UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRODUCT DESIGN AND ANALYSIS OF AUTOMATIC MOTORIZED CAT FEEDER FOR LARGE CAGE SIZES

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BACHELOR OF MANUFACTURING ENGINEERING TECHNOLOGY (PRODUCT DESIGN) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Manufacturing Engineering Technology (Product Design) with Honours

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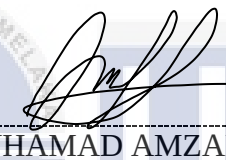
DECLARATION

I declare that this Choose an item. entitled " Product Design And Analysis Of Automatic Motorized Cat Feeder For Large Cat Cage" is the result of my research except as cited in the references. has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : 

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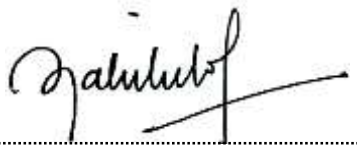
Date : 11/1/2023

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 Manufacturing Engineering Technology (Product Design) with Honours.

Signature : 

Supervisor Name : *TS. DR. SYAHIBUDIL IKHWAN BIN ABDUL KUDUS*

Date : 12/1/2023

DEDICATION

I dedicate this project to the Almighty God, Allah SWT, the Creator of all entire beings in the universe. He has been this project's main source, strength, and inspiration. “He has given everything from Him as the pay for what the people have done their work”. I also dedicate this project to my family, especially my parents. My father, Md Noor bin Chik. Thank you for the great support you have given me for this entire life. My mother, Mrs Nuran Murni binti Ahmad. Thank you for being the best mother I have ever had. Thank you for being the greatest parent, raising me from when I was a child until to how big I am ke it is nothing. Not to forget, I dedicate this project to my supervisor, Ts. Dr Syahibudil Ikhwan Bin Abdul Kudus, my siblings, and my friends. Thank you for all the words, the motivation, the inspiration, and everything. Without their support and prayers, I may not be able to do this as far as I could.

ABSTRACT

This study aims to design and analyze a suiTable an automatic motorized cat feeder for large cage sizes. Using the Internet of Things (IoT) based cat feeder, can be enhanced with monitoring and controlling functions. The Internet of Things (IoT) develops a vast network of devices that exchange data regularly. Therefore, Consumers are increasingly interested in smart home devices and gadgets, which allow them to connect all of their devices for increased convenience, comfort, energy efficiency, and, most importantly, practicality, which is one of the project's main goals. The cat feeder system developed in this research is separated into two primary sectors which are measurements and control while the design structure is focused on the structure inappropriate position to be placed on a large cage size. To create an automatic cat feeder for large cage size, design research is conducted to comprehend the design structures, functions, materials, and applications of the cat feeder, and then design improvement and design for prototyping are implemented using SolidWork software. Secondary data were gathered and used as benchmarks to satisfy the intended functions of the cat feeder. Material selection and plateform design have been made as part of design modification and improvement. Furthermore, finite element analysis is carried out to analyse the cat feeder mounter and to ensure the fabrication of a cat feeder that can withstand maximum loads of up to 10 kilograms. Static analysis is used, and the result is a factor of safety of 28.57. Furthermore, prototype design verification is verified according to factor of safety and benchmarks from secondary data interpretation to fulfill project objectives. This shows the value of 28.57 factor of safety is safe under the design load. Polyamide-12 nylon powder are selected as material except mounter knobs and arduino components. Thus, the main prototype fabrication method is conducted by using SLS 3D printing machine. Arduino system code is writted by using Arduino software. Moreover, measuring instruments are used for dimensional inspection by manual method. Cat feeder is assembled and tested after fabrication. A usability test is conducted in order to gather user feedback, confirm the cat feeder's intended uses, and spot any unknown design flaws. Overall, the cat feeder is an alpha prototype, meaning that ongoing design improvement is required to satisfy the demands of the specific requirent. In the end, cat owners don't have to worry about feeding their pets and can watch over their caged cats from a distance.

