

Matthew Unger  
resume & portfolio

# Matthew Unger

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## Education

### Milwaukee Institute of Art and Design (2014 - 2017)

- Bachelors of Fine Arts in Industrial Design

-3.5 Average GPA

### William Rainey Harper College (2011-2014)

- Associates in Science

- Associates in Arts

- 3.5 GPA Average

-Volunteered setting up gallery space

## Experience

### Marquette University HEIR Lab Intern (April 2015 - March 2017)

- Industrial Design Consultant / Intern

-Work with design partner researching, need finding, and conceptualizing a robot prototype.

-Developed CADD model housing with multiple internal components

-Learning about Raspberry Pi's and Human computer interaction (HCI)

### MIAD Information Technology (2015-Present)

Technology Assistant - Information Technology(2015 - Present)

Provided technical support for customers on all operating systems

-Monitored / maintained service desk queue, and developed strong customer service skills

-Provided support for mobile devices, tablets, and software applications

### MIAD Woodworker (June 2014 - August 2015)

-Used various woodworking machinery to craft tables, desks, and cabinets

## Acheivements

-Accepted paper/workshop in 2017 HRI conference @ Vienna, Austria

-**2016 Masterlock Sponsored project** 2nd Place

- **2015 Fiskars Sponsored project** 2nd Place

**Teaching assistant** teaching Solidworks and Autodesk Fusion 360

### Volunteering:

-**Urban Ecology Center** (Early 2016 - Mid 2016)

-**Community Service For Roselle Police Explorers Volunteer** (2009-2011)

-**Volunteer for Friendship Village elderly home** (2009-2010)

## Skills

### Software:

-Solidworks

-Adobe Illustrator, Photoshop and Indesign

-Microsoft Office

-Microsoft Windows

-Mac OSX

-Android

### Technology:

-8 years P.C. Desktop building experience

-3D Printing (hardware and software)

-Raspberry Pi/GPiO

-HCI & HRI design (Internship)

### Hands On:

-5 years woodworking and modeling experience

-Computer repair

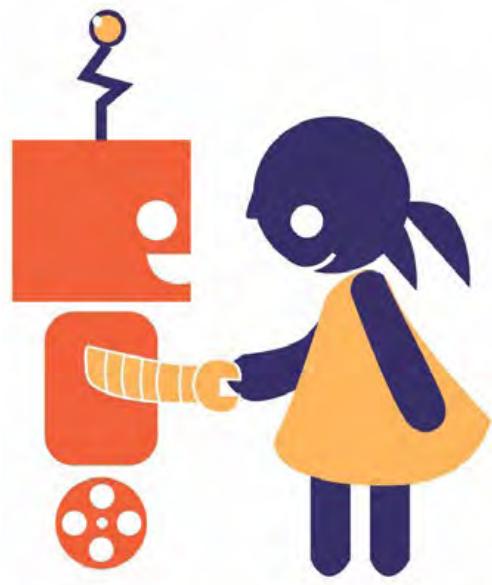
### Currently Learning:

Adobe After Effects

-Proto.io/Axure

-HTML & CSS





Designing a Low Cost STEM  
Education Robot

## Wouldn't It Be Nice If A Robot...

- Could carry things for you
- Catch your mistakes before you can
- **Act as a tutor / companion**
- Enhance virtual experience / Be a "camera" robot, and implement virtual reality with 360 video
- Can mesh UX/UI/Hardware in an effective way
- Can catch the user's attention and vice versa
- Was as social as its user's age group
- Recognized its user based on past experiences
- Had a body that was modular with any device
- Had expressive, yet abstract graphics to display emotion
- Helped kids with homework (Homework Helper)
- A robot could engage students with creative freedom / healthy competition
- **Do one thing well**

## Questions : 3/23

- How much is this robot going to be dependent on ipad/iphone etc
- Can we make it smarter ? Socially?
- Should we consider 360 video ?
- How customizable should the robot be?
- How can we make it so that it stands as an asset to the classroom, but does not replace the tutor/teacher?
- What grade level / Who's the user?
- How can we make the user a hero?

