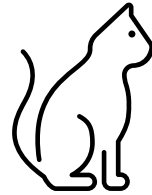# Senior Design I

Interactive Cat Toy

Department of Electrical Engineering and Computer Science

University of Central Florida

Dr. Samuel Richie

Dr. Lei Wei

Initial Project Document and Group Identification

Divide and Conquer

Group 25

Aliza Grabowski	CPE	
Joseph Lopez	CPE	
Vu Nguyen	EE	
Elizabeth Vargas	EE	→

Project Narrative

Pet cat owners, who adore their furry feline friends, love to see them having fun while engaged in play. Pet cat toys are a great way to help an owner enjoy time with their cats and to have fun. Finding the right toy to really thrill a cat; however, can be a tough challenge. Our interactive cat toy is specifically designed to entice cats to play. We utilize features that are well known to attract and entertain kitties. Our project is designed to provide owners and their pet cats with hours of engaging fun!

In the world today, it is estimated that the domestic cat population exceeds 400 million; and that 373 million cats around the globe are kept as pets. (1) Here in the USA, it is estimated that there are 93.5 million cats kept as pets, with about one-third of all US households having at least one pet cat. (2) This provides for a large market of pet owners looking for toys to entertain their fun- loving felines.

There is a huge variety of pet cat toys on the market. These toys are made in an array of shapes, and they have a range of interactive features. What makes our interactive cat toy different, is our unique combination of multiple features that best intrigue and entice cats to play; along with a phone application with which cat owners can control built-in features of the toy.

Our toy is a whimsical plush, representing a real-life animal, so that kitties will be enticed to grab it and to play with it, even if its other features are not switched on. We chose to model our toy after a lifelike animal because cats are naturally drawn to play with small animals in the wild, and because small animals are just plain cute! While our project is currently in the design stages, the shape and name of our pet cat toy is not yet set in stone. As we investigate which animal design best attracts our kitty test subjects, we will solidify our choice of animal shape for our project design.

A key feature for our interactive cat toy is an interactive phone application. Owners will be able to control various features of this fun cat toy with the touch of a button within the app.

Many pet cat owners can attest, and it is well documented, that cats love to play with laser pointer lights. Our interactive cat toy incorporates a strip on which a light display is produced. Various aspects of this light display can be controlled with a phone application, such as light pattern and color. We are placing this control at the cat owners' finger tips, to entice their kitty as they know best.

Through our phone application, other controllable features included with our toy design are animal motion and noise makers. Our toy mimics subtle movements and sounds of small animals that will peak the curiosity

of any cat. This is another feature that can entertain any cat with hours of play.

Finally, everyone has heard that cats are drawn irresistibly to the scent of catnip. So, we have designed our toy to contain a catnip pouch shaker. This is another feature that can be controlled via our phone application. With a touch command upon our phone application, the scent of cat nip can be disbursed into the air to attract a playful pet kitty.

While we are still considering the appropriate appearance for our cat toy, we are also considering appropriately naming our toy. We believe that an endearing and fun name is important for a toy that will entertain someone's special cherished pet.