ABSTRAK

Kajian ini bertujuan untuk merekabentuk dan menganalisis penyuap kucing bermotor automatik yang sesuai digunakan untuk sangkar kucing yang besar. Menggunakan penyuap kucing berasaskan Internet of Things (IoT), ia boleh dipertingkatkan dengan fungsi pemantauan dan kawalan. Internet of Things (IoT) membangunkan rangkaian peranti yang luas yang bertukar-tukar data secara tetap. Oleh itu, Pengguna semakin berminat dengan peranti dan alat rumah pintar, yang membolehkan mereka menyambungkan semua peranti mereka untuk meningkatkan kemudahan, keselesaan, kecekapan tenaga dan, yang paling penting, praktikal, yang merupakan salah satu matlamat utama projek. Sistem penyuap kucing yang dibangunkan dalam penyelidikan ini diasingkan kepada dua sektor utama iaitu pengukuran dan kawalan manakala bagi reka bentuk luaran tertumpu kepada struktur dalam kedudukan yang sesuai untuk diletakkan pada sangkar kucing yang besar. Untuk mencipta penyuap kucing automatik untuk saiz sangkar yang besar, penyelidikan reka bentuk dijalankan untuk memahami struktur reka bentuk, fungsi, bahan dan aplikasi penyuap kucing, dan kemudian penambahbaikan reka bentuk dan reka bentuk untuk prototaip dilaksanakan menggunakan perisian SolidWork. Data sekunder dikumpul dan digunakan sebagai penanda aras untuk memenuhi fungsi penyuap kucing yang dimaksudkan. Pemilihan bahan dan reka bentuk plat telah dibuat sebagai sebahagian daripada pengubahsuaian dan penambahbaikan reka bentuk. Tambahan pula, analisis unsur terhingga dijalankan untuk menganalisis pelekap penyuap kucing dan untuk memastikan fabrikasi penyuap kucing yang boleh menahan beban maksimum sehingga 10 kilogram. Analisis statik digunakan, dan hasilnya adalah faktor keselamatan 28.57. Tambahan pula, pengesahan reka bentuk prototaip disahkan mengikut faktor keselamatan dan tanda aras daripada tafsiran data sekunder untuk memenuhi objektif projek. Ini menunjukkan nilai 28.57 faktor keselamatan selamat di bawah beban reka bentuk. Serbuk nilon poliamida-12 dipilih sebagai bahan kecuali tombol pelekap dan komponen arduino. Oleh itu, kaedah fabrikasi prototaip utama dijalankan dengan menggunakan mesin pencetak SLS 3D. Kod sistem Arduino ditulis dengan menggunakan perisian Arduino. Selain itu, alat pengukur digunakan untuk pemeriksaan dimensi dengan kaedah manual. Penyumpan kucing dipasang dan diuji selepas fabrikasi. Ujian kebolehgunaan dijalankan untuk mengumpul maklum balas pengguna, mengesahkan kegunaan yang dimaksudkan oleh pemakan kucing dan mengesan sebarang kecacatan reka bentuk yang tidak diketahui. Secara keseluruhannya, penyuap kucing ialah prototaip alfa, bermakna penambahbaikan reka bentuk yang berterusan diperlukan untuk memenuhi permintaan keperluan khusus. Akhirnya, pemilik kucing tidak perlu risau untuk memberi makan kepada haiwan peliharaan mereka dan boleh mengawasi kucing sangkar mereka dari jauh.

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LIST OF SYMBOLS AND ABBREVIATIONS

cm	-	Centimetres
kg	-	Kilograms
N	-	Newton
MPa	-	Mega-pascal
CAD	-	Computer aided design
SLS	-	Selective laser sintering
BOM	-	Bill of materials
3D	-	3-Dimensional
STL	-	Stereolithography
HOQ	-	House of Quality
QFD	-	Quality Function Deployment
PDS	-	Product Design Specification
R	-	Respondents

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CHAPTER 1

INTRODUCTION

1.1 Background

Raising animals is one of the long-standing human behaviors, according to Estep and Hetts in 1992 human-animal interactions can be defined as the degree of relatedness or distance between animals and humans(Anggraini et al., 2020). The relationship requires mutual individual recognition. Tactile, visual, olfactory, gustatory, and auditory stimuli from humans may be emphasized in animals. Whether or not the influence on an animal's behavior and physiology is good depends on the quality of human-animal relationships.