# Empathy Study

## Hear

- Brother took course: assumption that she will be fine
- Went over test problems, used pen and paper
- Game centered activity
- Cross Cultural
- Teaching structured units

## Think

- Needed help and went in to get it
- Thought about why she was doing what she did : deeper understanding behind her problem solving methodology
- Relationship with kids was important
- Adjusting to multiple personalities
- Children had trouble memorizing things

## See

- Realization that other students were attending tutoring sessions / struggling
- Flashcards were helpful
- Relating to how some things were difficult.
- Field Trip Friday
- Students like teaching other students
- Students liked using Scratch Programming
- Drawing pictures for understanding
- Audio Listening

## Feel

- Feelings of insecurity, shame, pressure because she was not as good at chemistry
- Reassurance by other students and teachers
- Tutoring has negative connotations
- Feeling frustrated led to reluctance to asking for help.
- Felt more confident about working and asking for help
- Sad when students didn't know the answers / realizing that parents could have helped more
- Liked being looked up to
- Created a "safe space"
- Bad behavior was brought to school
- Enjoying the "Aha!" moments

# Market Inspiration

"Kirrobo"



"CodYbot"



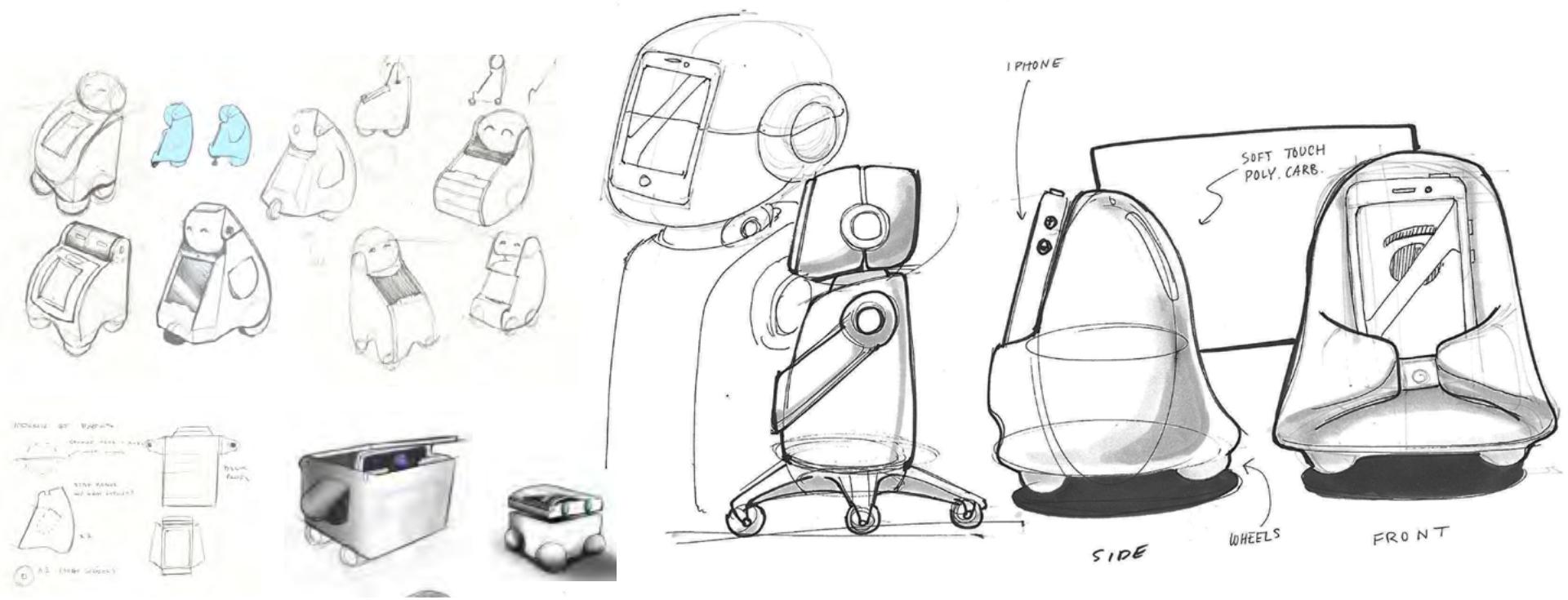
"JIBO"



