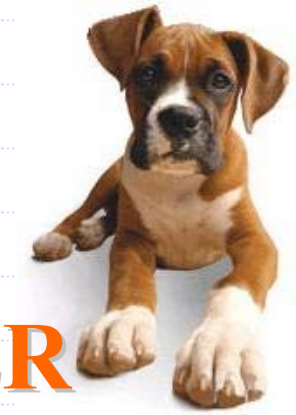
PRODUCT DESIGN & DEVELOPMENT

PRESENTATION



PROJECT II FINAL

DESIGN AN AUTO - PET FEEDER

Supervisor: Dr. Pisut Koomsap

Reported by GROUP 2

- Pham Bach Duong
- Nguyen Le Tuong
- Trinh Huu Phuc
- Huynh Huu Phuong

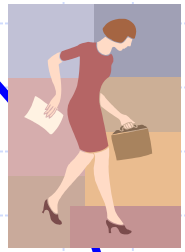
Contents

- Introduction
- Objective of the project
- Concept development process (Brief Progress Presentation)
- Process driven design
- Product architecture
- Detail design
- Prototype
- Design for manufacturing
- Testing and refinement
- Demonstration

Introduction

- Company - **ThinkPet®**
  - Established in 2002
  - Designs & develops PET related products
- Main products
  - Pet households.
  - Pet entertainment.
  - Pet feeder.
- The company's development team is designing and developing the pet feeder model PFD01

Objective of the project



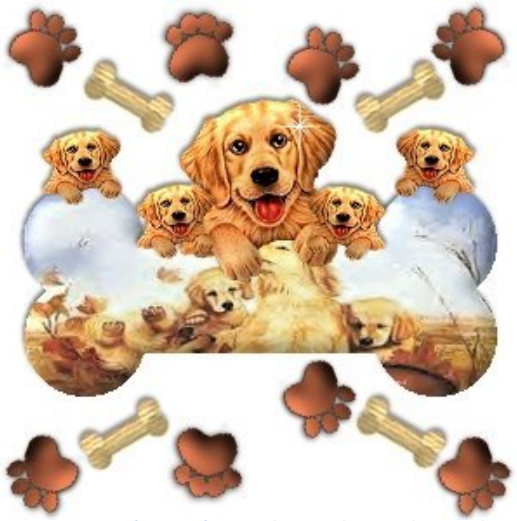
Brief Progress Presentation

Mission statement

Product description: 7 days Programmable Automatic Pet Feeder for small – medium dogs and cats

Assumptions and constraints:

- Both supply food and water
- Programmable ability
- Affordable price
- Portability
- Easy installation and removal



Brief Progress Presentation (Cont.)

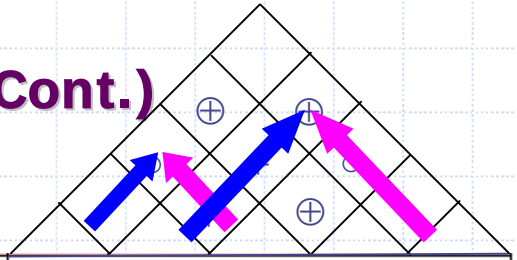
Survey customer needs

- Methodology: interview and written survey
- Customer selection matrix

Market segment	Customer types		
	Lead Users	Users	Retailers
Busy, on-the-go pet owners	8	3	3
The elderly and handicapped	5	5	2
Children	0	4	

Brief Progress Presentation (Cont.)

House of Quality

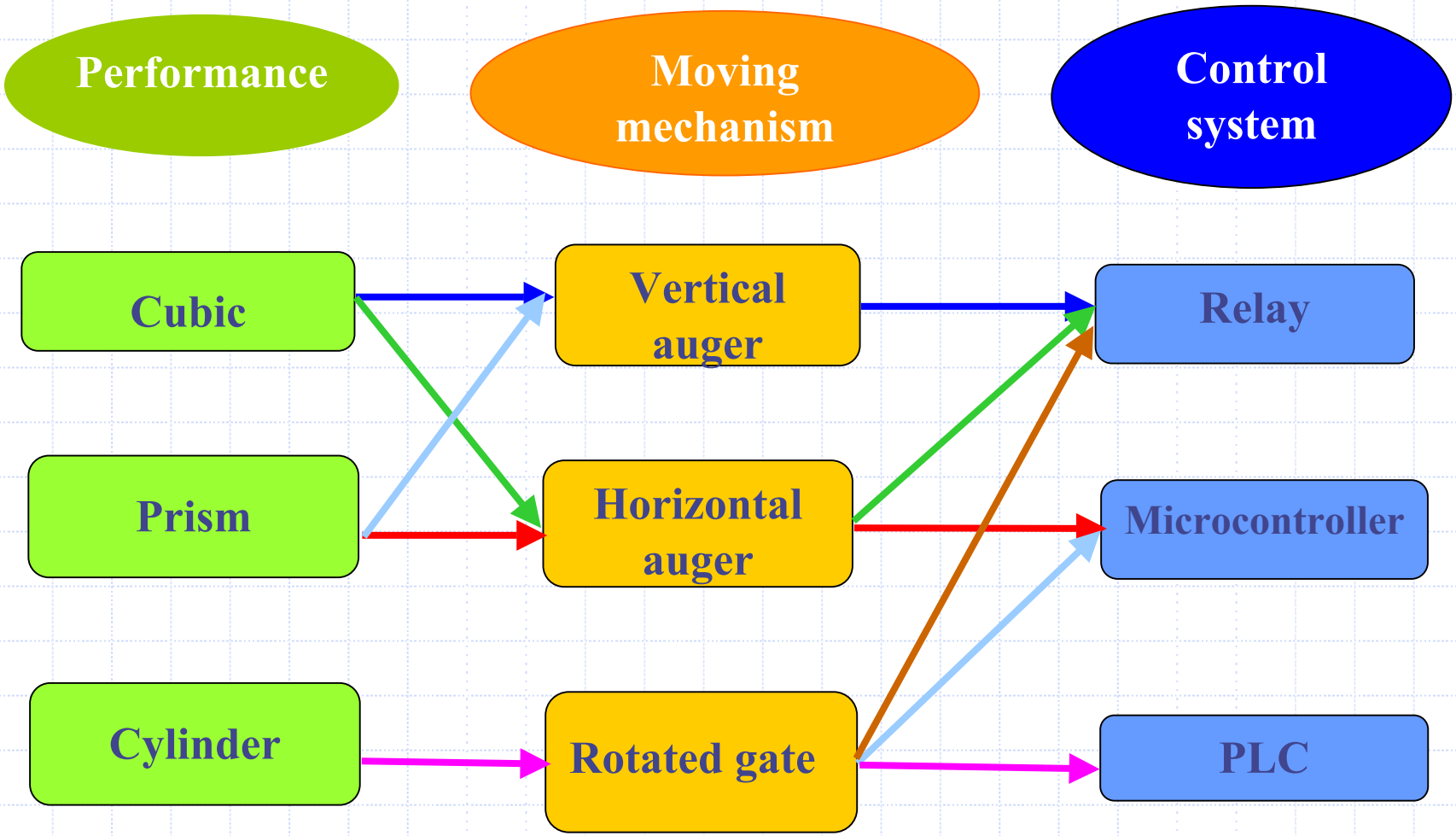


HOWs / WHATs	IMPORTANCE	KEY PRODUCT & PROCESSES				
		Stainless steel material	TCVN_04	Unit manufacturing cost	Total mass	Corn oil concentration
DIRECTION OF IMPROVEMENT		↑	↓	↑	↑	↓
Programmable	5					
Safety	4		9			1
Anti-insects	3					9
Multifunction	4					
Durable	3			3		
TARGETS		> 96%	pass	< 120 USD	< 3kg	> 1 cc
ABSOLUTE IMPORTANCE		123	36	54	60	36
RELATIVE IMPORANCE		12%	4%	5%	6%	4%

Imp	Improvement	Sale	Scores	%Scores
5	1.25	1.5	9.4	14
4	1.3	1.3	6.8	10
3	1	1.4	4.2	6
4	1.125	1.3	5.9	9
3	1	1.4	4.2	6

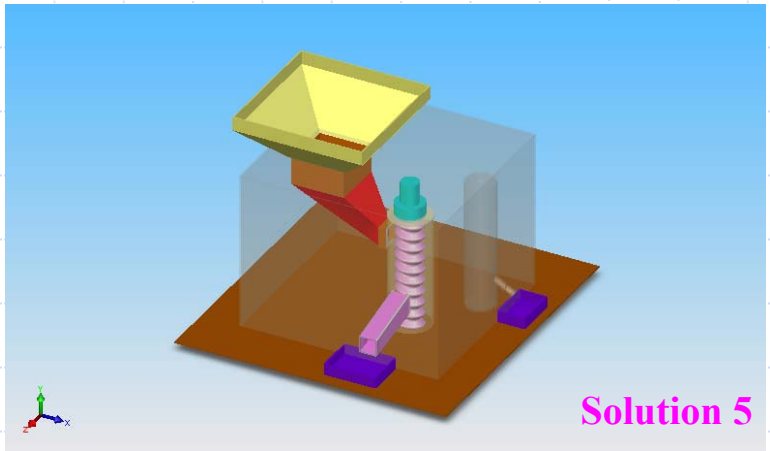
Brief Progress Presentation (Cont.)

