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KORİNT YAYINCILIK

DEVELOPMENT OF SMART CAR WASTE BOX

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ABSTRACT

Cat waste box has been widely used among cat owners to assist the management of faeces and urine. There are various types of cat waste box in the market with different features. However, most of the design is either manually operated or semi-automatic with limited function. The owner still needs to scoop out all of the cat waste clumps and dispose it regularly which is unpleasurable, time consuming and inefficient. In addition, there is a potential of cat's injury during cleaning operation for semi-automatic cat waste box. The initial study was done by evaluating cat owners' problems and needs while using the current product. Thus, the objectives of this project are to design a smart cat waste box that could be operated automatically with the implementation of IoT, to help users save their time to dispose cat daily waste and to ensure cat safety during cleaning process. This project is best used for two cats at a time. Methods used involves problems identification, idea generation, product design, material selection, fabrication process, modification, testing and analysis. Several testing's have been constructed to evaluate the product, such as the effectiveness of the scoop to drag the faeces to waste compartment, time taken for one complete cycle, durability and safety of cats during operation. The finding shows that the percentage of waste to be scooped up into waste compartment is 90% while the percentage of litter granular to be scooped up into waste compartment is 2% for clay type and 40% for paper type. The time taken for one cycle is 55 seconds with stepper motor speed of 30 rpm. This period of time could help prevent any accidents or injuries to cats, as well as improving the safety of the product. The maximum push mass for the stepper motor is 180 g. Conclusively, the implementation of IoT in this product has save a lot of time and energy. Users only need to press the push button on the phone or use voice assistance to clean up the cat waste instead of using their hands manually.

Keywords: Cat waste box, waste disposal, scoop.

1. Introduction

In this modern world, evolution of technology is not a queer thing to society anymore. Technology started to develop throughout the days around the world to thrive along in this modern era. People start to create and design things to have a better performance, efficiency and to help society overcome their problems. In this project, we decided to create a new cat litter box with different and new features from the previous cat litter box that is in market. We wanted to make differences from the previous design especially by adding green sustainability concept.

Cat lovers comes in all ages and occupation and they usually have to go to school, work or overseas. Usually, owners do not have enough time to clean cat faeces regularly. This matter might be a problem to all cat owner because cat waste box needs to be clean every day for people who own one to two cats per house. Cat waste

box that was already in the market also has a feature that the scoop can move automatically. However, it is quiet inconvenience because the scoop operates automatically without the supervision of cat owner and this can lead to cat's body parts being stuck in the product. In addition, there is a potential of cat's injury during cleaning operation for semi-automatic cat waste box.

Objective

Therefore, to overcome those problems, the objectives have been developed which are:

1) To design a smart cat waste box that could be operated automatically with the implementation of IoT.
2) To help users save their time to dispose cat daily waste.
3) To ensure cat safety during cleaning process.

Project Scope

A limitation on the operation has been set to ensure that the product can fully achieved the objectives. The scopes are:

1) This product is suitable to be used for one to two cats.
2) Could be used four times a day before cleaning need to be done.

2. Literature Review

There are many types of cat waste box in market with different design and functions. It started manually, then through time and technology development, it started to change bit by bit. Cat waste box started to evolve to ease and simplify cat owner's life which an automatic performance is added to fulfill user needs. Table 1 shows how cat litter box was changed through the time.

Table 1: Comparison of cat waste box design and feature

Types of cat waste box	Criteria	Design	Method
	Scoop moves on a straight line. Cat's waste is disposed into waste compartment.	Rectangle	Automatic
	Platform moves in circular motion. Cat's waste is disposed into toilet bowl.	Round	Automatic
	Scoop is fixed in a place. Platform moves in circular motion. Cat's waste is disposed into waste compartment.	Round	Automatic

3. Methodology

The processes involved in this project is shown at Figure 1. The design, fabrication, assembly and testing processes of the project have been done at fitting workshop involving cutting, gluing and fastening.

