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# THE MAKING OF AN AUTOMATIC DOG FEEDING DEVICE WITH THE USE OF ARDUINO UNO AND SERVO MOTOR

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## ABSTRACT

As individuals continue to live busy lifestyles, neglect remains prevalent among dog owners. Therefore, malnutrition among dogs, caused by improper feeding habits, remains a rampant issue worldwide. The main objective of this study is to create an automatic dog feeding device out of Arduino Uno and Servo Motor. For the purpose of dog food dispensing, the Arduino Uno, an open-source electronics platform based on simple hardware and software, was used in the servo motor operations. Thus, the device utilized two main components Methodology: The researchers utilized the experimental design of research as well as the quantitative method. The results of the study show the dispensing capabilities of the automatic dog feeding device under increasing loads. Additionally, the servo motor's dispensing precision was proved with slight deviations from the expected weight to the actual weight averages. Moreover, the Arduino Uno's dispensing accuracy and its reliability was tested wherein the device dispensed on cue with minimal deviations in time. The results demonstrated that the automatic dog feeding device can effectively dispense dog food meeting the various criteria tested. The discussion states the significant contribution of this study toward pet care technology and the field of engineering. Asserting that the findings of this study allow for better understanding of the role of technology in the pet industry. Lastly, in accordance with the limitations of the study, it is recommended that the design and functionality of the device may be enhanced and improved by later researchers.

**KEYWORDS:** Automatic Dog Feeding Device, Arduino Uno, Servo Motor, Malnutrition, Pet Owners

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## 1. INTRODUCTION

Undoubtedly, it is an important responsibility for dog owners to ensure their pets receive the essential care and nourishment they require. However, it is not certain a dog owner would be present at all times; in such cases, an Automated Dog Feeding Device proves essential. Owners are able to save time on tasks such as feeding, watering, and medicating their dogs (Boateng et al., 2022). It is important for routine tasks to be performed by an automatic device since dog owners will be able to multitask with its assistance. The purpose of this project was to make a dog owner's life easier and more convenient. At the present time, automated technology is preferred because it is easy to use, simple to access, and manageable to monitor. An Automatic Dog Feeding Device is offered to address the issue of supplying food and water for dogs when the owner is away from home. Using this device, the owner may provide food and water to their pet at a preferred planned time (Koley et al., 2021).

To keep up with the current demand for ease of use and accessibility, automated technology has proliferated in various aspects of our lives. A proposed prototype that solves the issue of providing food to pets when the owner is away (Koley et al., 2021). The proposed system, which consists of a microcontroller and a servo motor, was used to create a smart pet feeder that can be coded to the owner's preferred scheduled time. Moreover, a study by Jain et al. (2023) stated that the autonomous pet feeding system is created to monitor the eating habits of pets and is designed to cater to the pet's eating schedule, which will be based on its feeding patterns.

Malnutrition in dogs poses a significant risk to their health and welfare. Whether attributed to suboptimal dietary choices or underlying medical conditions. Studies examining the rate of undernutrition in hospitalized dogs have been uncommon. Between 25% and 65% of hospitalized dogs were believed to be undernourished (Molina, 2018). Moreover, dog owners are prone to forgetting to feed or carelessly feeding their dogs as they live busy lifestyles. Signs of inadequate food intake are increasingly visible in pets with irresponsible owners. Additionally, finding the ideal feeding strategy will enable optimization that will increase the advantages for dogs while lowering the chances of issues (Chan, 2015). It is usual that primary treatment is needed to solve malnutrition. These treatments are expected to target the underlying illness that is producing malnutrition, and a dietary regimen should be created specifically for the current state of the disease (Gagne & Wakshlag, 2015).

Traditional stainless steel dog bowls are the usual way that dog owners prefer to feed their dogs. The price value of these bowls may vary from store to store, although Amazon offers a variety of bowls from 40QR to 100QR. However, it is common nowadays for dog owners to use dog feeding devices for their convenience. With our device, it aims to be cost-friendly and simple to make at home since most tools that will be utilized can be found at home, spending less but also saving the environment from the

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production of new materials to produce more dog feeding devices. Moreover, the price range of dog feeding devices on the market is exorbitant. For example, the Wet Dry Food Water Automatic Pet Feeder by Delxin (Xiamen) Technology Co., Ltd. is around 200QR to 254QR. Hence, it is more beneficial to take advantage of the materials that are available within your home to create an Automatic Dog Feeding Device rather than buying from markets that are a higher-cost.