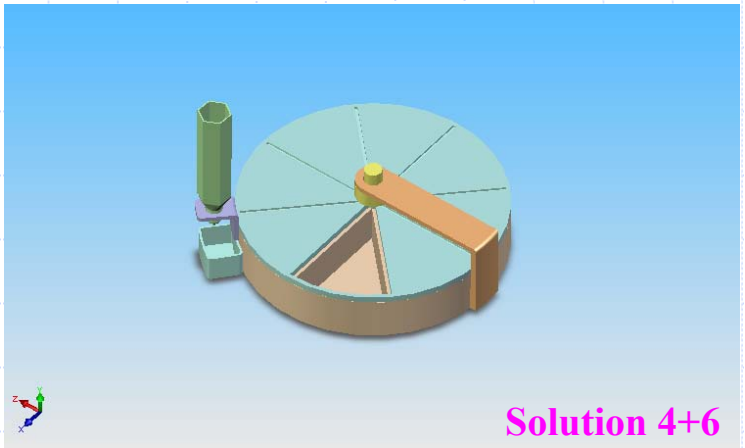
Concept generation_*Combination table*

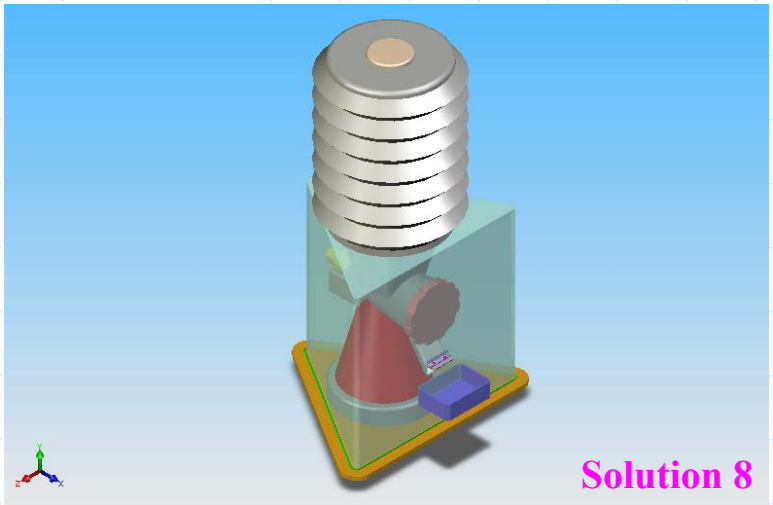


Brief Progress Presentation (Cont.)

_ Concept candidates _







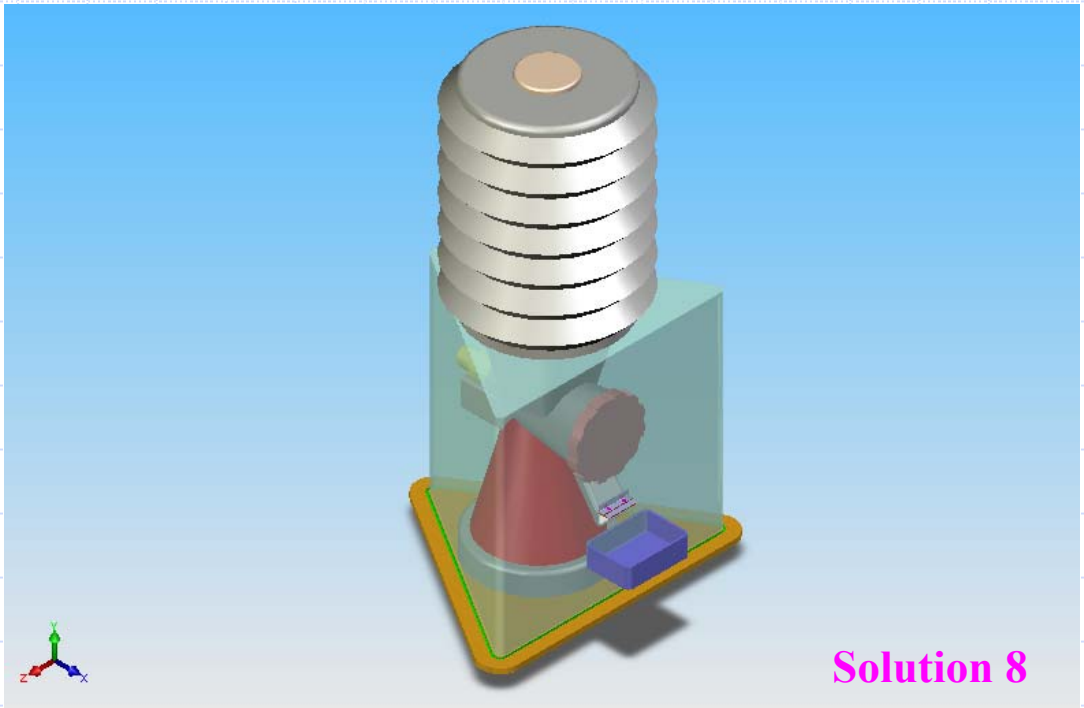
Concept selection (Cont.)

Concept scoring

		Concept			
				Selection 4 + 6	
Selection criteria	**Weight**	**Rating**	**Weighted score**	**Rating**	**Weighted score**
Performance	10%	2	0.2	1	0.1
Ease of use	20%	3	0.6	3	0.6
Reasonable price	20%	3	0.6	2	0.4
Durability	30%	3	0.9	2	0.6
Portable	10%	2	0.2	3	0.3
Programmable	10%	3	0.3	4	0.4
	Total score	**1.54**		**2.4**	
	Rank	**3**		**2**	
	Continue?	**No**		**No**	

Brief Progress Presentation (Cont.)

_ Selected concept _



Process Driven Design

Develop manufacturability design goals

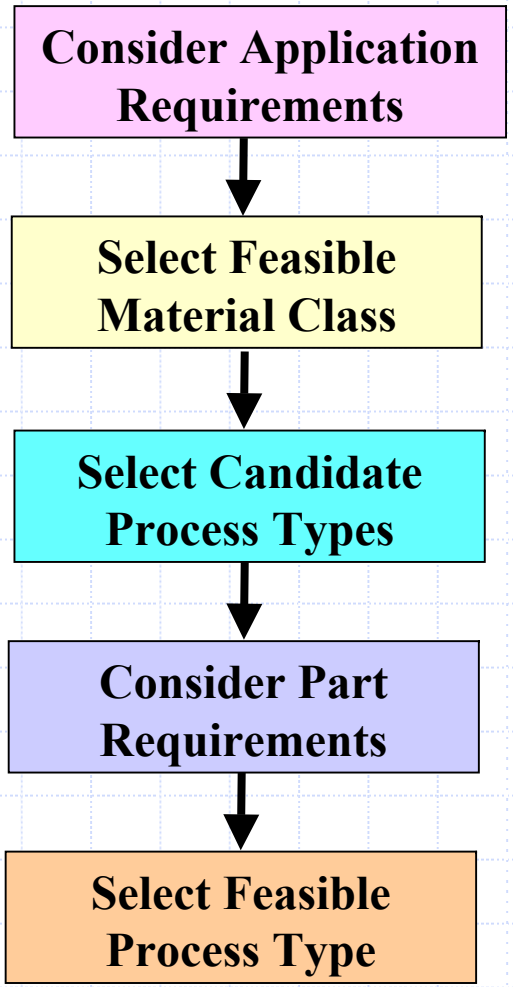
- Minimize the number of parts and separate operations
- Program, assemble and operation test the electronic components with existing assembly lines
- Use the standard components and fasteners such as IC, DC motor, screws,…

Develop manufacturability design goals

- The division between standard and designed components
- The product architecture
- The assembly concept with assembly structure is frame-based construction
- Basic material and process classes for key components: choose Material first approach

Process Driven Design (Cont.)