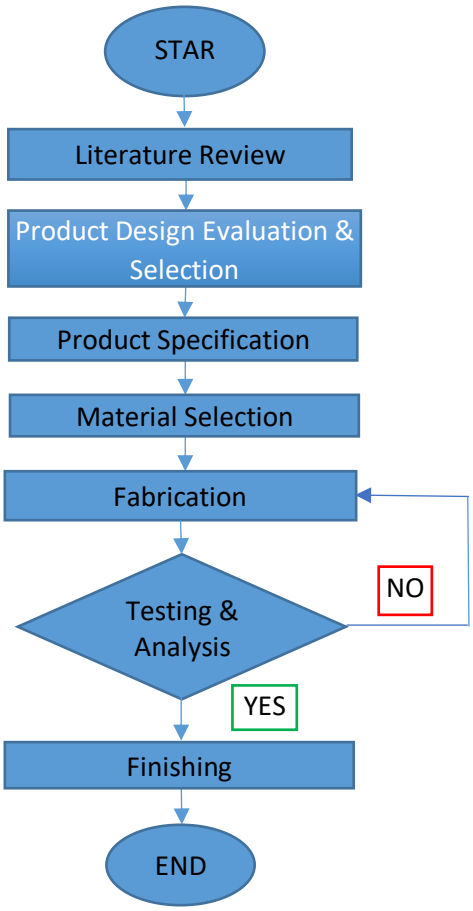
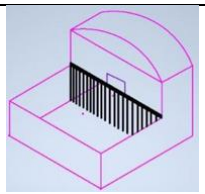


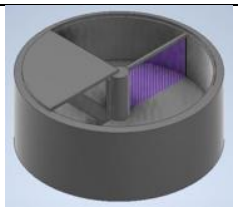
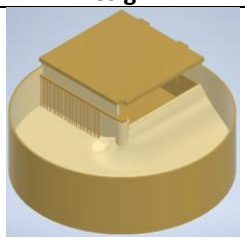
Figure 1: Project flow chart

Concept Design and Evaluation

There are three designs that have been proposed. Five criteria's have been identified which are function, safety, cost, appearance and size as shown in Table 2. From the evaluation, design C is the best model with the highest score on four of those criteria. Thus, it is chosen as the final design.

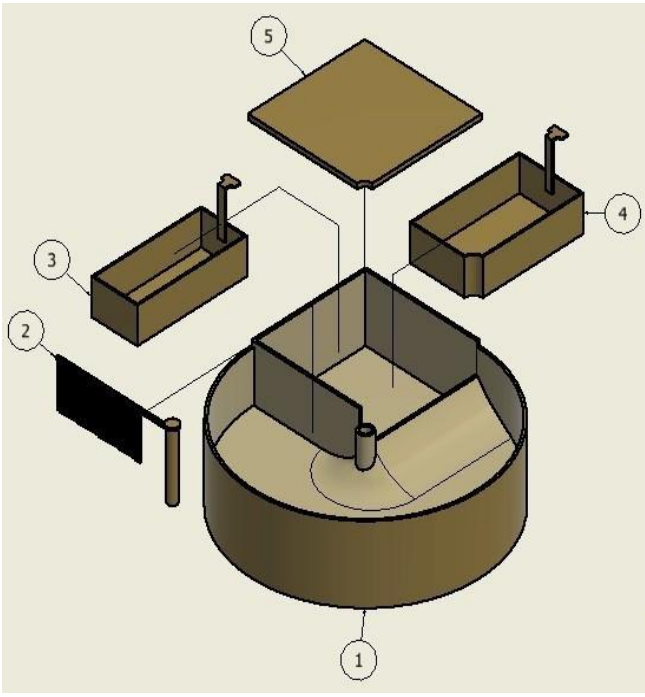
Table 2: Selection process for concept design

Model	Criteria				
	Function	Safety	Cost	Appearance	Size
 Design A	X	X	✓	X	X

 **Design B**	X	X	✓	✓	✓
 **Design C**	✓	✓	X	✓	✓

Product Design

Figure 2 shows the final design for Smart Cat Waste Box. The main parts of the machine consist of body, scoop, anti-smell compartment, waste compartment and lid. Overall size is 512 mm x 512 mm x 150 mm. This specification was determined by the user survey, which most of the users would prefer a bigger design to be used for a larger cat breed.



PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	Body Cat Litter Box	To put sand and cats to litter.
2	1	Scoop	To scoop cats's waste into waste compartment.
3	1	Anti Smell Compartment	To put any kind of anti smell product to prevent bad odour.
4	1	Waste Compartment	Cat's waste are collected in waste compartment.
5	1	Waste Compartment Lid	To contained waste compartment.