The purpose of this study was to address the practical need for a reliable and automated solution to feed dogs while promoting their overall health and well-being. In today's fast-paced world, pet owners often face challenges in maintaining regular feeding schedules for their pets. This research aims to design an efficient and user-friendly dog feeding machine that leverages the versatility of Arduino Uno microcontrollers to ensure timely and accurate meal dispensing. Combining an Arduino Uno and servo motors together provides a reliable, flexible, and cost-effective means to construct a dog feeding device with accurate control and adjustable features. The position of the feeder can be controlled by a servo motor, which allows for precise portion control. In addition, utilizing the Arduino Uno as a microcontroller or the central processor, for controlling a weight sensor and a servo motor that is fixed onto the dispenser to control its motion (Suffian, 2021). Pet owners can program the machine to dispense specific quantities of dog food for each meal, preventing the risk of overfeeding or underfeeding. Moreover, the ability to set up a consistent feeding schedule ensures that dogs receive meals at regular intervals throughout the day, effectively regulating their eating habits.

The practicality of the Automatic Dog Feeding Device is evident in its user-friendly design, which simplifies feeding schedules and portion control. It offers convenience to busy pet owners, ensuring dogs are consistently fed on time and in the right amounts, thus promoting their health and well-being. Additionally, its ability to cater to specific dietary needs and prevent overfeeding or underfeeding makes it a practical solution for pet owners seeking to enhance their canine companions' nutrition and overcall care.

**a. 1.1. Research Questions**

The objective of this study was to create an Automatic Dog Feeding Device with the use of Arduino Uno and Servo Motor. Specifically, this study aimed to answer the following:

1. How effective is the dispensing capability of the Automatic Dog Feeding Device, under various loads in terms of grams per half-revolution;
2. How effective is the dispensing precision of the Automatic Dog Feeding Device in terms of grams; and
3. What is the dispensing accuracy of the Automatic Dog Feeding Device on a quarter-hourly basis?

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**b. 1.2. Hypothesis**

H1: The making of an automatic dog feeding system with the use of Arduino Uno and Servo Motor is possible.

## 2. METHODOLOGY

The study utilized the experimental design of research. Experimental design is the process of conducting research in an objective and effective manner in order to maximize efficiency and present data as results from formulated hypotheses (Wait, 2020). In general, the objective was to determine the effect of a factor or independent variable on a dependent variable. In this study, the Arduino Uno and Servo Motor is the independent variable, and the Automatic Dog Feeding Device is the dependent variable. Furthermore, the quantitative method was used to properly organize the experiment and collect the necessary data. This method is necessary because it provides a high level of control over the variables that demonstrate an outcome and is beneficial in obtaining accurate, consistent, and precise results.

**c. 2.1. Research Locale**

The research study was conducted at Philippine School Doha in Doha, State of Qatar, specifically in the Mesaimeer Area (Zone 56), Al Khulaifat Al Jadeeda Street (St. 1011), as the researchers are not only students of this school but also required facilities present in the school will enable them to make their product.

**d. 2.2. Data Gathering Procedure**

The procedure shows the step-by-step process that shows and instructs how to make an Automatic Dog Feeding Device with the use of Arduino Uno.

### 2.2.1. Ensuring protection and maintaining safety

(a) Wear personal protective equipment such as safety goggles and safety gloves while performing the procedures below to avoid hazardous conditions.

(b) Use a safety electrical mat and insulated tools while performing the connection of wires below to avoid electrostatic charges.

### 2.2.2. Making the parts of the machine

(a) Take out two different sized cans for food storage. The taller can is can A and the shorter can is can B. In both of the cans, mark a pivot hole and a feeding hole shaped as a quadrant on the upper part of the can for can B, and the bottom part of the can as for can A.