_ Material and Process selection _



Prototype, no load

PVC, stainless steel, mica, rubber

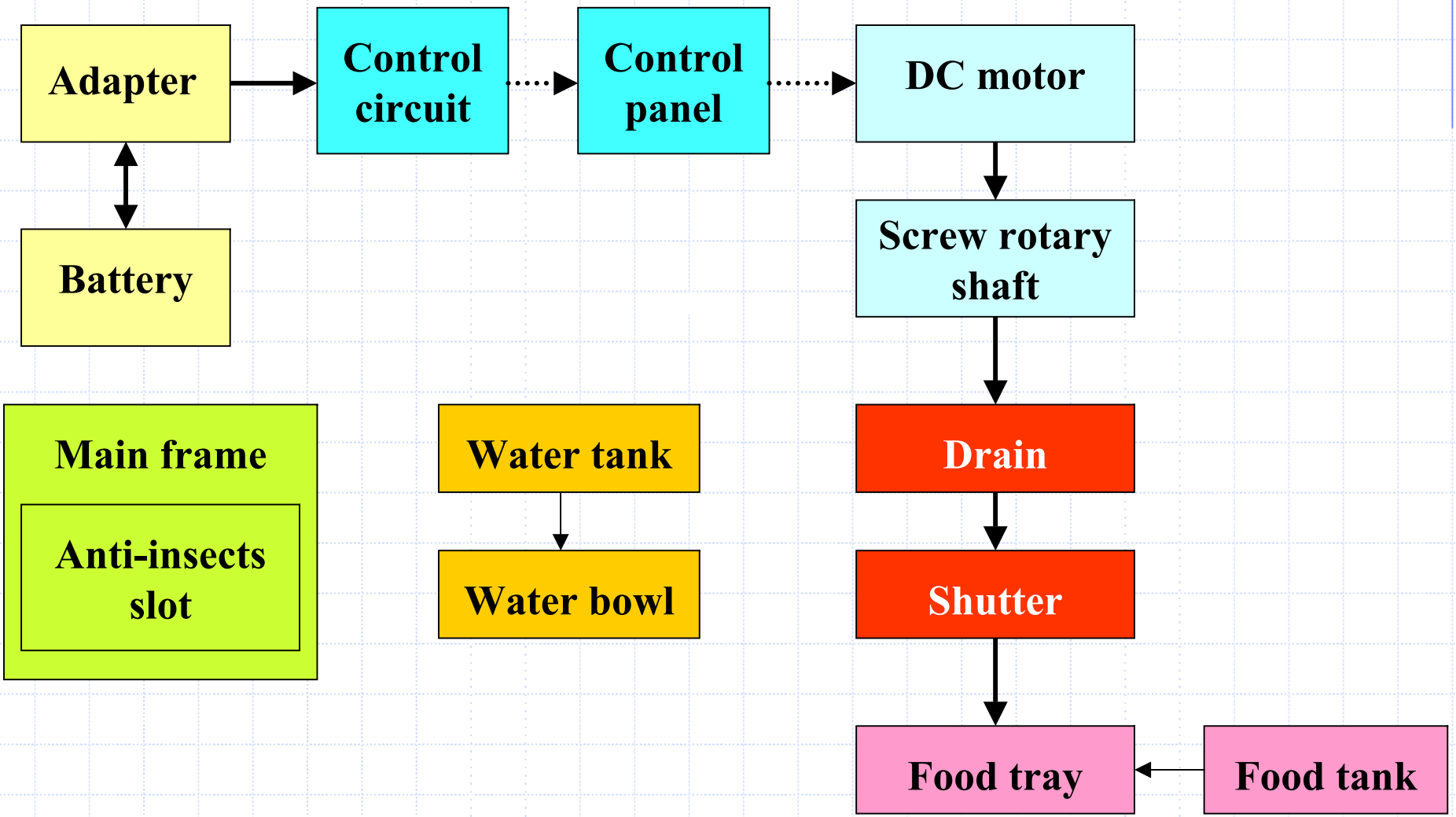
Extruding, tapping, shaping, turning, welding, cutting, grinding