Figure 2: Final design

Fabrication Process

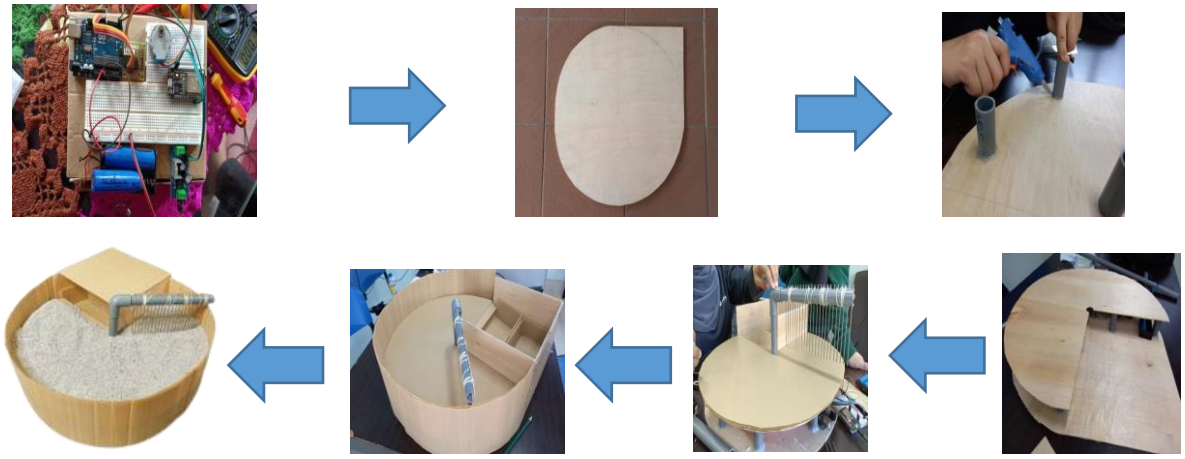


Figure 3: Fabrication and installation process

As shown in Figure 3, fabrication process starts with the assembly of electrical part including Arduino Uno, breadboard, jumper wire and other components. Next step is body parts fabrication including base cutting, PVC pipe cutting, platform, scoop, waste compartment and body cover. The distance between rod is decided at 1 cm to be able to scoop the cats waste without catching the litter too much.

4. Result and Discussion

Several testing have been constructed to evaluate the product which consists of time taken for the scoop to make a one complete cycle, the maximum mass of waste that can be pushed by stepper motor, the percentage of waste that can be pushed by the scoop to the waste compartment and the percentage of cat litter to be scooped up to the waste compartment.

1) Time to make one complete cycle:

Time for stepper motor to make a complete cycle is determined by various factors. The less torque a stepper motor has, the faster it rotates. Stepper motor's speed has been set at 30 rpm, which is the optimal value. The result is one complete rotation takes roughly 55 seconds at a stepper motor speed of 30 rpm and a turn of 270°. This period of time can help to prevent any accidents or injuries to cats, as well as improve the safety.

2) Maximum mass pushed by stepper motor:

Numerous factors have been considered, including scoop mass, maximum waste mass, and litter depth. The scoop weighs 100 g and the depth of the litter is about 1 inch. Waste mass has been increased gradually until the maximum limit. As a result, the maximum mass that the stepper motor able to push is 100 g + 80 g = 180 g. It is about 4 times of normal cat waste weight.

3) Percentage of waste to be scooped up:

To determine the percentage of waste that can be scooped into the waste compartment, several waste sizes were studied and experimented. The probability for large-sized waste to be pushed into the waste compartment

is higher than for small-sized waste. This is because the distance between the stainless steel rod in the scoop has a distance of 1 cm between each other. After several testing, the percentage of waste that could be pushed by the scoop into the waste compartment is approximately 90 %.

4) Percentage of waste to be scooped up:

The percentage of the litter to be pushed depends on the type of litter and the size of the litter. The result is litter type 1 (Figure 4) has a low percentage to be scooped up which is about 2 % compared to litter type 2 (Figure 5) which has a percentage of 40 %. Table 3 shows the summary of overall test result.

Figure 4: Cat litter type 1

Figure 5: Cat litter type 2

Table 3: Testing result.

Test	Result
Time taken	55 second
Mass	180 g
Wasted scooped	90 %
Litter scooped	2 %

5. Conclusion

As a conclusion, the objectives set have been achieved which is to design a smart cat waste box that could be operated automatically with the implementation of IoT. Users only need to press the push button on the phone or use voice assistance to clean up the cat waste instead of using their hands manually which takes a long time to do it. Smart Cat Waste Box also have a safety features for cats. This is because the time taken for the scoop to

do one complete cycle takes a long time which is approximately 55 s. With this slow movement of the scoop, any possibility of cat accident could be avoided and if the scoop is moving and hits the cat, it will not cause any injuries to the cat.

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