Cats are one of the world's most popular pets, and Malaysia is no exception. This animal has been a part of human life for around 6000 to 10000 years (Anggraini et al., 2020) . Humans and cats had a relationship approximately 4000 years ago in ancient Egypt. The Egyptians even considered the cat to be a sacred animal at the time. Cats have unique characteristics in Islam.

Cats are, in fact, animals that we usually see and are near."(HR. Abu Daud, An Nasa'i, Ibnu Majah, Ad Darimi, Ahmad, Malik at Tirmidzi.) This hadith is Saheeh, according to Syaikh Al Albani in Irwa'ul Gholil Number 173. The hadith says that because the cat is a clean animal devoid of najis, keeping one is accepTable and beneficial, if the cat is nurtured so that it loves its own family.

Feeding is one of the most vital aspects of cat ownership. Keeping a cat at home, on the other hand, takes time and effort. According to the results of the distributed questionnaires, 66.2 percent of the 77 respondents had forgotten to feed their pet cats on

occasion, due to forgetfulness and busyness. Under other circumstances, 76 percent of the 79 respondents with homecoming activities just leave the cat at home, either entrusted or abandoned, with the value of care to meet the cat's demands 63.1 percent above 5 (1 to 10 scale) of 65 respondents. Data from additional polls revealed that 87.3 percent of 79 respondents need a tool to assist cat keepers in solving the problem (Anggraini et al., 2020).

Singhania (2015) Has described how to create an autonomous pet monitoring and feeding system using the Internet of Things in "Automatic Pet Monitoring and Feeding System Using IoT." The goal of using the term in its current form is to provide a global answer to the issues that everyone in the world is currently experiencing. The system's goal is to minimize human interference with caring for pets in their busy lives. Only by automating the pet-care process is this feasible. This pet care system is an all-in-one piece of equipment for keeping an eye on your pet's activity. It also makes the pet feel free.

1.2 Problem Statement

Based on background research, cat owners may not be able to see their cats regularly due to work or travel. Despite their busy schedules, almost every Malaysian family owns a cat or more than one. Nowadays, owning a cat is difficult since the cat must be cared for while the owner is not around, especially when the owner has more than one cat. When feeding their cat and needing to feed their cat every day, time constraints become a burden on cat owners due to rushing for work and other preferences. Consider the fact that the owner must want to ensure that their cat gets fed at the same time every day, even if they are not at home. Cats are used to following a routine, whether their owners are aware of it. Another individual cannot be expected to follow the owner's schedule. Here are some problem statements from the background research:

1. Keeping a cat at home, on the other hand, takes time and effort
2. Cat owners always forget to feed their pet cats on occasion, due to forgetfulness and busyness.
3. Homecoming activities just leave the cat at home, either entrusted or abandoned.

As a result, a new product, the Automatic Motorized Cat Feeder for Large Cage Sizes, has been developed as a solution to this problem. Instead of asking neighbors or friends to feed the cats, the owner may now feed their cat whenever and wherever they want without having to leave the house by just clicking on a smartphone application. This could assist cat owners in providing proper diet management for their pets and assisting cats in living healthy lives.

1.3 Research Objective

From the problem statement explained above, several objectives need to be completed at the end of this project. The main objectives of this project are:

1. To design and develop automatic motorized cat feeder that matches a large cage size.
2. To develop and test the feeding mechanism of an automatic motorized cat feeder by using the Arduino system.
3. Analyze the design and system of an automatic motorized cat feeder through usability test for target users.

1.4 Scope of Research

This study focuses on a home cat that is inside a large cat cage that only receives food and does not receive water. In this project, Node MCU ESP8266 as the main controller works together with the Wi-fi module. Using this machine, the owner can feed their cats by Google Assistant from anywhere. However, the owner can feed their cats by using the IFTTT application. Both software and hardware will be used in the implementation of this design.

Moreover, the scope of this study describes the extent to which the research field will be investigated in the work and the parameters that will be used through the process. The automatic motorized cat feeder should be of high quality to maintain the product's durability and the appearance of it should be good looking.

The other main scope of this project is to examine the importance of automatic motorized cat feeders to ensure criteria based on user requirement by using Product Design Specification (PDS), Quality Functional Deployment (QFD), Pugh's method, and weighted rating method.