Prototype only

Shaping, tapping, cutting, welding

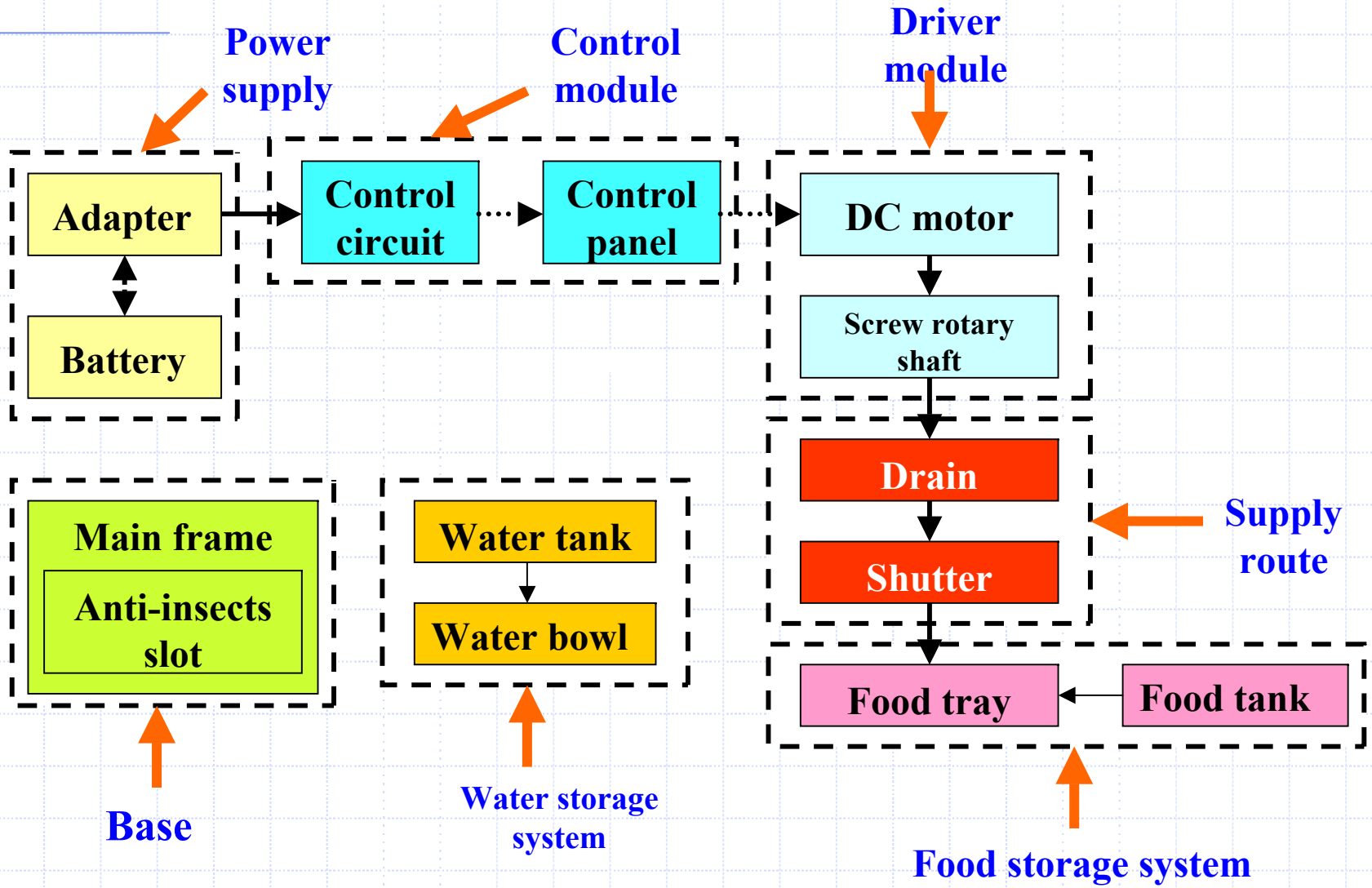
Product Architecture

_Create schematic for the product _



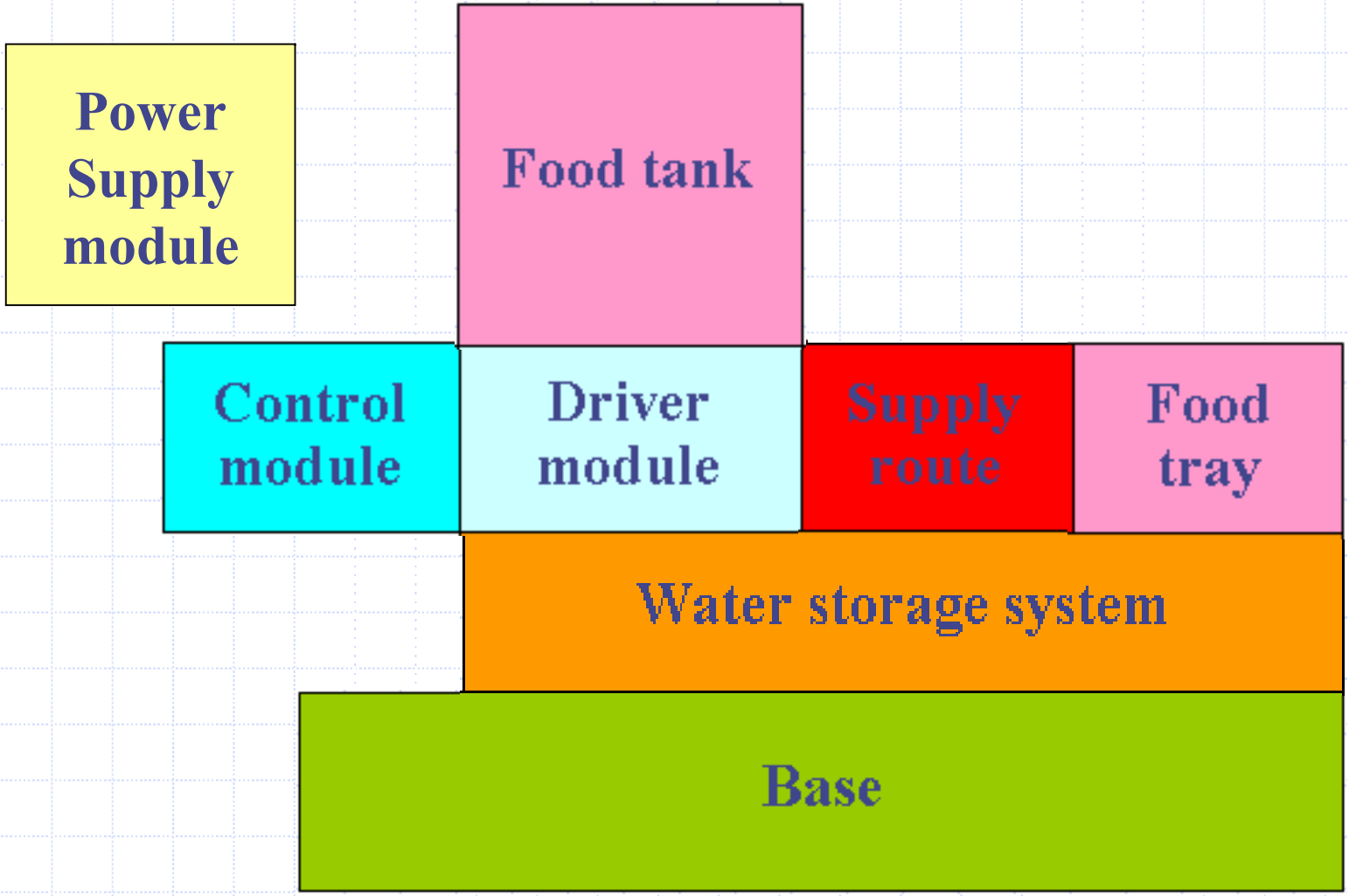
Product Architecture (Cont.)

Cluster the elements of the schematic



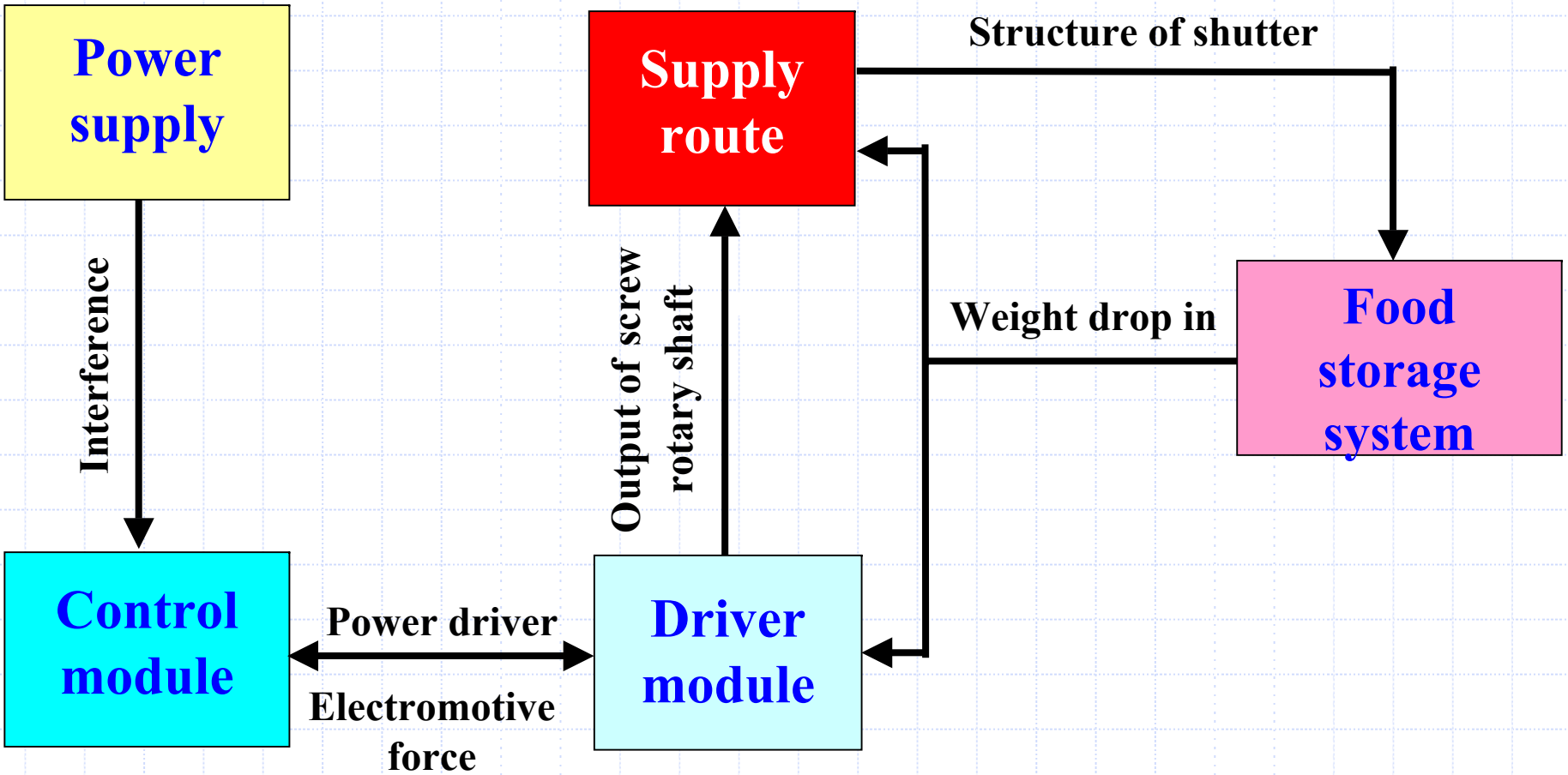
Product Architecture (Cont.)