"YUMI" - Omate



# Ideations



# Movements



# Model refinement



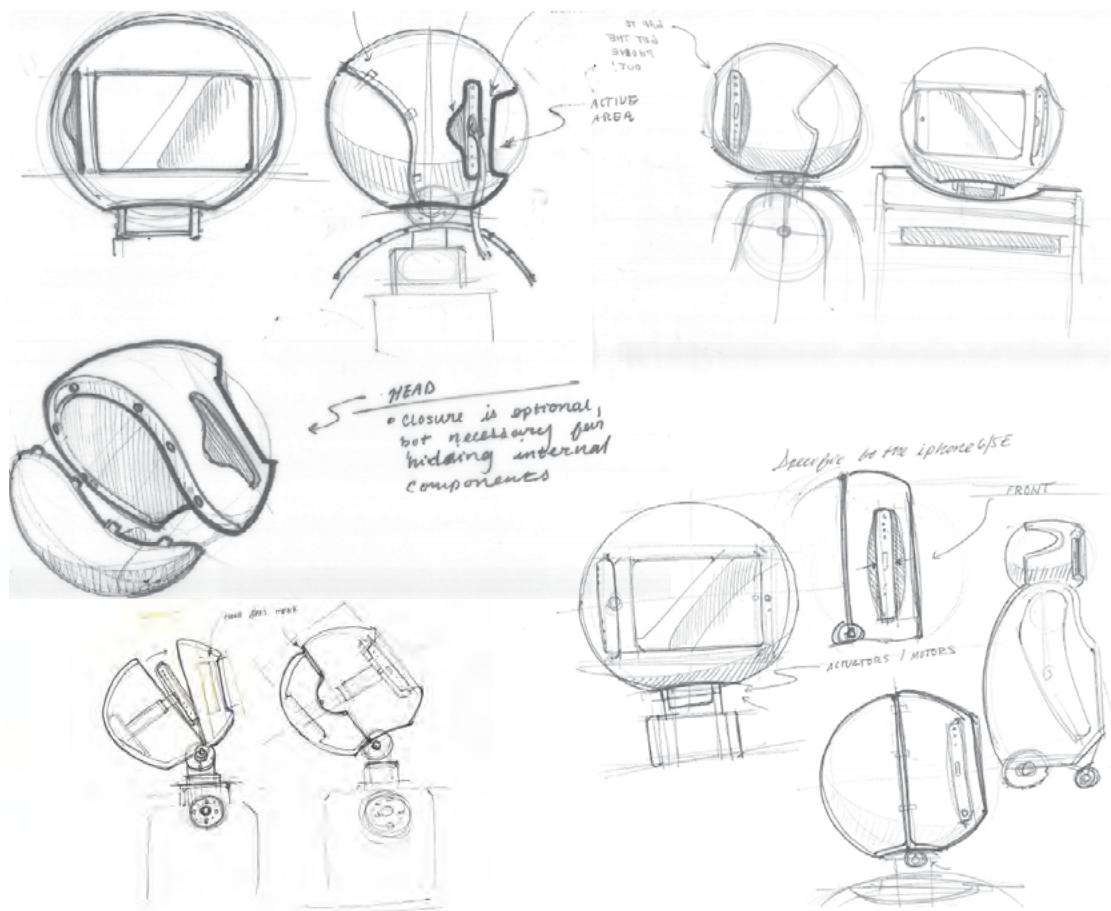
Back shelf



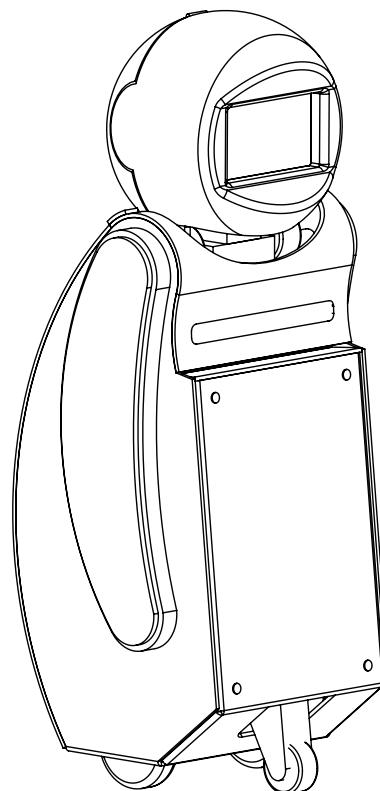
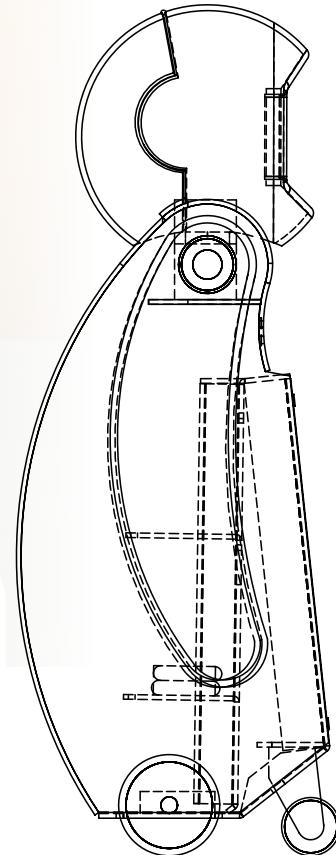
Velcro IPad



