Reliable Smart Pet Feeding Machine Using Arduino Uno Starter Kit

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Abstract. Pet feeding can be done manually by pet owners, or automatically with the help of the pet feeders. The main concerns here are to solve the issue of unavailability of pet owners and the hygiene aspect in pet feeding. The developed automated system enables pet owners to feed their pets while they are away. The main objective of operating this research is to develop an automated pet feeding device focusing on in house pets by utilizing Arduino Uno as its Central Processing Unit (CPU) or microcontroller which function to control a weight sensor (load cells) and a servo motor. Smart Pet Feeding Machine is an automated pet feeding device designed to run based on weight mechanism. It will automatically dispense pet foods when minimum amount of pet food weight is triggered and will automatically stop dispensing when it reaches maximum amount of weight. Its architectural design includes a vertical storage compartment to store pet foods, a square opening at the bottom for dispensing, a motorized dispenser and an aluminium bowl to place dispensed pet foods. The motion of dispenser is operated by a servo motor attached to the dispenser.

1. Introduction

Nowadays, owning pet at home is no longer a trend. Taking care and feeding pet is no longer a burdensome task since there are huge numbers of pet feeder in the market. However, there are not much pet feeding machines that serve meal for pet freshly. Contaminated food will cause health issues to pets. One of the illnesses is called foodborne. This disease exists due to bacteria carried in contaminated foods.

As an overview, an automated pet feeding machine consists of a single-entry feeding zone, a feeding bowl, a food storage container, a sensor, a memory storage and at least one processor [1]. The processor selected to be integrated with Smart Pet Feeding Machine is Arduino Uno microcontroller, which is programmed using Arduino Software. Arduino Uno Starter Kit is a low-cost robotic kit. As the name implies, it suits starter. One driving concern of this work is the affordability and accessibility of educational tools to students and schools that do not possess enough financial support [2]. This device operates using weight mechanism and therefore a weight sensor is integrated to the system. Load cells are embedded to the device to sense the weight of pet food remaining. There are few reasons and advantages of using strain gauge type load cells as the weight sensor. One of them is its simple mechanism. A sensor probe has a first end disposed within the interior space. The sensor probe also includes a second end opposite the first end outside the interior space. At least one load cell is
disposed within the interior space and is operatively engaged with the first end of the sensor probe [3,4].

2. Problems encountered by pet owners
The most primary problem is the unavailability of pet owners to feed their pets. Unavailability of pet owners due to work and other commitments are difficult to be solved without any helping device. Hence, here comes the usage of pet feeding machine. However, the operating mechanism of available of pet feeder has several rooms for improvement where the main concern is the cleanliness of pet food [5]. Besides, the design pet feeder available in the market does not suit pet owners who own more than one pet at home. This problem leads to issue where pets are not being feed accordingly [6]. Next problem is hygiene aspect in pet feeding. Improper pet feeding leads to low cleanliness level and might cause pet food contamination. Thus, this issue can cause health problems to pets.

3. Methodology

3.1. Designing process
Few sketches are made to ensure the design capable to achieve requirements needed to build the Smart Pet Feeding machine. Every design is reviewed and analysed to sort out advantages and disadvantages. From this stage, flaws in design can be detected. Hence, better modification can be done to make the design better. Based on review on designs, the best design is selected to be drawn via Autodesk Inventor 2015. The dimension of every part is reconsidered again in order to make the product suits the requirements and needs. During this stage, there might be several changes made due unsuccessful mechanism of design. Throughout designing stage, two designs are drawn with different specifications and dimensions. In Smart Pet Feeding machine, it can be classified into three main sections. The main sections are housing, hopper (dry pet food storage) and control gate dispenser. Other related parts are storage opening and pet food bowl. A preliminary study is conducted to determine the amount or weight of pet food to be dispensed. This study covers the average amount of pet food to be consumed by pet at once. Based on this study, 40 grams of pet food is set to be poured at single dispense. Hence, this will ensure the amount of pet food in the pet bowl is around 50 grams every dispense session, where initially it is left with 10 grams of pet food.

3.2. Programming stage
Arduino Software is utilised to develop the program. The programming is done on Arduino Uno via Arduino Software which programmed to control gate dispenser using weight sensor [7]. The weight sensor is used to detect the weight of remaining dry pet foods. Once the weight sensor detects a reading where it is set to detect weights which are less than 50 grams, the circuit will be completed. This means that the control gate dispenser will open and dispense the dry pet foods into pet food bowl. The mechanism of dispensing the pet foods is designed to be simple and minimalistic. By only dispensing pet foods when it is less in amount can ensure in providing clean meal to pets. This is to ensure the food dispensed earlier is eaten first by the pets before serving another meal.

3.3. Fabrication
The Smart Pet Feeding Machine model is fabricated using reliable materials. The materials can be classified into two categories which are software and hardware. The materials selected for the housing and base are mostly scrap materials. Hence, this gives more room on budgeting for software purchases [8]. The materials used for Smart Pet Feeding Machine’s body are plywood, aluminium tin and Perspex. Special part such as dispenser is fabricated using 3-Dimensional printer [9]. Then, these components and parts are assembled together. Then, the finished product is tested and the result is analysed.
3.4. Experimental process
Analysis conducted is limited to weight sensor performance and servo motor functionality [10]. The experimental setups are shown below:

- Pet food kibbles are poured into storage compartment of the device.
- The device is connected to laptop and switched on.
- The results on amount of pet food dispensed is monitored via Serial Monitor display in Arduino Software.
- The result obtained and status of motorized dispenser is recorded and tabulated.
- The pet food dispensed in the pet bowl is then removed.
- Step 1 until 5 is repeated for 10 times to get an average amount of pet food dispensed.
- The average amount of pet food dispensed by the device is calculated and recorded.