Create a rough geometric layout

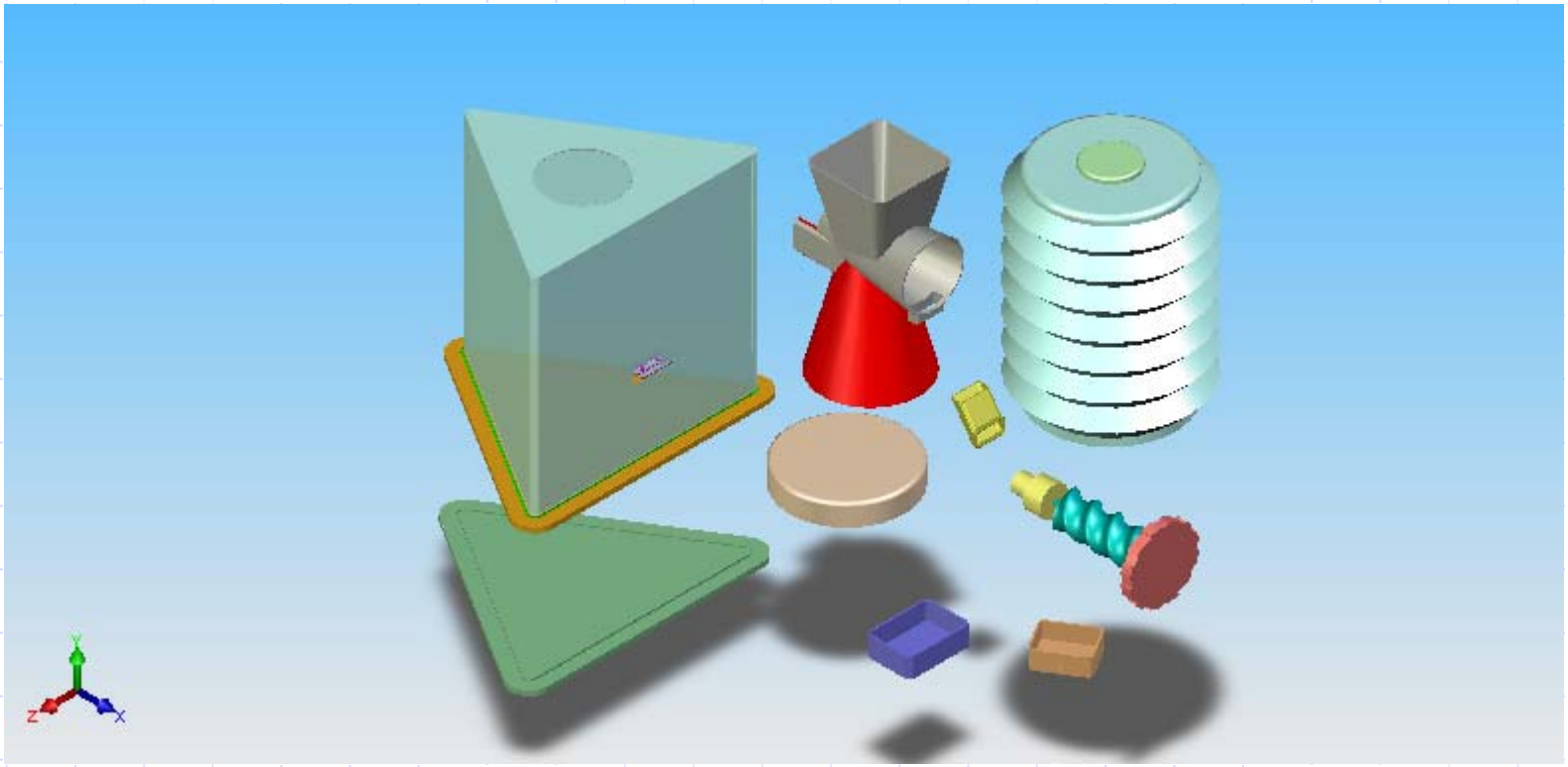


Product Architecture (Cont.)

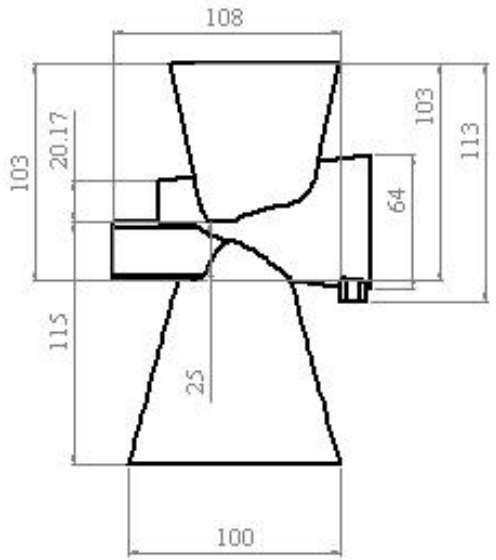
_ Identify the incidental interactions _

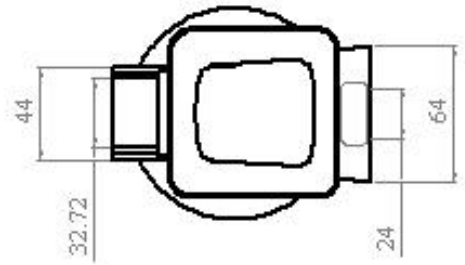


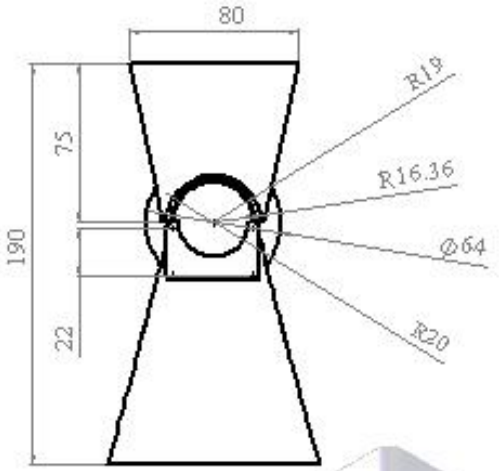
Detail Design



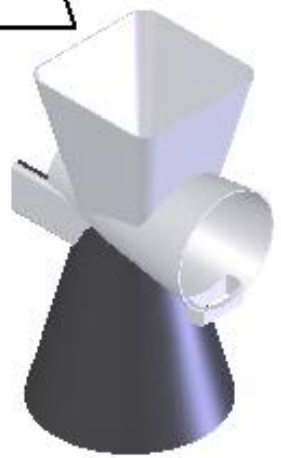
Detail Design



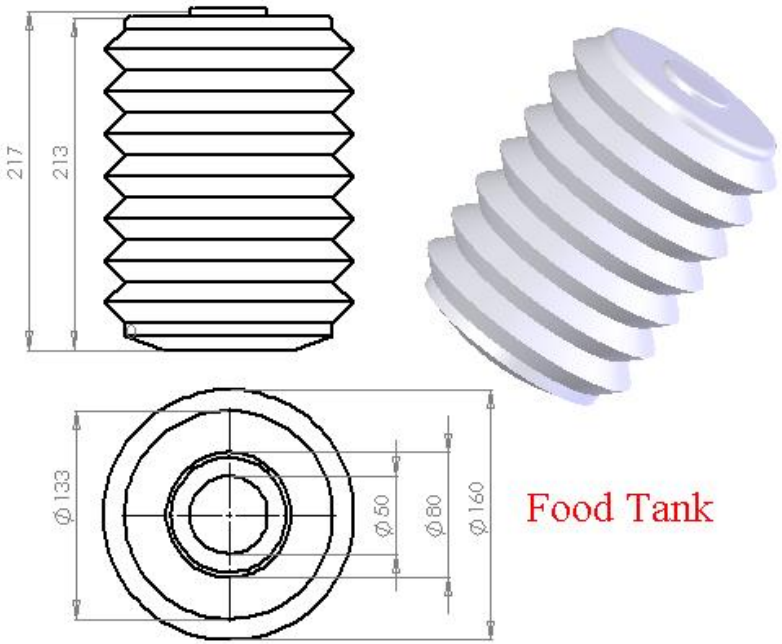




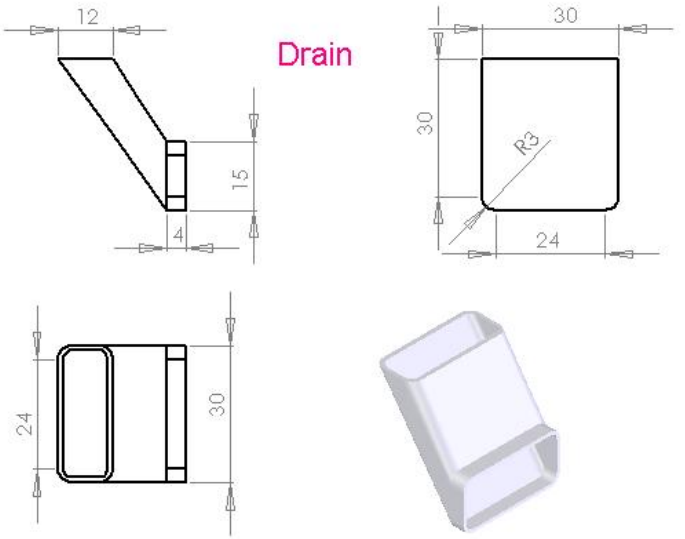
Slot B



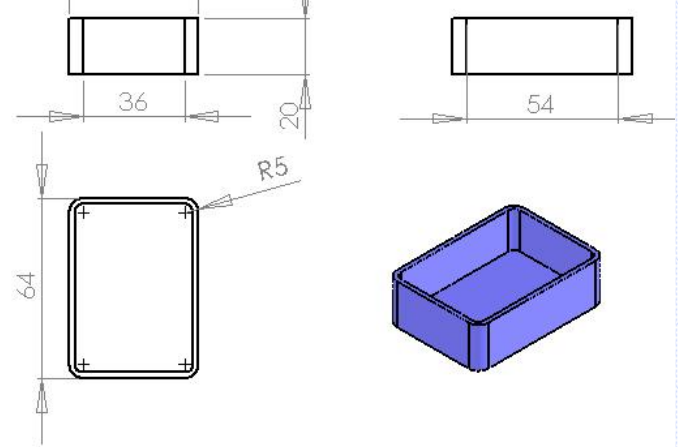
Detail Design (Cont.)