Research shows cats are drawn to all the features that we have combined into the design of our interactive cat toy. We believe that our pet cat toy can become a favorite for cat lovers across the globe! We wish for our product to supply much enjoyment of life for both owners and their precious pets alike!
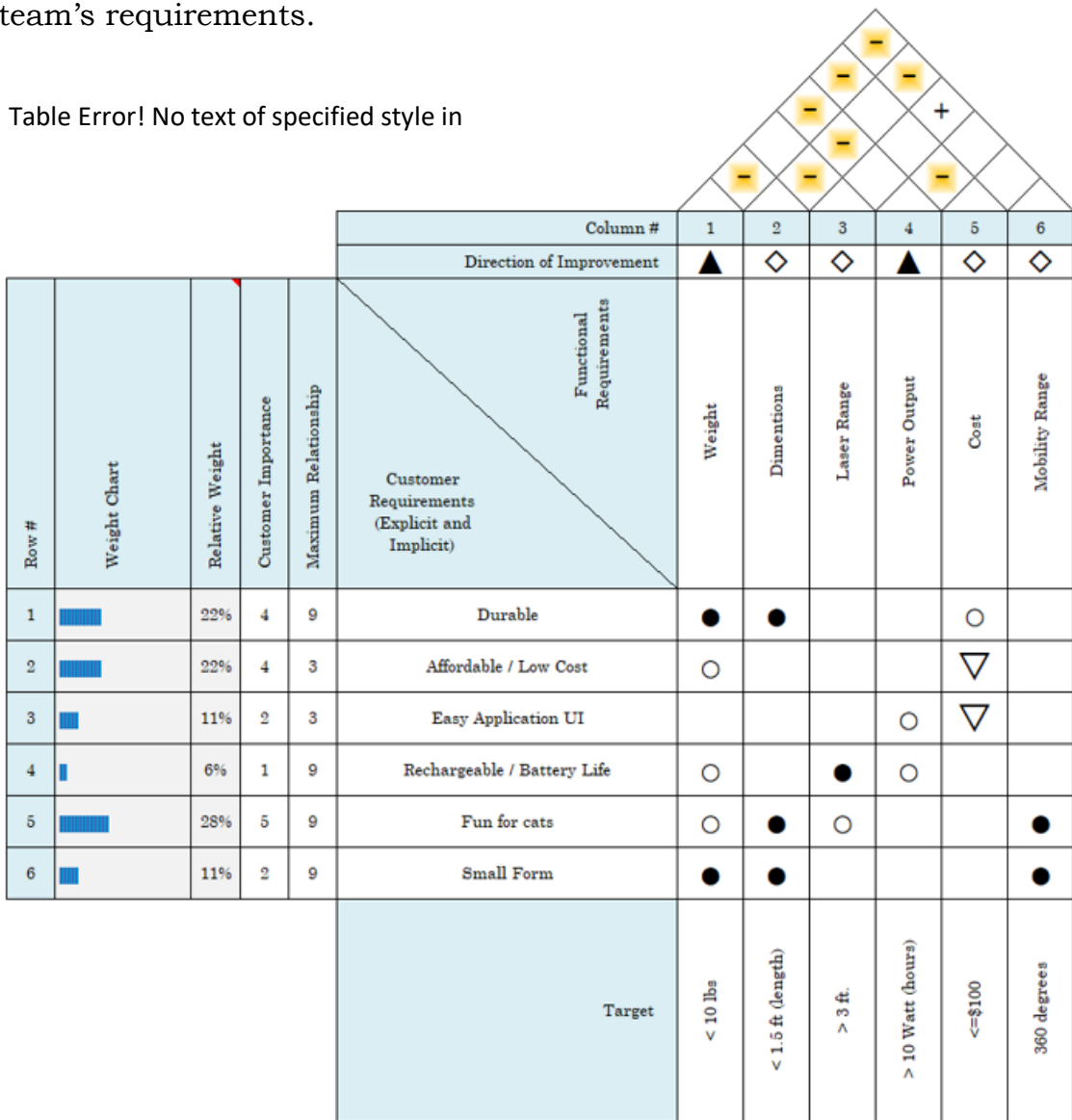
Requirements Specifications

Table **Error! No text of specified style in document.**-*1*: Requirements Specifications		
Component/Feature	**Parameter**	**Specification**
Battery	Run Time	> 60 min
Charger	Charging Time	< 4 hours
Electronic Circuit	Safe Current	< 10 mA
	Safe Voltage	< 10 Volts
Basic Features		
Motor (shaker)	Low Noise*	< 60 dB
Motor (body movement)	Low Noise*	< 60 dB
Joint	Range of motion	30-60 degrees
Speaker	Volume	≈ 60 dB
Lighting	Color	Single
	Casing	Waterproof
Advanced Features		
Lighting	Color	Multi
Motion Detector	Detection Distance	≤ 1.5 feet
Wireless	Range**	≈ 100 feet
Phone Application	Response Time	< 2 seconds
Stretch Goal Features		
Video Camera	Real Time Video Delay	< 400 ms
Speaker	Volume	≈ 60 dB

House of Quality

A House of Quality diagram is particularly important when establishing the requirements that are needed between the marketing team and the engineering team. This allows the two teams to understand the tradeoffs that will be needed to create the ideal product.