Exploded View



# 1/4 Scale Mockup



Awake



Happy/excited



Angry



Sleeping



Confused/Surprised



Sad

# Internal Components



iWatch



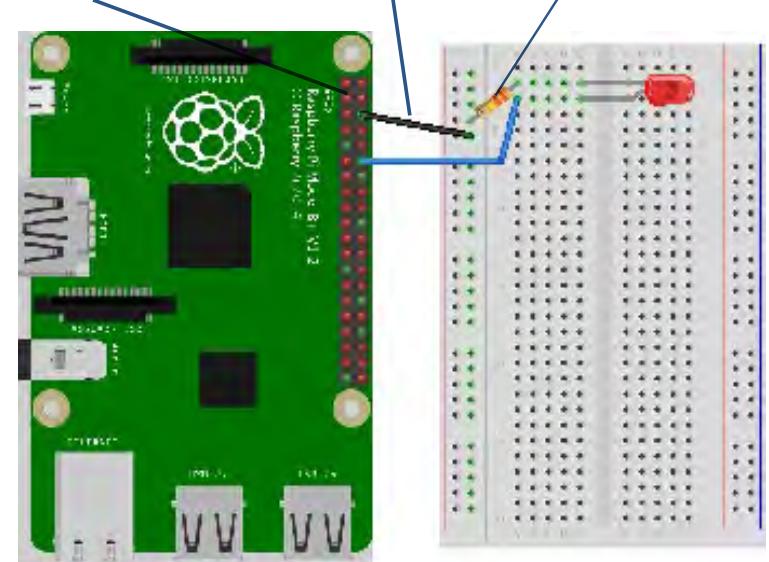
Raspberry Pi 3



Lithium Ion Battery



Servo



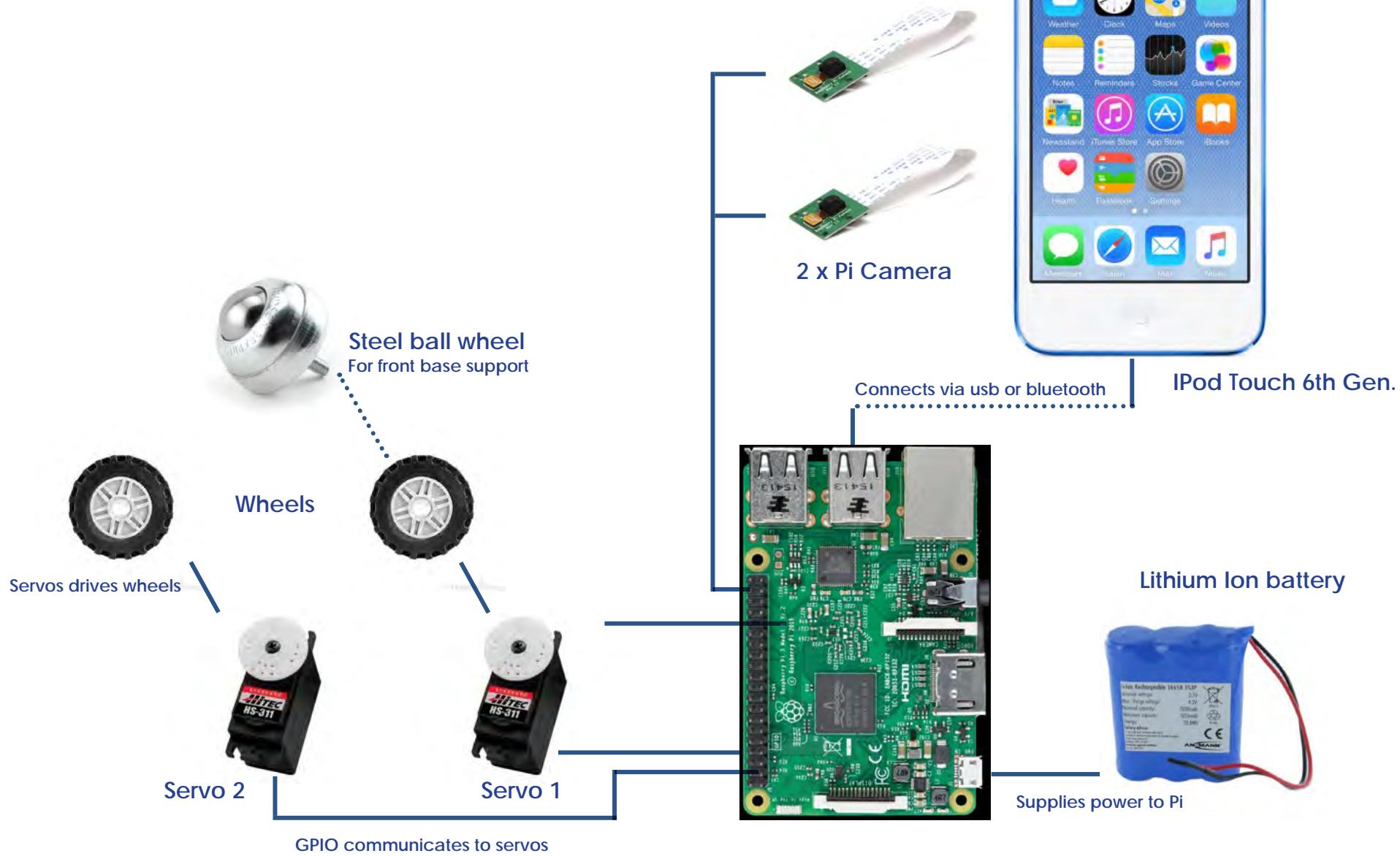
Raspberry Pi

Breadboard

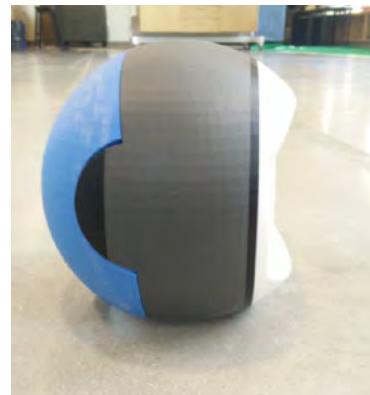
```
import RPi.GPIO as GPIO ## Import GPIO library  
GPIO.setmode(GPIO.BOARD) ## Use board pin numbering  
GPIO.setup(7, GPIO.OUT) ## Setup GPIO Pin 7 to OUT  
GPIO.output(7,True) ## Turn on GPIO pin 7
```

