Pet food autofeeder by using Arduino

*M Ibrahim¹, H Zakaria² and EE Wei Xian¹

¹School of Manufacturing Engineering, Universiti Malaysia Perlis, Malaysia.
²School of Mechatronic Engineering, Universiti Malaysia Perlis, Malaysia.
³Design for Sustainable Research Group, School of Manufacturing Engineering, Universiti Malaysia Perlis, Malaysia.

*Corresponding author: maliki@unimap.edu.my

Abstract. Automated pet feeder is a product that would replace manual feeding method which can be set at a required feeding amount and feeding time. Innovation of pet feeder is used to overcome forgetful of the pet owner to feed their pet and to avoid extra spending expenses by leaving them at a pet hotel. The objective of this project is to design and develop a mechanism for pet feeder. In this project, Arduino is used as the microcontroller to control the mechanism and to operate the system with a given set time. Finite element analysis is used to analyze the maximum stress that the designed mechanism can withstand. Furthermore prototype testing on the mechanism with experimental and theoretical was conducted, the result of the analysis is analyzed. The analysis is providing the path to make sure the final concept of the pet feeder is reached.

1. Introduction

Pet is good accompany partner to human. It helps to reduce the stress from living life style and as a precaution to keep away burglars [1]. Nowadays, pet treats as one part of the family member. Therefore, healthy level of the pet need to consider and focus on balance diet. Different size of the pet will have different amount on consuming and different nutrient needed. From the survey, the obesity problem among LI the pet is happened due to pet owner is busy with work [2]. In additional to that, pet doesn’t have ability to get the food itself, and it has to depend on the pet owner to feed them. Therefore, Automated Pet Feeder is created and used to solve the problems feeding the pet on time with required portion.

Automated pet feeder is started popular among the choices of pet owner used to replace the traditional feeding method. The product brings convenience to pet owner by setting the feeding time and portion of the food, which it helps to make sure the pet receives the required diet through a day [3]. The automated pet feeder trains the pet how to consume food properly and consume at certain time. The result of using pet feeder is the pet will receive their diet and pet owner can be no worry about feeding their pet [4].

From the survey of Association for Pet Obesity Prevention, there are 56% of dogs and 60% of cats are classified as the obesity by their veterinary healthcare professional [2]. The obesity problems happened due to the pet owners is busy with their working and lack of time to bring their pet go for exercise. Not only lack of time bring LI pet to exercise, pet owner worry forgetting to feed their pet, they will pour the big amount of the pet food on the bowl which causes overfeeding their pet [5]. To overcome the obesity and starve problem, the design on automated pet feeder is produced and bring the convenience to the pet owners.

The study on mechanism that used to pour out the pet food out from container has divided into motion, there are linear motion and rotational to linear motion [6]. The rotational motion of mechanism
placed linear under container, it moves pet food out by using the rotational motion [7]. From the researched, the advantages of using rotational to liner motion can be avoiding the pet food be blocked in the hopper [8].

Objective of doing this research is to design and develop a mechanism for automated pet feeder which able to give appropriate portion of pet food on a given set time.

2 Methodology

Market survey is the initial method used to collect the data for design specification. Three method on collecting data are online survey, interview session and questionnaire. After collecting the customer needs, table of screening and scoring will use to finalize the specification that needed on final design. Market survey on existing product is being analyse based on the product specification.

Final concept design is to designed and detailed drawing of each component is generated by using Solid Works. Finite element analysis is used to analyze the mechanism of the pet feeder. The mechanism is applied 40N force and the analysis that carried out are total deformation analysis, equivalent elastic strain, minimum principal stress, maximum principal stress and maximum shear stress.

Prototype is fabricated and undergoes the experiment testing on the mechanism to ensure that the feeding process run smoothly without any obstruction involving mechanism of pet food and designated Arduino program for the prototype.

![Arduino system of Automated Pet Feeder.](image)

**Figure 1.** Arduino system of Automated Pet Feeder.

Figure 1 shown the pet feeder Arduino system. The component is Real Time Clock(1), Liquid Crystal Display(2), Dc Motor(3), Buzzer(4), 4x3 Keypad(5) and a limit switch(6). Arduino is being used as the microcontroller in which it can adjust the feeding time and number of portions.
3 Result and Discussion

Figure 2. Final design of Pet Feeder.

The design of the pet feeder as shown in Figure 2. The mechanism that used in the pet feeder is rotational to linear motion. The mechanism is installed in between the base part of the component.