(b) With the handsaw, cut out a hole in can B, making sure the servo motor fits.

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(c) On can A, glue the servo horn at the center of the bottom of the can that will serve as a torque.
(d) On can B, glue the servo motor on the pivot hole, and adjust the level depending on the space needed between can A and can B.
(e) Attach can A and can B together, and mount the adapter to the servo horn. Make sure that can A can still rotate.
(f) On can B, create an opening nearby the food hole made earlier for an area for food to dispense. Shape it into a smile.
(g) Cut out the opening made.
(h) On can B, using the lid of can A create a shape that will fit the opening of the food hole and glue gun it to the opening.

### 2.2.3. Connection of wires

With the Arduino Uno, place the yellow wire in the Digital I/O 9 and connect it to the servo motor. Using a brown wire, place it in the GND. After that,connect the brown wire to the servo motor. Lastly, with the red wire that is placed on the 5V Pin, connect it to the servo motor.

### 2.2.4. Programming the commands

(a) Open the Arduino Software.
(b) Input the program into the Arduino Software.
(c) Verify the commands and upload them to the Arduino Uno microcontroller.

## 3. RESULTS

This section presents the results and interpretations of the data that were collected during the testing procedure in relation to the research questions.

### 3.1 Dispensing capability of the Automatic Dog Feeding Device, under various loads, in terms of grams per half-revolution

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**Table 1: Dispensing Capability in terms of grams per half-revolution ($g/hrpm^2$)**

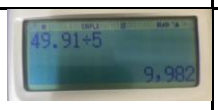
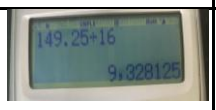
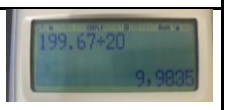
| Capacity Level | 25% Capacity | 50% Capacity | 75% Capacity | 100% Capacity |
|---|---|---|---|---|
| Photos |  |  |  |  |
| Dispensed Weight | 49.91g | 100.43g | 149.25g | 199.67g |
| No. of half-revolutions | 5hrpm | 9hrpm | 16hrpm | 20hrpm |
| Grams per half-revolution ($g/hrpm^2$) |  $9.98g/hrpm^2$ |  $11.16g/hrpm^2$ |  $9.32g/hrpm^2$ |  $9.98g/hrpm^2$ |

Table 1 shows the dispensing capability of the dog feeding device in terms of grams per half-revolution. The dispensed weight was measured using a digital balance, the number of half-revolutions was counted by tallying each half-revolution made by the device. Lastly, grams per half-revolution (g/hrpm2) was measured by dividing the dispensed weight by the number of half-revolutions. For reliable results, four trials were conducted and each trial varied in the amount of dog food in the container. In the first trial, 25% of dog food was placed in the container which yielded a result of 9.98g/hrpm2. In the second trial, 50% of dog food was placed in the container yielding a result of 11.16g/hrpm2. In the third trial, 75% of dog food was placed in the container which yielded a result of 9.32g/hrpm2. Lastly, 100% of dog food was placed in the container in the fourth trial, yielding a result of 9.98g/hrpm2. Therefore, the average grams per half-revolution is 10.11g/hrpm2.

Evaluating the results, the Automatic Dog Feeding Device was proven to be consistent and reliable in its dispensing capability. Based on its grams per half revolution, the results showed minimal deviation from the expected amount. Similarly, the study conducted by Darie et al. (2021) supports the finding that servo

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motors provide precise control and high torque output, even in demanding applications. Therefore, the device is capable of performing under heavy loads.