While the design for our project is still being decided upon, we are working on building a House of Quality diagram to be presented within our next Divide and Conquer report. The House of Quality will show the correlation between the requirements from the engineers, the relationship of the requirements of the engineer team compared to the marketing team requirements, and finally the direction of improvement from the engineer team's requirements.
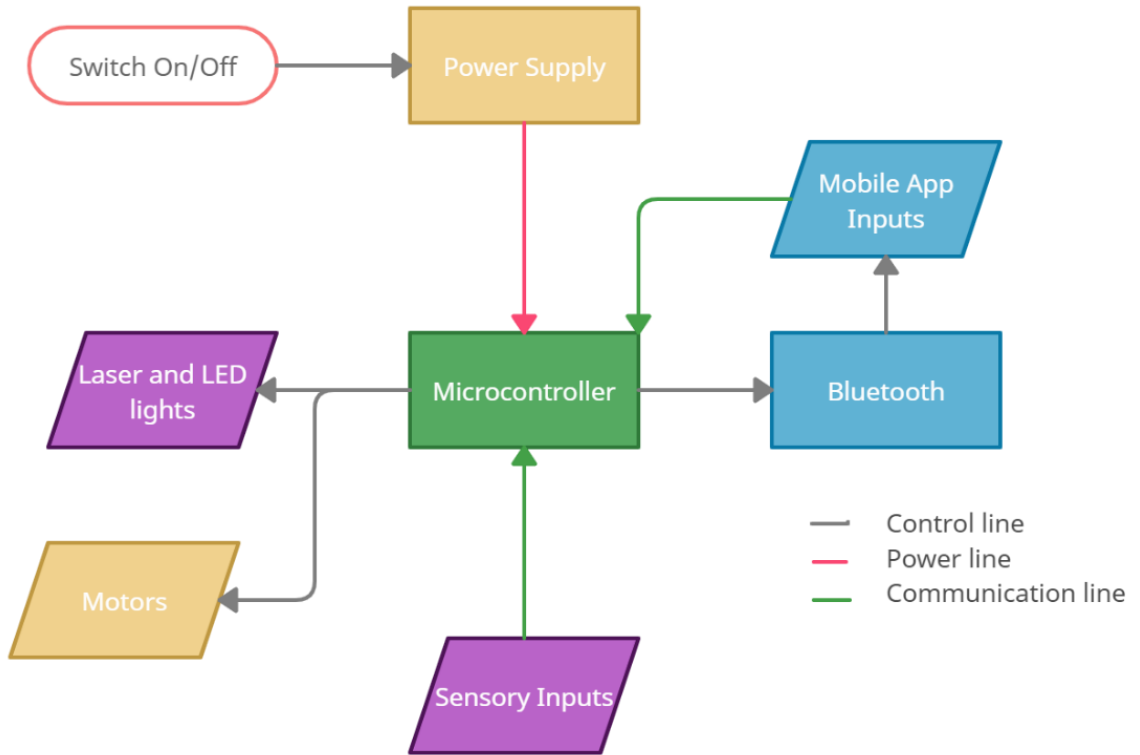
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Column #	1	2	3	4	5	6
Direction of Improvement	▲	◇	◇	▲	◇	◇
Functional Requirements	Weight	Dimensions	Laser Range	Power Output	Cost	Mobility Range

Row #	Weight Chart	Relative Weight	Customer Importance	Maximum Relationship	Customer Requirements (Explicit and Implicit)	Weight	Dimensions	Laser Range	Power Output	Cost	Mobility Range
1	▮▮▮▮	22%	4	9	Durable	●	●			○	
2	▮▮▮▮	22%	4	3	Affordable / Low Cost	○				▽	
3	▮▮	11%	2	3	Easy Application UI				○	▽	
4	▮	6%	1	9	Rechargeable / Battery Life	○			●	○	
5	▮▮▮▮▮	28%	5	9	Fun for cats	○	●	○			●
6	▮▮	11%	2	9	Small Form	●	●				●
					Target	< 10 lbs	< 1.5 ft (length)	> 3 ft.	> 10 Watt (hours)	<=$100	360 degrees

Correlations		Relationships		Direction of Improvement	
Positive	+	Strong	●	Maximize	▲
Negative	–	Moderate	○	Target	◇
No Correlation		Weak	▽	Minimize	▼