Figure 3. Result for number of experiment against portion.

From the prototype testing, the feed size for one period is 10 grams, due to the prototype is scale down to 1:5. In real scale of prototype, it almost will be 20 grams of the amount. Figure 3 shows the consistency of the experimental feed size for each periods. It is fall between the range 9.8 and 10.1 g, it considered as constant feed size.

Figure 4. Result of mechanism analysis.

From Figure 4, ANSYS is used to analyze the maximum stress can be withstanding at the critical point. The analysis that applied is static structural, whereas rectangular rack is the moving object while the spur gear is fixed at the base part of pet feeder nozzle diameter and 0.1mm layer thickness. While the lowest (level8) have 60-degree orientation angle, 0.3mm nozzle diameter and 0.1mm layer thickness.
**Table 1.** Summary result of mechanism analysis.

|        | Total deformation (m) | Von-Mises Stress (Pa) | Maximum Shear Stress (Pa) | Maximum Principal Stress (Pa) | Minimum Principal Stress (Pa) |
|--------|------------------------|-----------------------|---------------------------|-----------------------------|-----------------------------|
| PET    | 1.6768 e-006           | 34024                 | 19272                     | 18111                       | -20433                      |
| HDPE   | 3.7242 e-006           | 34034                 | 19293                     | 18130                       | -20457                      |

From Table 1, it shows that HDPE has higher probability that can withstand higher force applied on the mechanism. Total deformation of HDPE can be reach 3.7242 e-006 which higher than PET. The total deformation is included the elastic deformation and plastic deformation. Among the stress analysis that going through, HDPE shown the higher value that can withstand more stress and more force to the mechanism of pet feeder. The Von-Mises stress of HDPE is higher than PET, it known that the theoretical measure of stress used to estimate yield failure criteria in the material. While the principal stress is directly measurable stress by adding the load exceeds the principal stress which the failure occurs in one dimensional tensile test.

![Figure 5. Schematic Diagram of Automated Pet feeder](image)

The system that design is the automated pet feeder able to adjust three main criteria. By pressing ‘*’, the user is able to adjust the real time based on the time when they start to use. Secondly, by pressing ‘1’ and ‘2’, the user is able to set the first and second feeding time respectively. Lastly, by pressing ‘3’, the user able to adjust the feed size up to 9 periods. One period means that the rectangular rack with measuring cup moved forward and backward. Forward action means that move the pet food drop to pet bowl, the backward action of rectangular rack also known as the original position of the rectangular rack which is the filled the measuring cup with the pet food.
4. Conclusion
Overall, the objective of automated pet feeder by using the Arduino is achieved. The automated pet feeder can be adjusted the feeding time and the motor can rotate according to the required time. The material that used to fabricate the part of automated pet feeder is HDPE. The Manufacturing process that will be used is extrusion molding process. Besides that, the mechanism analysis is analyzing by using ANSYS. It has mention the critical part of the mechanism and it shows the maximum stress that can be applied on the mechanism. Recommendation for improvement on the design of the pet food container is adding the rotary bladder to rotate the pet food when the mechanism is moved. It is to reduce the probability caused the pet food stuck at the end of the container due to the compact of the pet food.

5. Acknowledgement
The authors would like to express profound gratitude and deep appreciation to the School of Manufacturing Engineering, School of Mechatronics Engineering and Universiti Malaysia Perlis in providing research platform as well as providing the facilities and equipment.

References
[1] McConnell, Allen R, Brown, Christina M, Shoda, Tonya M, Stayton, Laura E, Martin and Colleen E 2011 Friends With Benefits: On the Positive Consequences of Pet Ownership *Journal of Personality and Social Psychology* **101** (6) 1239-1252.
[2] Shiham K 2017 *Pet obesity survey result*.
[3] Pedigree 2016 *Dog Feeding Guidelines* 70 201 206
[4] James F 2017 *Automated Pet Feeder* **63** 21-24
[5] Jenks S 2018 *Our Fat Pets* The New York Times 9-10
[6] Layosa C 2018 *How to Convert from Rotary to Linear Motion*
[7] Robert L Pitchford Jr., 1418 W, & 134th St., Compton C 90222 (1985). Timed automatic pet feed and water dispenser.
[8] Hernandez R, Slaughter D, Whaley D, Tate J and Asiabanpour B 2016 Analyzing the Tensile, Compressive, and Flexural Properties of 3D Printed ABS P430 Plastic Based on Printing Orientation Using Fused Deposition Modeling 939–950.