UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND PRODUCTION OF A CHARGE COUPLE DEVICE (CCD) CAMERA HOLDER FOR A TRAVERSE SYSTEM USING ADDITIVE MANUFACTURING METHOD

MUHAMMAD SYAMIL BIN CHE SUKRI
B091310342

BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE TECHNOLOGY) WITH HONOURS

2022

Faculty of Mechanical and Manufacturing Engineering Technology

DESIGN AND PRODUCTION OF A CHARGE COUPLE DEVICE (CCD) CAMERA HOLDER FOR A TRAVERSE SYSTEM USING ADDITIVE MANUFACTURING METHOD

Muhammad Syamil Bin Che Sukri

Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

2022

DESIGN AND PRODUCTION OF A CHARGE COUPLE DEVICE (CCD) CAMERA HOLDER FOR A TRAVERSE SYSTEM USING ADDITIVE MANUFACTURING METHOD

MUHAMMAD SYAMIL BIN CHE SUKRI

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this thesis entitled “Design, Production Of A Charge Couple Device (CCD) Camera Holder For A Traverse System Using Additive Manufacturing Method” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : Muhammad Syamil Bin Che Sukri

Date : 27-1-2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

Signature : 

Supervisor Name : Puan Fadhilah Binti Shikh Anuar

Date : 27-1-2022

DEDICATION

To my beloved parents,

Che Sukri Bin Che Leh and Noraini Binti Nordin

Thank you for all the support, encouragement, enthusiasm, patient and willingness.

To my honoured supervisor,

Puan Fadhilah Binti Shikh Anuar and all UTeM lecturers and staffs.

To my dearest friends

Thank you for always giving me a guidance and persistent help to complete this project thesis.

ABSTRACT

A Charge Couple Device (CCD) camera is the most often utilised application in particle image velocimetry (PIV) systems since it is used for measuring. Errors are caused by both computational and environmental causes. Without a suitable camera holder, the camera can easily be tilted, resulting in incorrect flow speeds. When using a camera tripod manually, it's difficult to calibrate the camera position accurately and precisely. As a result, using the manufacturing additives approach to prototype the camera holder is necessary to ensure that the CCD camera can be held appropriately. Additionally, Auto Cad software was utilised to create the design for the camera holder. It is an excellent approach to locate the correct design concept to use the pugh technique as a procedure to perform the design selection process. As a result, the camera holder is expected to be able to firmly hold the camera while also being placed on an aluminium profile to allow for camera movement. Finally, the camera holder's specifications must match the true dimensions of the 76mm (W) x 76mm (H) x 54.6mm (L) ccd camera in order to hold it properly.

ABSTRAK

Kamera Charge Couple Device (CCD) adalah aplikasi yang paling sering digunakan dalam sistem velocimetry image particle (PIV) kerana digunakan untuk mengukur. Kesalahan disebabkan oleh sebab komputasi dan persekitaran. Tanpa pemegang kamera yang sesuai, kamera dapat dimiringkan dengan mudah, menghasilkan kelajuan aliran yang salah. Apabila menggunakan tripod kamera secara manual, sukar untuk menentukur kedudukan kamera dengan tepat dan tepat. Akibatnya, dengan menggunakan pendekatan aditif pembuatan untuk membuat prototaip pemegang kamera diperlukan untuk memastikan pemegang camera yang betul dihasilkan. Selain itu, perisian Auto Cad digunakan untuk membuat reka bentuk pemegang kamera. Ini adalah kaedah terbaik untuk mencari konsep reka bentuk yang betul dengan menggunakan teknik pugh sebagai prosedur untuk melakukan proses pemilihan reka bentuk. Hasilnya, pemegang kamera diharapkan dapat memegang kamera dengan kuat sementara juga diletakkan pada profil aluminium untuk memungkinkan pergerakan kamera. Akhirnya, spesifikasi pemegang kamera mesti sepadan dengan dimensi sebenar kamera 76mm (W) x 76mm (H) x 54.6mm (L) ccd agar dapat menahannya dengan betul.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Merciful,

The Most Gracious First and first, I would want to express my gratitude and appreciation to Allah the Almighty, my Creator and Sustainer, for all I have received from the beginning of my existence. I would like to express my gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for facilitating this research.

My heartfelt thanks to my primary supervisor, Dr. Fadhilah Binti Shikh Anuar of the Faculty of Mechanical and Manufacturing Engineering Technology at Universiti Teknikal Malaysia Melaka (UTeM), for her encouragement, guidance, and inspiration. Her unflinching patience in mentoring and imparting precious insights will be remembered for eternity. Additionally, to my Academic Advisor at Universiti Teknikal Malaysia Melaka (UTeM), Mr. Mohd Faez Bin Zainol, for his unwavering support throughout my journey.