Python code to make LED light up

# Componet Layout



# Large ProtoTpye



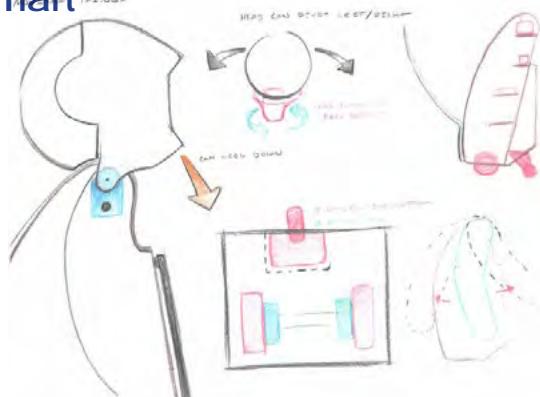
# Small Prototype



iPad display mounts to chest

Head houses iPhone /smart phone

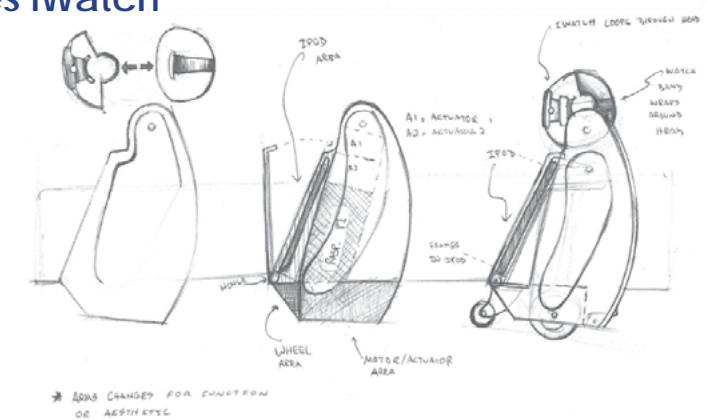
~5 servos



Front flips open for Ipad touch

Head houses iWatch

~3 Servos



# User experiences

## PRO'S

- Cute and friendly looking
- Reminiscent of "EVA" from Walle or "Big Hero Six"
- Likes colors in head
- Smaller robot perceived as more for kids
- Big Robot is good for people with low vision
- Smaller = More