Food Tank

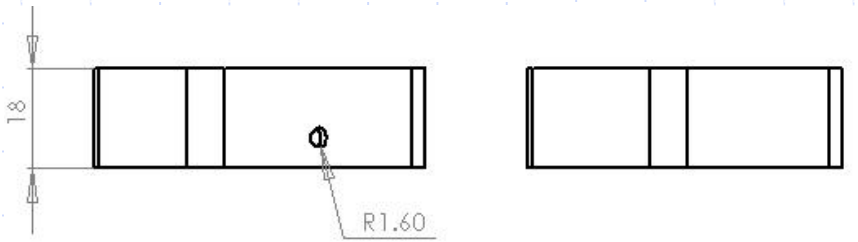


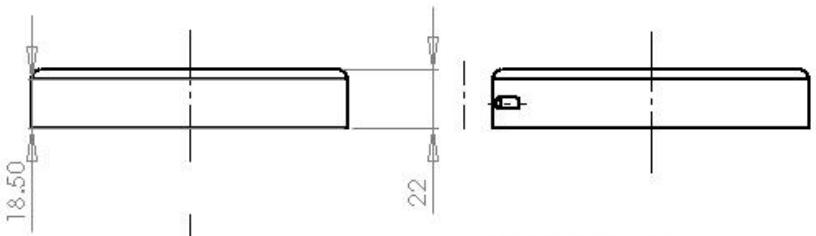
Drain



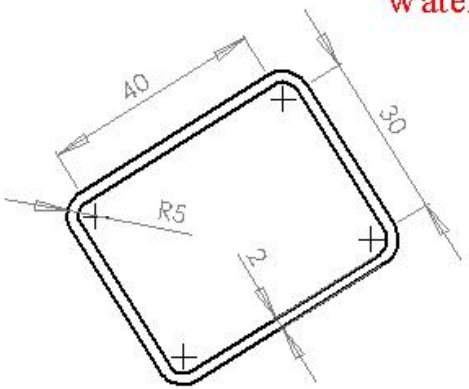
Food Tray

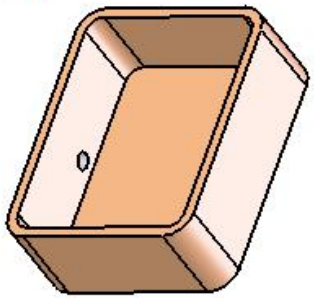
Detail Design (Cont.)