Finally, and most importantly, I want to express my heartfelt appreciation to both of my loving parents, Che Sukri Bin Che Leh and Noraini Binti Nordin, for their support and for being a pillar of strength in all my undertakings. My lifelong gratitude to my best friends for their tolerance and understanding. Additionally, I'd want to express my gratitude to my family and closest relatives for their unwavering support, love, and prayers. Finally, I want to express my gratitude to everyone who assisted, supported, and inspired me to pursue my studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

2D	-	2-Dimension
3D	-	3-Dimension
AM	-	Additive Manufacturing
CAD	-	Computer-Aided-Design
CCD	-	Charge Couple Device
PA66	-	Polyamide 66
mm	-	Length
PIV	-	Particle Image Velocity
m/s	-	Velocity
CTE	-	Charge Transfer Efficiency
QE	-	Quantum Efficiency
CCE	-	Charge Accumulation Efficiency
Hz	-	Frequency
SLA	-	Stereolithography
SLS	-	Selective Laser Sintering
FDM	-	Fused Deposition Modelling
ASTM	-	American Society for Testing and Materials
NPD	-	New Product Development
RP	-	Rapid Prototyping
SFF	-	Solid free Form Fabrication
LM	-	Layered fabrication
DCM	-	Digitalizing the Construction Monitoring

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

This chapter describes the objective of the research project, the importance of this study and its problems, including the limitation of this research project. It also describes the subject matter, goal, and criteria for the analysis, which serves as an introduction to the project.

1.2 Project Overview

In the present age of IR 4.0, the fact that a digital camera is incorporated into a smartphone makes it easy to use a digital camera or to capture moments more easily. Cameras, on the other hand, are available in a range of configurations, depending on their intended function, including DSLR cameras, mirrorless cameras, small digital cameras, and action cameras. When it comes to modern optical microscopes, one of the most important components to consider is the Coupled Charging Device (CCD), which is often integrated into the camera and is used to increase the brightness of each probe light source while also forcing them to move in synchronization with one another. Electronically scanned film images are converted into visual images using charge coupled devices (CCD) sensors, light and laser densitometers, and flat scanners. These technologies allow the conversion of qualitative film images into visual images based on the optical density of the film. (Jurik, 2007).

The Particle image velocimetry (PIV) system is one of the applications that makes use of the CCD camera technology. Particle image velocimetry (PIV) is a non-intrusive, quantitative, and qualitative optical measurement device that is based on lasers. Flow

visualization and measurement are accomplished via the use of the instantaneous velocity field, the average flow field, and the average flow visualization(Hu *et al.*, 2001). A new kind of camera holder will be developed as part of this project, which will be more convenient and simpler to use in conjunction with a PIV system, in order to achieve this goal.

It was with the help of this design, which was made using the most current manufacturing technologies, including CATIA V5R21 and Ansys Workbench software, that a new ergonomic camera holder was developed and manufactured using 3D printing. Also included is the use of a lightweight FS3200PA Nylon powder material and the use of an Additive Technology known as Selective Laser Sintering to create the product itself (SLS).

1.3 Problem Statement

Having the CCD camera in the incorrect position may result in many problems, including the amount of mistakes produced by computation and environmental conditions, among others (Stolzenburg *et al.*, 2011). In the lack of an appropriate camera holder, it is possible that the flow velocity measurement will be inaccurate as a consequence of the camera tilting easily. It is more difficult to calibrate the camera position, laser shot, and picture alignment when using a camera tripod that is operated manually. The calibration of the PIV system will take substantially longer and will need the participation of at least two individuals.

An automated traverse system may be utilized instead of a tripod as a consequence of this development. A proper CCD camera holder, on the other hand, will be necessary in order to guarantee that the camera holder is suitably supported and moveable on the traverse system. Unfortunately, there is no particular holder for a CCD camera available on the market (Model no: 630090). Additionally, a camera holder that was designed to fit a certain aluminum profile with dimensions of 40 mm x 40 mm was examined for use with an in-house built traverse

system. Therefore, various important design elements of the holder must be taken into consideration in order to support both the camera size and the aluminum profile at the same time.

1.4 Research Objective

The aim of the research is to ensure that the camera holder can tightly hold the camera and place it on the aluminum profile. Specifically, the objective is:

a) To design a camera holder to match a Couple Charge Device (CCD) camera of a Particle Image Velocity (PIV) system.

b) To analyze the camera holder design using finite element analysis (FEA) and produce a prototype using AM method.