Block Diagrams

Hardware Block Diagram

Switch On/Off

Power Supply

Mobile App Inputs

Laser and LED lights

Microcontroller

Bluetooth

Motors

Sensory Inputs

— Control line
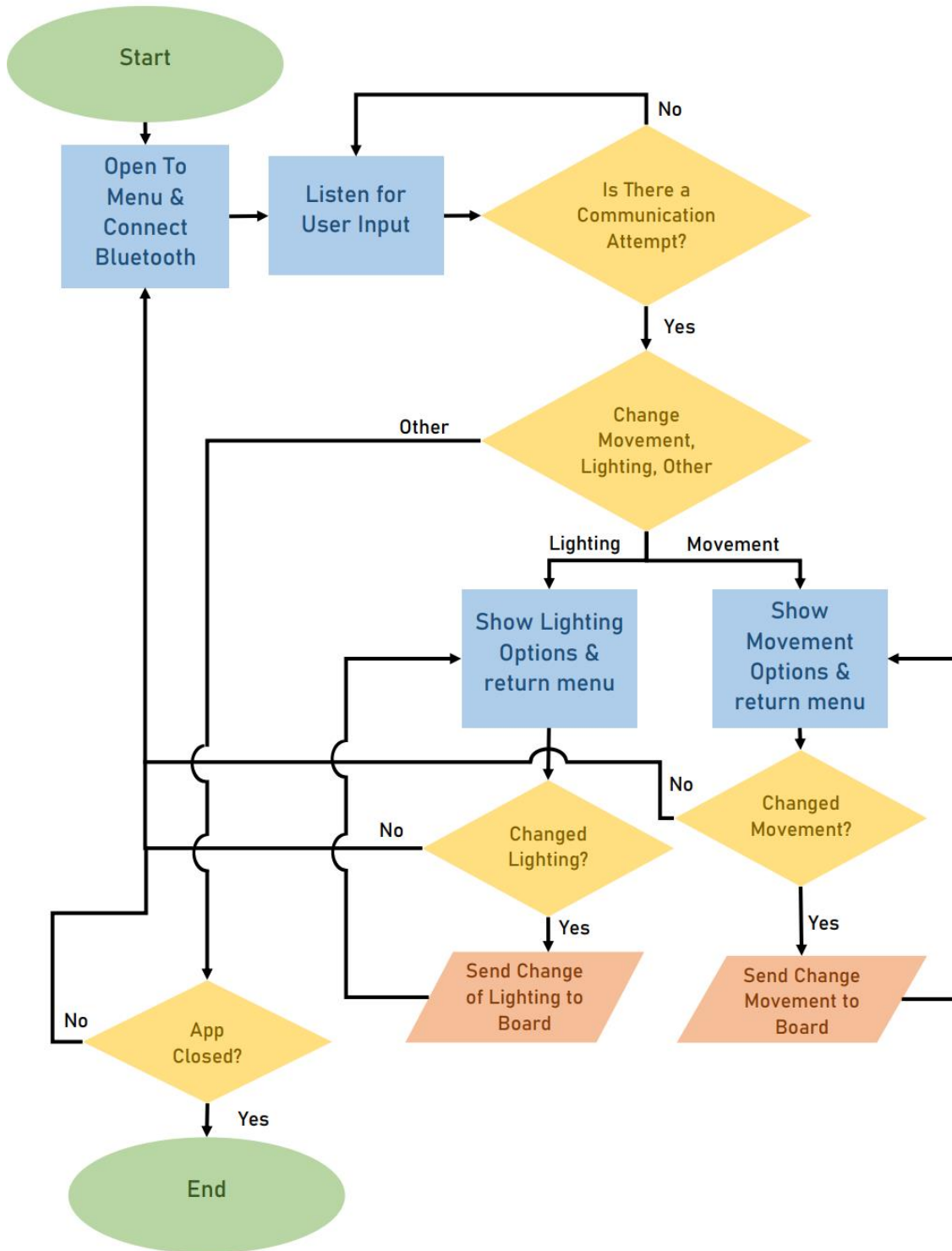— Power line
— Communication line

Elizabeth Vargas

Vu Nguyen

Aliza Grabowski

Joseph Lopez

Software Logic Flowchart

Project Budget and Financing

As our project is currently in the design stage, costs estimates are based on web searches and store pricing. We expect that our total cost estimate will be changing throughout the design process. Our estimates are rounded up to the nearest dollar for convenience.