Figure 1. Experimental flow.
4. Result and analysis

*Figure 2.* Isometric View of the Smart Pet Feeding Machine (Zaini, 2018).

**Table 1.** Results of Testing on Smart Pet Feeding Machine Dispensing Accuracy.

| Testing | Weight of Pet Food Dispensed (g) | Status of Dispenser     | Percentage of Error (%) |
|---------|---------------------------------|-------------------------|-------------------------|
| 1       | 42.7                            | Successfully dispensed | 6.75                    |
| 2       | 42.4                            | Successfully dispensed | 6.00                    |
| 3       | 41.8                            | Successfully dispensed | 4.50                    |
| 4       | 41.5                            | Successfully dispensed | 3.75                    |
| 5       | 41.1                            | Successfully dispensed | 2.75                    |
| 6       | 40.7                            | Successfully dispensed | 1.75                    |
| 7       | 40.3                            | Successfully dispensed | 0.75                    |
| 8       | 40.2                            | Successfully dispensed | 0.50                    |
| 9       | 40.1                            | Successfully dispensed | 0.25                    |
| 10      | 40.2                            | Successfully dispensed | 0.50                    |

4.1 Average weight of pet food dispensed

The average weight of pet food dispensed is obtained by dividing the sum of dispensed pet food weights with the number of testing of experiment.
Average weight of pet food = \[
\frac{42.7 + 42.4 + 41.8 + 41.5 + 41.3 + 40.7 + 40.3 + 40.2 + 40.1 + 40.2}{10}
\]

= \frac{411}{10} = 41.1

Based on the results tabulated in Table 1, it can be calculated that the mean weight of pet foods dispensed by Smart Pet Feeding Machine is 41.1 grams. Hence, from this data, it can be stated that the coding works on this project successfully.

4.2 Percentage of error

\[
\text{Percentage of error} = \frac{\text{Weight}_{\text{experimental}} - \text{Weight}_{\text{theoretical}}}{\text{Weight}_{\text{theoretical}}} \times 100
\]

(1)

Example on calculation for percentage of error during individual test. Using result obtained in Test 1.

Percentage of error = \[
\frac{42.7 - 40.0}{40.0} \times 100 = 6.75\%
\]

Calculation for average of percentage of error by Smart Pet Feeding Machine. This approach is done to verify the efficiency of this design and hence obtaining the overall performance of device.

Percentage of error = \[
\frac{41.1 - 40.40}{40.0} \times 100 = 2.75\%
\]

4.3 Analysis of results

![Graph of Weight of Pet Foods Dispensed against Number of Testing](image)

**Figure 3.** Graph of Weight of Pet Food Dispensed against Number of Testing.
Based on graph plotted above, Figure 2 shows the weights of pet foods dispensed in the total of ten tests. At Test 1, the weight of pet foods dispensed is 42.5 g, which exceeds 2.5 g from coded program where according to coding it should dispense 40 g of pet foods. Whereas the weight of pet food dispensed gradually decrease until Test 6. This situation occurred due to few possible reasons. Firstly, at Test 1, it dispenses the most due to weight of pet foods inside the storage compartment is at the highest point. Hence, the force applied might be slightly higher at initial tests. Next possible reason is due to delay in the control system. When the device is switched on, delay in time to close the dispenser might cause the pet food to be dispensed more than programmed. However, these errors do not affect the functionality of the Smart Pet Feeding Machine since the pet bowl can store more amount of pet foods. Furthermore, the amount of pet foods left in the pet bowl is not fixed. Hence, if the initial weight is lesser, the motorized dispenser will dispense more. Following tests which are Test 7 until 10 shows steady rate of dispensing pet foods. In these tests, it can be denoted that the control system is stable and ready to operate steadily as programmed. The initial error happened in earlier test is acceptable since it does not affect the functionality of the product.

![Graph of Percentage of Error against Number of Testing](image)

**Figure 4.** Graph of Percentage of Error against Number of Testing.

Figure 3 above shows the trend of percentage error of Smart Pet Feeding Machine performance. Based on this graph, it can be seen that the percentage of error is decreasing in every test and approaching zero. Hence, this proves that the device can operate smoothly as programmed.

5. **Conclusion**

This project had achieved the target and solved the issues stated in problem statements. The first issue that been solved is the cleanliness aspect during feeding pets. Whereas the automated pet feeder normally dispenses pet food at several times and this design is unsuitable for pet owners who owns more than one pet in house. Furthermore, the prices for automated pet feeding machines available in the market are very high. Hence, the enhanced controller system is developed for Smart Pet Feeding Machine where it can solve issues in cleanliness aspect, price issue and versatility of its function. Simple operating control system which implements Arduino Uno as the microcontroller and the easy to find materials for the housing allow Smart Pet Feeding Machine to be built at affordable price. Besides, the microcontroller is designed to be functioned in normal house condition where standard pressure and temperature of surrounding would not affect its functionality. Next to be concluded is the
uniqueness of the Smart Pet Feeding Machine itself where most of the materials used to fabricate the housing are scrap materials. This is the best approach of this project which it proves that such product like automated pet feeding device can be developed at home.

6. References

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7. Acknowledgments

This research is supported by Osaka Gas in Cultural Exchange Foundation (OGFICE) Research Grant Scheme 2017/18 under research titled “Drying Process of Lemantak (Sago Powder) using an Automated Machine for Cottage Industries in Sarawak”. The authors would like to thank the Faculty of Engineering, Universiti Malaysia Sarawak (UNIMAS) for providing sponsorship and facilities for this research.