1.5 Scope of Research

In particular, the focus of this study is the design of a camera holder utilizing additive printing techniques, as well as the testing of a certain aluminum profile size that will be utilized in combination with the camera holder. The camera holder is being developed particularly for a CCD camera with dimensions of 76mm(W)x76mm(H)x56.4mm(L), made by the TSI company. The camera holder should allow for at least one direction of movement on the aluminum profile, either forward or backward.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

To guarantee that a project works successfully, various elements should be fully analyzed and examined before to start. The project will be changed in view of the collected data in order to continue working effectively and achieving the project's objective. To get the best outcome feasible, researchers evaluated all data or information acquired from a variety of sources during the course of their study. This is done to confirm that the CCD camera holder meets with all standard specifications and operates as designed.

2.2 Type of Camera Holder

When photographing or filming, it is critical to keep the camera steady. It also has a more realistic movement thanks to the compact camera. While the camera is naturally stable, it is possible that further stabilization is necessary. A mobile phone camera that is not equipped with an ultrasonic lens must be used with image stabilization. An absence of this characteristic may cause the picture to seem unsteady. On the market are tripods for cameras such as the Kirk Low-Profile Tripod and Handle Pod, as well as the Magnus Bendable Tabletops with Smartphone Mount and the Table Top Tripod (Todd Vorenkamp, 2015).

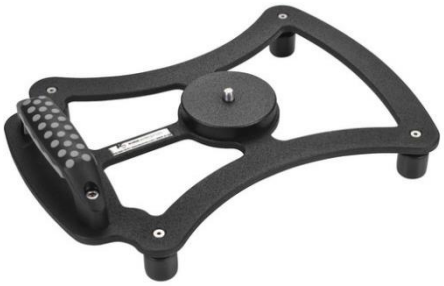

Figure 2.1 Shows Kirk Low Pod Camera holder

It acts as a support for the camera and allows it to snap pictures from low angles or in close proximity to the subject. There is just one-color option: black. Using a carrier handle that has been included into the frame, the camera support may be lifted up and moved about the room. Aside from that, the mount's four rubber feet keep it from rolling around over rocks and other rough terrain. - Because of the powder coating applied to the metal frame, it will last for years.

Figure 2.2 Shows HandlePod Camera holder

Handle Pod Camera Holder is a one-of-a-kind, easy-to-use support for point-and-shoot cameras and ultra-compact camcorders. The foldable portable mount is secured to any camera using a 1/4"-20 screw, which is industry standard. The strong grooved handle of the Handle Pod adds extra stability while shooting handheld video in portrait or landscape orientation. When the Handle Pod is folded down, it transforms into a quadpod for use on a table, and its four rubber feet provide stable video and still capture from any flat surface when used in conjunction with a tripod.

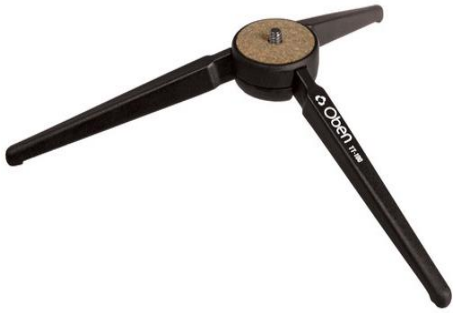

Figure 2.3 Shows Table Top Tripod

The Table Top Tripod is ideal for photographing from a table top or other high surface. Alternatively, you may set the TT-100 on the ground or floor to get more stable low-angle images. The TT-100 is constructed entirely of aluminum for robustness and lightweight, making it an ideal tool for macro or product photography. The overall load capacity of the system is 6 lb. The tripod has a little ball head that connects to the 1/4"-20 screw on the tripod and fits almost any camera. The ball may be loosened with a single lever, enabling the camera to tilt or pan. The ball pivots and pans 360 degrees, and a groove on one side allows for a 90-degree tilt in one direction.

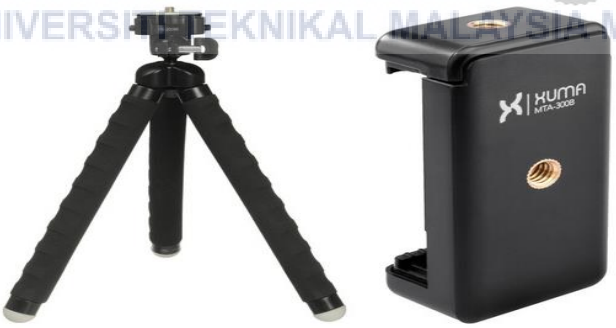

Figure 2.4 Shows Bendable Tabletop Tripod with Smartphone Mount

These straps may be looped around a fence, a tree limb, a chair leg, or anything else that is both sturdy and compact enough to keep the tripod's legs in place. In addition, the smartphone mount is compatible with the vast majority of protective covers on the market. As a result, you'll always have it with you. It only weights approximately 6 oz, so you can carry it