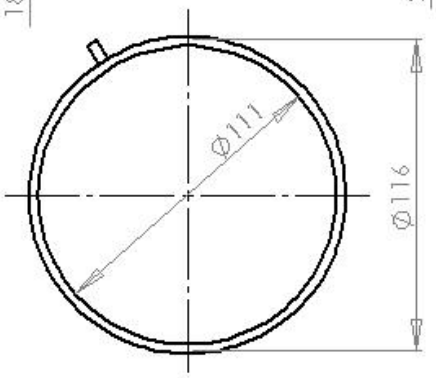




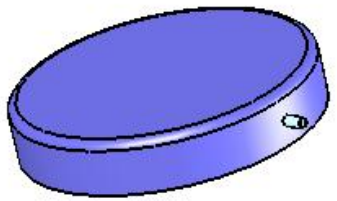
Water Bowl



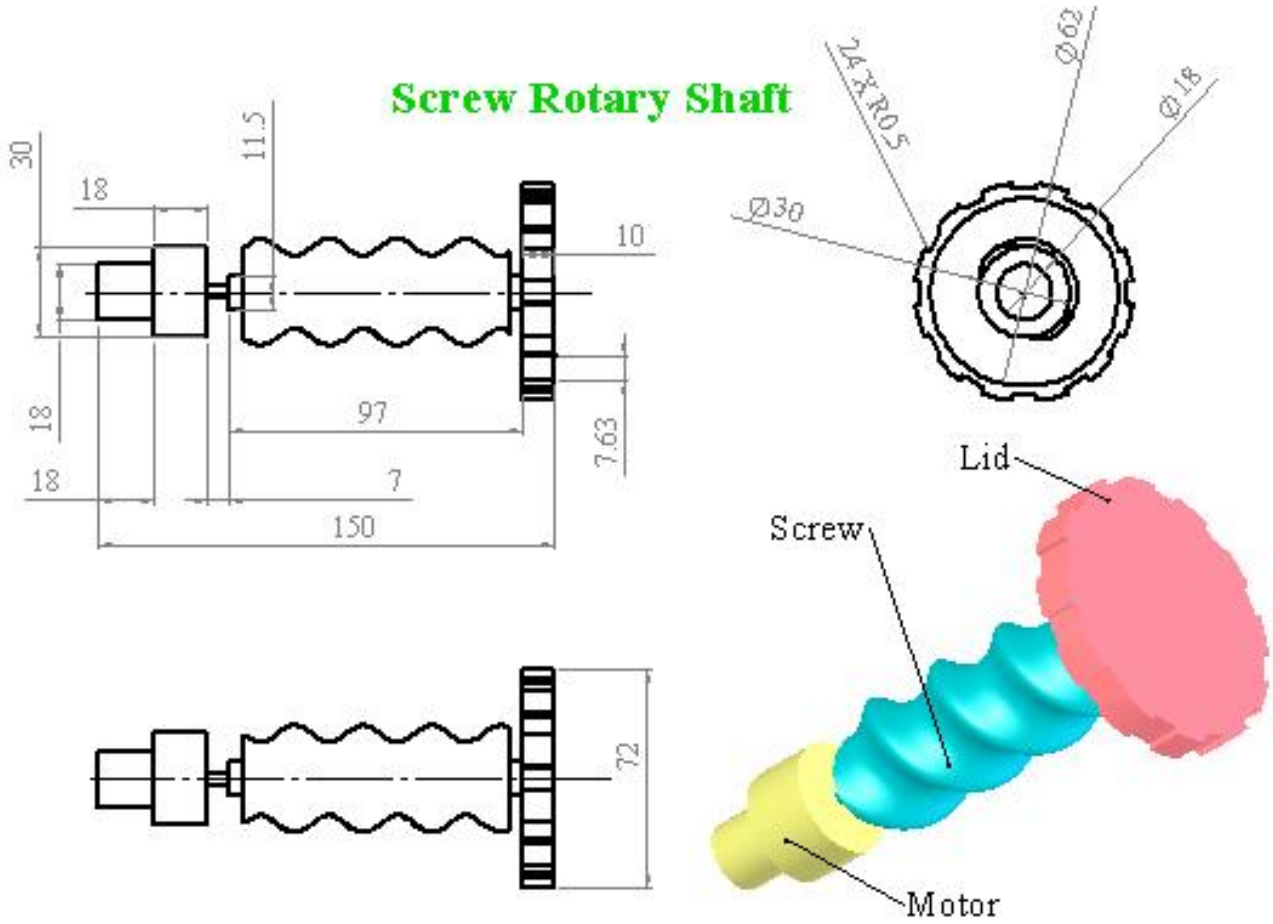




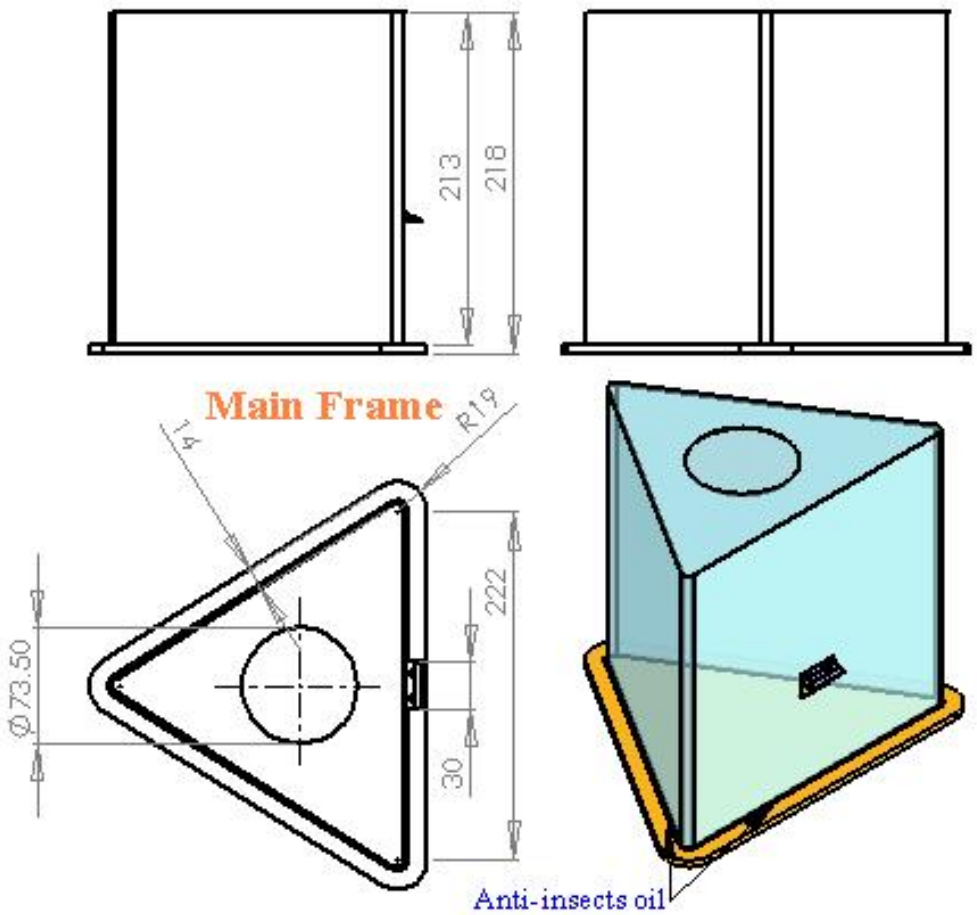
Water Tank



Detail Design (Cont.)

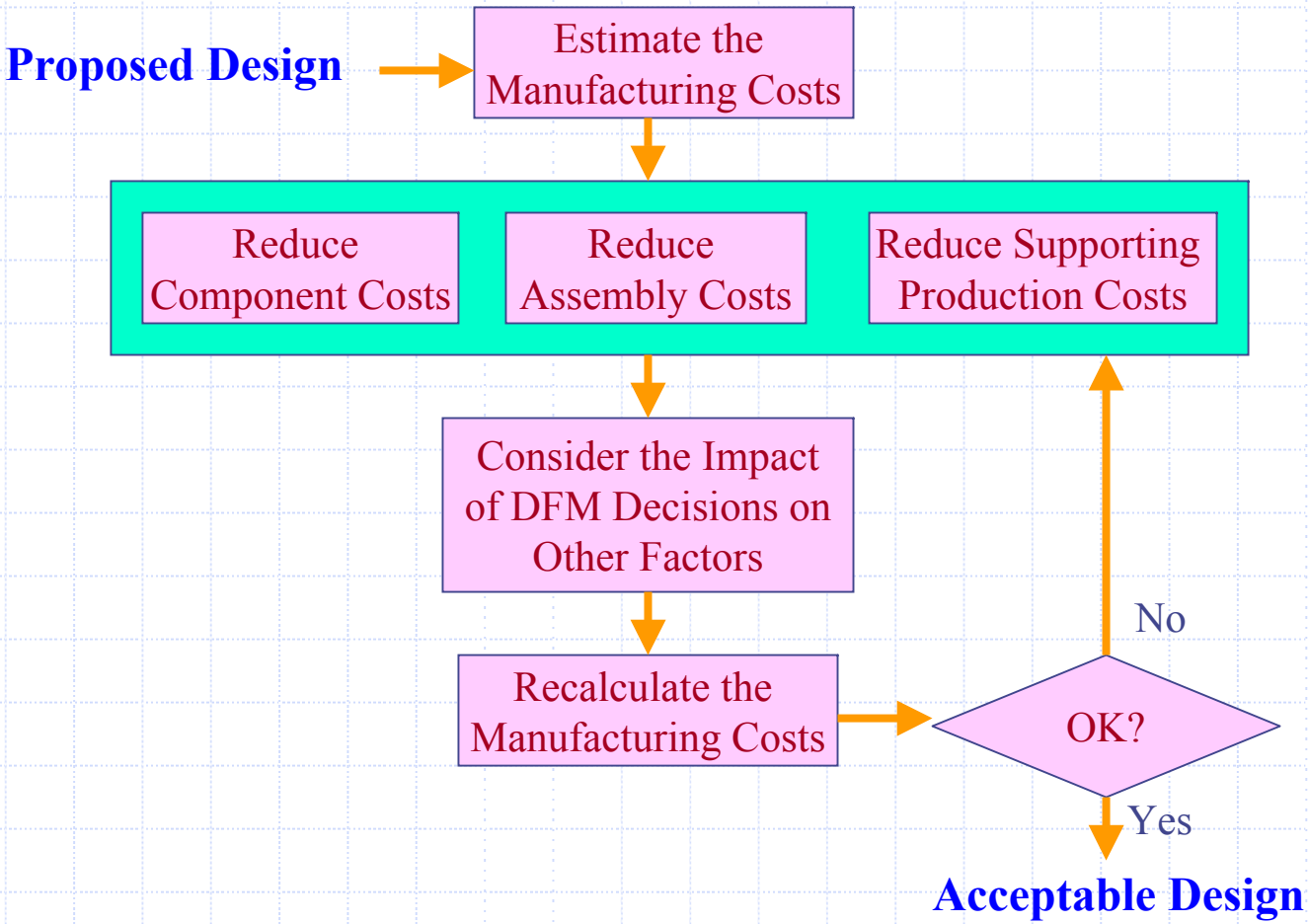


Detail Design (Cont.)



Design for manufacturing

DFM Methodology



Design for manufacturing (DFM)

Manufacturability Analysis Worksheet

Part or Operation	Qty	Type	Assembly				Part Elimination				Assessment			
			H	I	S	C	Motion	Mat'l	Ass'y	CFE	V	M	UI	Note
Main frame	1	2	-	0	0	+	N	Y	Y	0	0	0	0	
Water tank	1	2	0	0	0	+	N	Y	Y	0	0	0	0	
Slot base	1	2	+	+	+	+	N	N	Y	0	0	0	0	
Drain	1	2	+	0	0	0	N	N	Y	0	0	0	0	
Screw rotary shaft	1	2	0	0	-	-	Y	N	Y	0	0	-	0	
Control circuit board	1	2	+	-	0	-	N	Y	Y	0	1	+	0	
Adapter	1	2	0	0	0	0	N	Y	Y	0	3	+	0	
Top cover	1	2	+	+	+	+	N	Y	Y	0	0	0	0	
Shutter	1	2	+	+	0	0	Y	N	Y	0	0	0	0	
Control panel	5	2	+	0	0	-	N	Y	Y	0	3	+	0	
Food tank	1	2	-	+	+	+	N	N	Y	0	0	0	0	
Food tray	1	2	+	+	+	+	N	Y	Y	0	0	0	0	
Water bowl	1	2	+	+	+	+	N	Y	Y	0	0	0	0	
Roof	1	2	+	+	+	+	N	N	Y	0	0	0	0	
Handle	1	2	+	+	0	+	N	N	Y	0	0	0	0	
Small tank	1	2	0	+	+	+	N	N	Y	0	0	0	0	

Design for manufacturing (Cont.)

Manufacturability Analysis Worksheet

			Assembly				Part Elimination				Assessment			
Part or Operation	Qty	Type	H	I	S	C	Motion	Mat'l	Ass'y	CFE	V	M	UI	Note
Main frame	1	2	-	0	0	+	N	Y	Y	0	0	0	0	
Water tank	1	2	0	0	0	+	N	Y	Y	0	0	0	0	
Slot base	1	2	+	+	+	+	N	N	Y	0	0	0	0	
Drain	1	2	+	0	0	0	N	N	Y	0	0	0	0	
Screw rotary shaft	1	2	0	0	-	-	Y	N	Y	0	0	-	0	

$\sum Qty = 20$

$\sum CFE = 0$

Design for manufacturing (Cont.)