Initial cost estimates suggest that our project can be built for about $500. Group members plan to finance the project and to each contribute one-fourth of the cost.

Part	Supplier	Price Per Unit	Units	Qty	Total Cost
Toy Covering					
Thread (Heavy Duty)	JoAnn Fabrics	$5	spool	1	$5
Outdoor Fabric	JoAnn Fabrics	$30	yard	.3	$10
1" Utility Cord	JoAnn Fabrics	$3	yard	1	$3
Fill	JoAnn Fabrics	$20	bag	1	$20
Seamstress	G-MA	$10	hour	2	$20
Catnip	Pet Supermarket	$6	pkg	1	$6
Electrical Circuitry					
Circuit Board	TBD	$50	board	2	$100
Wires	TBD	$15	set	1	$16
Battery	TBD	$25	set	1	$25
Battery Holder	TBD	$3	case	1	$3
Mechanical Parts					
Hinge	TBD	$15	hinge	1	$15
Shaking mechanism	TBD	$40	part	1	$40
Chassis	TBD	$10	case	1	$10
Servo Motors	Adafruit	$12	motor	2	$24
Misc. Components					
System Control(s)	TBD	$25	controller	2	$50
LED / Laser	TBD	$30	strip/laser	1	$30
Speaker	TBD	$10	part	4	$10
Blue Tooth	TBD	$12	part	1	$12
Expandable Components					
Camera	TBD	$30	part	1	$30
Total Cost					**$ 429**

Project Milestones for Senior Design I & II

Senior Design I		
Dates	**Task Description**	**Status**
Aug 24 - 26	Group Organization	Complete
Aug 24 - Sept 8	Project Selection	Complete
Sep. 10	Divide and Conquer (V1) - 10 page	in progress
Sept 8 - Dec 11	Technology Investigation & Design	in progress
Oct 1	Divide and Conquer (V2)	
Nov 5	60 pg Draft Senior Design I Documentation	
Nov 19	100 page SD I Report Submission	
Dec 7	Final Document Due	
Senior Design II		
Dates	**Task Description**	**Status**
Jan 10	Build Prototype	
TBD	Testing & Redesign	
TBD	Peer Presentation	
TBD	Finalize Prototype	
TBD	Final Report	
TBD	Final Presentation	

Decision Matrix

Each category has a rating out of 5, where 1 is the worst and 5 is the best. Each feature belongs to one of the following sub-categories: Primary Feature (P), Motor/Mobility (M), Application (A), Wireless Connection (W), Skin/Shape Prototype (S), and Others (O).

Features	Cost	Ease of Use	Durability	Marketability	Total
Laser Pointer (P)	3	3	3	4	13
LED Lighting Effects (P)	4	4	3	3	14
Catnip pouch shaker (P)	3	4	2	3	12
Hinge tail movement (P)	2	2	2	4	10
Non-Mobile (M)	5	5	5	2	17
Mobile (M)	2	3	3	4	12
Color control (A)	5	5	5	3	18
Tail movement (A)	4	4	5	5	18
Video to owner (A)	4	4	4	4	16
Light pattern signals (A)	5	5	5	3	18
Toy mobility (A)	3	3	4	5	15
Blue-Tooth (W)	4	4	4	3	15
Wi-fi (W)	2	4	5	5	16
Lizard (S)	3	4	3	4	14
Squirrel (S)	3	4	3	4	14
Chassis (S)	2	3	3	5	13
Glitter fabric (S)	2	5	4	4	15
Sensor (O)	4	4	2	5	15
Speaker (O)	2	5	3	3	13
Bell (O)	5	5	4	1	15
Camera (O)	1	3	3	5	12

Sources

1.

https://petpedia.co/cat-statistics/#:~:text=The%20exact%20number%20is%20difficult%20to%20determine%2C%20but,cats%20around%20the%20globe%20are%20kept%20as%20pets

2.
https://en.wikipedia.org/wiki/Cats_in_the_United_States#:~:text=The%20domestic%20cat%2C%20Felis%20catus%20or%20F.%20silvestris,percent%20of%20owned%20cats%20are%20spayed%20or%20neutered

3.
https://www.thefreedictionary.com/squirrely