### 3.2. Dispensing precision of the Automatic Dog Feeding Device in terms of grams

**Table 2: Dispensing Precision in terms of grams**

| No. of half-revolutions | 5 half-revolutions | 10 half-revolutions | 15 half-revolutions |
|---|---|---|---|
| Grams in Trial 1 |  |  |  |
| Grams in Trial 2 |  |  |  |
| Grams in Trial 3 |  |  |  |
| Average | 50.03g | 100.06g | 150.03g |

Table 2 shows the dispensing precision of the Automatic Dog Feeding Device in terms of grams. To maintain accuracy, three trials were conducted for each category. For 5 half-revolutions, trial one yielded a result of 49.86 grams, trial two yielded a result of 50.26 grams and trial three yielded a result of 49.98 grams, whereas the expected result is 50 grams. For 10 half-revolutions, trial one yielded a result of 100.07 grams, trial two yielded a result of 100.08 grams and trial three yielded a result of 100.03 grams, whereas the expected result is 100 grams. For 15 half-revolutions, trial one yielded a result of 149.99 grams, trial two yielded a result of 150.09 grams and trial three also yielded a result of 150.09 grams, whereas the

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expected result is 150 grams. At 5 half-revolutions, an average of 50.03 grams were dispensed, whereas the expected result was 50 grams. In 10 half-revolutions, the three trials showed an average of 100.06 grams, with an expected result of 100 grams. Lastly, in 15 half-revolutions, the three trials had an average of 150.03 grams with an expected weight of 150 grams.

After analyzing the data, there was minimal deviation in the device's dispensing precision, with averages ranging from 50.03 grams, 100.06 grams, and 150.03 grams, all of which are close to their expected weight. This indicates that the device is consistent and reliable in its dispensing distribution. Similarly, the study conducted by Amen et al. (2022) supports the finding that a repeatability error of 0.3% is optimal. In this case, a deviation of ± 0.36g is still considered within the range of precision.

### 3.3. Dispensing accuracy of the Automatic Dog Feeding Device on a quarter-hourly basis

**Table 3: Dispensing Accuracy on a quarter-hourly basis**

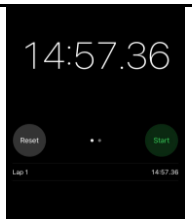
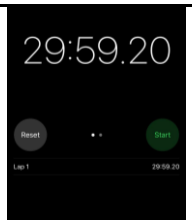
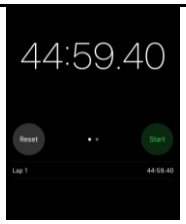
| Expected Time Dispensed | Trial 1<br>15 Minutes | Trial 2<br>30 Minutes | Trial 3<br>45 Minutes |
|---|---|---|---|
| Photos |  |  |  |
| Actual Time Dispensed (in minutes) | 14 minutes, 57 seconds | 29 minutes, 59 seconds | 44 minutes, 59 seconds |

Table 3 shows the dispensing accuracy of the Automatic Dog Feeding Device on a quarterly-hour basis. To measure its accuracy, three sets of time were conducted with a 15-minute gap each, utilizing a stopwatch to accurately determine the time it would dispense on a quarter-hourly basis. In the first trial, the actual time dispensed was 14 minutes and 57 seconds, whereas the expected result was 15 minutes. In the second trial, with the addition of another 15 minutes after the first set, the time dispensed was 29 minutes and 59 seconds, whereas the expected result was 30 minutes. Lastly, in the third trial after another 15 minutes from the second time set, the time dispensed was 44 minutes and 59 seconds, whereas the expected result was 45 minutes.

After evaluating the results, the dispensing on a quarterly-hour basis of the Automatic Dog Feeding Device was proven to be accurate and consistent. Based on its dispensed weight on a quarterly-hour basis, the

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results showed minimal deviation from the expected amount. Moreover, the study conducted by Ali et al. (2020) stated that fast response AC servomotors are highly demanded by industries for dynamic loads. Therefore, the device can dispense precise and consistent amounts over a long period of time due to the servo motor's precision.

### 3.4. Hypothesis

The researcher's alternative hypothesis which states that it is possible to make an automatic dog feeding system with the use of Arduino Uno and Servo Motor is accepted. The researchers were able to construct an automatic dog feeding device capable of performing dispensing operations.

