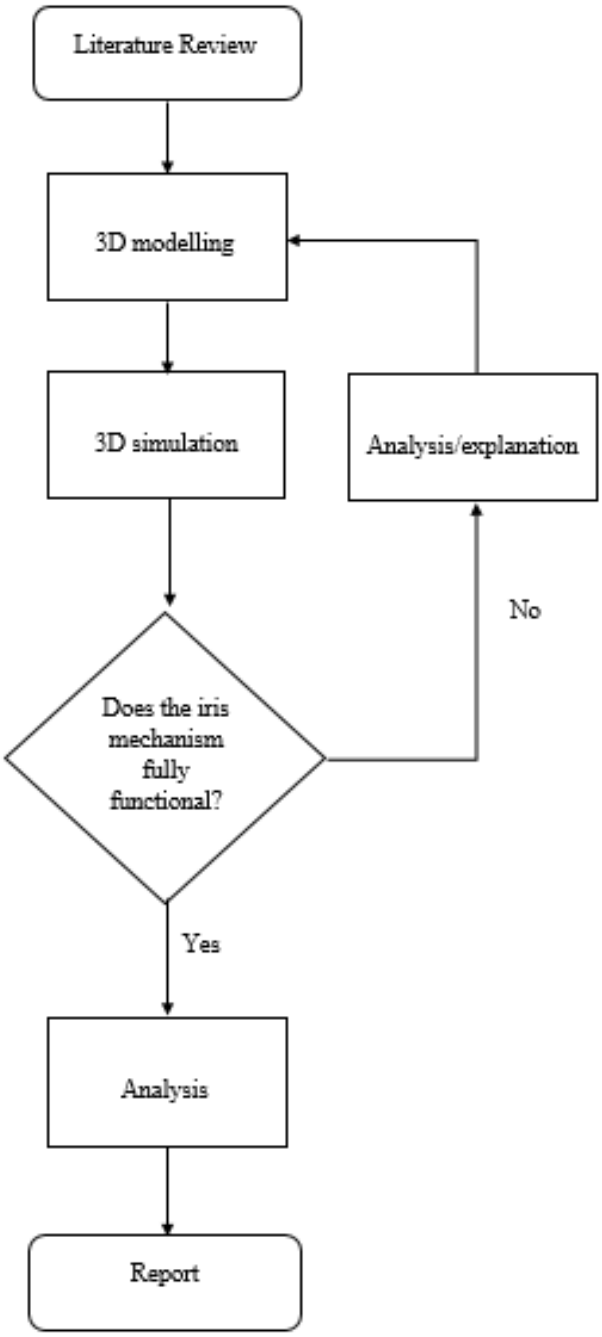

Figure 1.1: Flowchart of General Methodology.