Evaluating the DFM

$$Count\_ratio = \frac{\Sigma Qty - \Sigma CFE}{\Sigma Qty} = \frac{20 - 0}{20} = 1$$

With this count ratio, we have made a good design for auto pet feeder.

$$Value\_ratio = \frac{\Sigma(2\,\&\,3\_Value\_Rating)}{\Sigma Qty} = \frac{2}{20} = 0.1$$

The value ratio is close to zero. It is not good because almost parts are new design, it takes long time to make.

Therefore we try to trade off all elements to get the better results

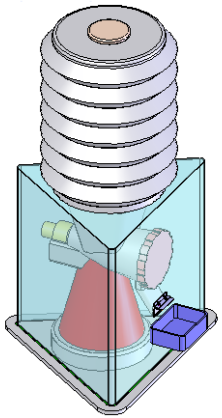
Bill of Material (BOM)

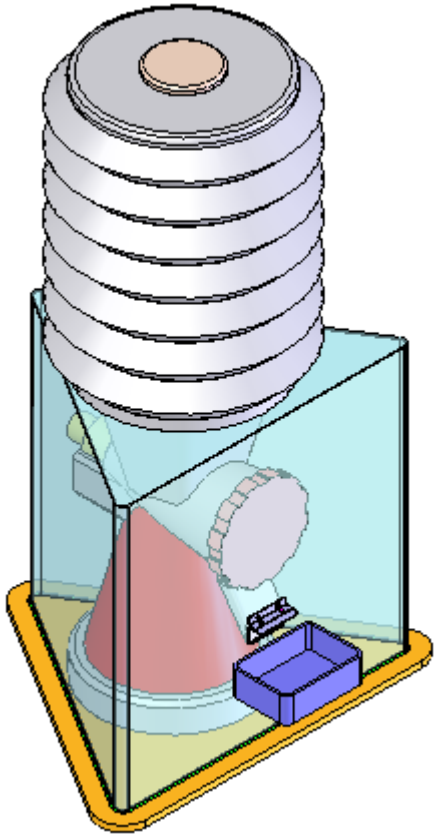
No.	Part name	Unit	Quantity	Material	Standard
1	Food tank	pcs	1	PVC	
2	Water tank	pcs	1	PVC	
3	Food tray	pcs	1	Stainless steel	
4	Water bowl	pcs	1	Stainless steel	
5	[redacted]				
6	Anti-insects oil	cc	1		
7	[redacted]				
8	Shutter	pcs	1	PVC	
9	Motor	pcs	1		Bristish standard
10	Control circuit board	pcs	1		TCVN
11	Switch	pcs	5		
12	Screw rotary shaft	pcs	1		
13	Screws	pcs	12		
14	Gasket	set	1	Composite plastic	
15	Adapter	pcs	1		TCVN
16	Battery	pcs	1		TCVN
17	Accessories	set	1		
Optional					
18	Roof	pcs	1	PVC	
19	Handle	pcs	1	PVC	
20	Small tank	pcs	1	PVC	

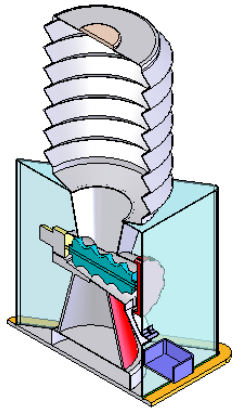
Bill of Material with estimated cost

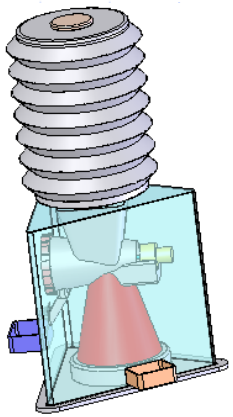
No.	Part name	Purchased materials	Processing (Machine +Labor)	Assembly (Labor)	Total unit variable cost
1	Food tank	1.75	1	0.1	2.85
2	Water tank	1.5	0.75	0.1	2.35
3					
4	Water bowl	1.25		0.15	1.4
5	Main frame	7		0.5	7.5
6	Anti-insects oil	0.25		0.05	0.3
7	Drain	0.3	0.2	0.1	0.6
8	Shutter	0.8	0.4	0.1	1.3
9					
10	Control circuit board	3		3	6
11	Switch	1		0.5	1.5
12	Screw rotary shaft	4	2.3	0.75	7.05
13	Screws	0.5		0.2	1.7
14	Gasket	0.5		0.2	0.7
15	Adapter	2		0.1	2.1
16	Battery	6		2	8
17	Accessories	3		0.5	3.5
Optional					
18	Roof	1.5	0.5		2
19	Handle	0.5	0.2		0.7
20	Small tank	1	0.6		1.6
				Total Cost	**54.25**

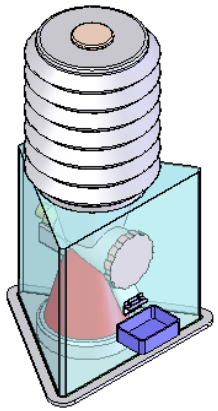
Prototype











Prototype (Cont.)

Physical prototype

Testing and Refinement

Faced problems _ Solutions_Adjustment

Problem 1: *Control circuit*

Problems	Solution
•Timer operation is inaccurate, so the cycle of machine has some errors.	Checking and repairing the circuit. Programming IC again.
•Falling power.	Increasing the power of the power supply. Checking the short circuit

Testing and Refinement (Cont.)

Faced problems _ Solutions_Adjustment

Problem 2: *Drain and shutter*

Problems	Solution
•The declination is unsuitable. → Food is got stuck or thrown out combust the motor	Adjusting the angle.

Testing and Refinement (Cont.)

Faced problems _ Solutions_Adjustment

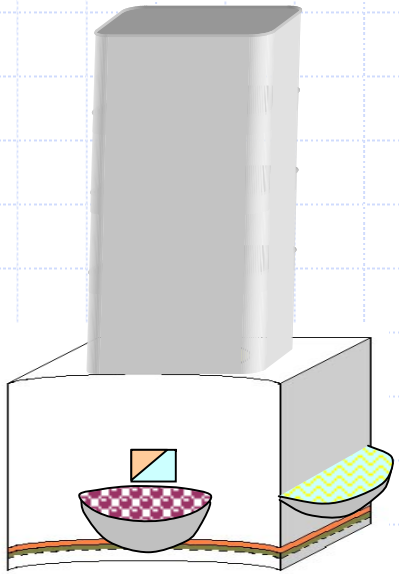
Problem 3: *Motor*

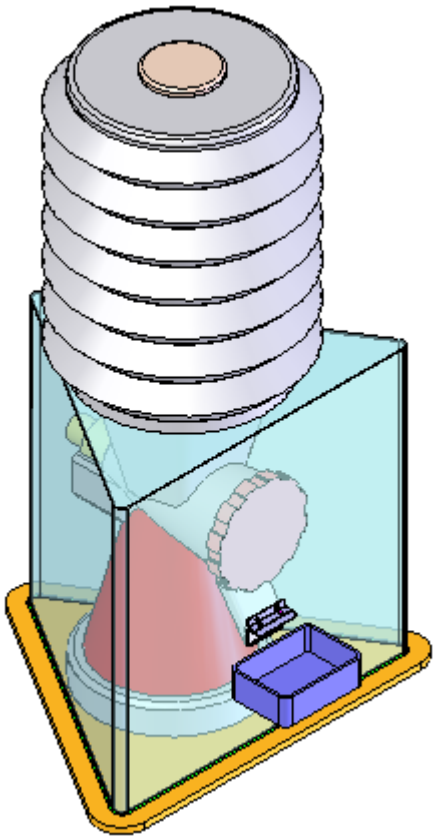
Problems	Solution
•Large power motor. → Waste the electrical energy and increase power driver.	Changing the motor. Reducing the power motor.
•Horizontal axis between the motor and screw rotary shaft is not coincident.	Adding the gaskets. Correcting the joints.

Conclusions

- Up to now, we elementarily complete designing the auto pet feeder, model PFD01, with prototype as demonstration.
- We also concentrate to optimize design and development processes for creating the best perfect auto pet feeder, with the best reasonable price.

Conclusions





Coming soon

- Enable voice communicate.
- Alternated dishes.
- Check if the pet leave the meal.
- Camera add-in.

THANK YOU FOR YOUR ATTENTION !


ThinkPet
is
Pet's Thing
WELCOME
TO
DEMONSTRATION