## 4. DISCUSSION

An Automated Dog Feeding Device greatly aids pet owners in saving time on chores like feeding, watering, and giving their pets their medications by utilizing an automatic dog feeder (Boateng et al., 2022). However, with every device being charged a higher price in the market, it was estimated that between 25% and 65% of hospitalized dogs were malnourished (Molina, 2018). Arduino Uno is a key component to several inventions as an open-source electronics platform that is simple to use, incorporating features such as accurate dispensing mechanisms, scheduling algorithms, and user interfaces adapted to pet owners' demands. Furthermore, the Arduino Uno's simplicity and ease of use decrease the entrance barrier for people with varied degrees of technical knowledge, allowing pet owners to adapt and improve their Automatic Dog Feeding Device to their different needs. Nevertheless, with an Automated Dog Feeding Device composed of an Arduino Uno, an essential component to many advancements as a user-friendly, open-source electronics system, this study aimed to create a device that is affordable and easy to assemble at home as the majority of the tools needed are already present, saving money and protecting the environment by avoiding the need to develop new materials in order to manufacture more dog feeding devices. This research sought to evaluate the dispensing capability of the dog feeding device by measuring the dispensed grams per half-revolution under various loads. The dispensing precision was measured by comparing the dispensed grams in each trial to the number of half-revolutions. Lastly, the dispensing accuracy on a quarter-hourly basis was assessed in terms of grams dispensed in three sets by using a stopwatch.

The investigation into the dispensing capability, precision, and accuracy of dog feeding devices represents a significant advancement in the current body of knowledge concerning pet care technology. Dispensing capability elucidates the load range with which these devices can distribute food, allowing for a better understanding of their practical utility in maintaining pet health and nutrition. Precision in dispensing pertains to the device's ability to administer precise portions of food, a crucial factor in ensuring balanced diets and preventing over or underfeeding, which can impact an animal's well-being. Furthermore,

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dispensing accuracy elucidates the device's reliability in delivering food according to programmed settings, crucial for pet owners who rely on these technologies to maintain feeding schedules, especially in their absence. Through rigorous examination of these parameters, researchers can contribute valuable insights to optimize the design and functionality of dog feeding devices, ultimately enhancing the quality of care provided to companion animals. Moreover, these key characteristics also provide major contributions to the present body of knowledge by pushing advances in dispensing technology and procedures of dog feeding devices. Other researchers and engineers would be able to improve dispensing systems, using innovative methods to increase capacity, precision, and accuracy.

Based on the results, the Automatic Dog Feeding Device dispensing capability proves to be reliable, as it displayed an average of 10.11g/hrpm2. Additionally, the dispensing precision proves to be dependable, with minimal deviation from the expected weight in comparison to the actual weight. Lastly, the device's dispensing accuracy is effective, wherein the actual time dispensed on a quarter-hourly basis is very close to the expected time dispensed.

This study demonstrated its ability to streamline pet care responsibilities, fostering an efficient and organized environment in line with the school's pro-environment mission. Additionally, it cultivates responsible pet ownership, fostering empathy among students and staff towards animals, while also enhancing school resources by reducing manual feeding and promoting sustainability.

The Qatar and Philippine communities are encouraged to adopt Automatic Dog Feeding Devices, utilizing readily-available materials to create cost-effective solutions that are environmentally friendly and user-friendly. These devices not only streamline pet care responsibilities but also promote responsible pet ownership and reduce the burden on resources. In this fast-paced world, the adoption of Automatic Dog Feeding Devices marks a significant advancement in how pet owners in Qatar and the Philippines care for their beloved companions. These innovative tools will not only streamline feeding schedules but also foster a future where responsible pet ownership is effortlessly integrated into daily life, promoting healthier and more fulfilling relationships between pets and their owners

Additionally, future researchers may also use this study as a guide to create projects with similar duties or components. Future researchers may enhance and improve the device's design and operation. This involves fine-tuning of the dispensing mechanism wherein a larger servo motor can be used. Moreover, increasing the storage capacity by using a larger storage can. Lastly, improvements in the device durability and base stability can be achieved by utilizing more sturdier materials and adding more weight on the base. Future researchers may also include advanced sensor technologies or alternate dispensing processes to improve the device's accuracy and efficiency. Future researchers are also urged to incorporate additional

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features, such as remote monitoring and portion adjustment, to increase the device's adaptability and value for pet owners.

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