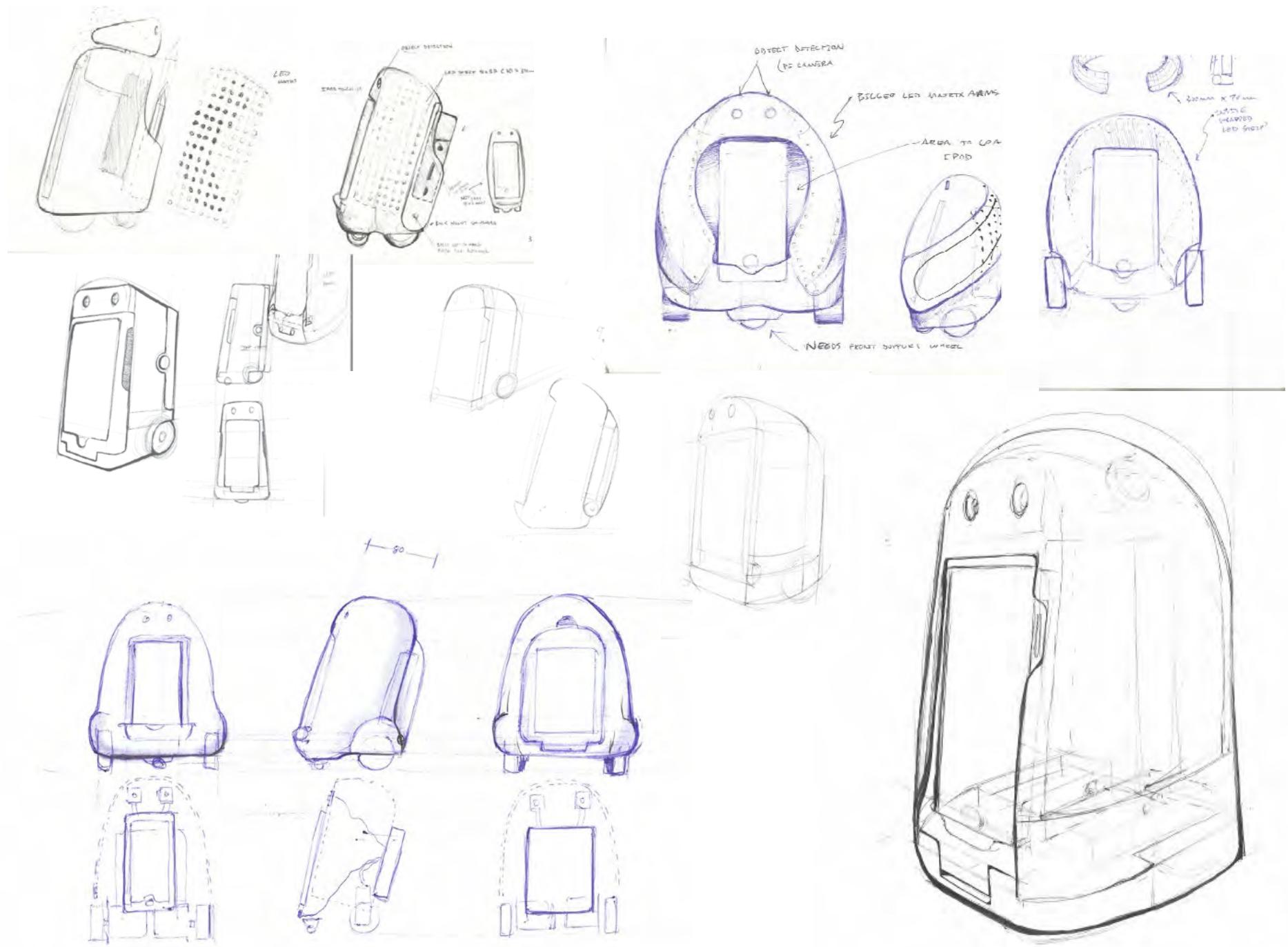
## CON's

- Big robot is easy to tip over.
  - Confused about large object detection slot
  - Arms do not function
  - Tempted to tamper with robot
- Did not like material, makes form look bulky.

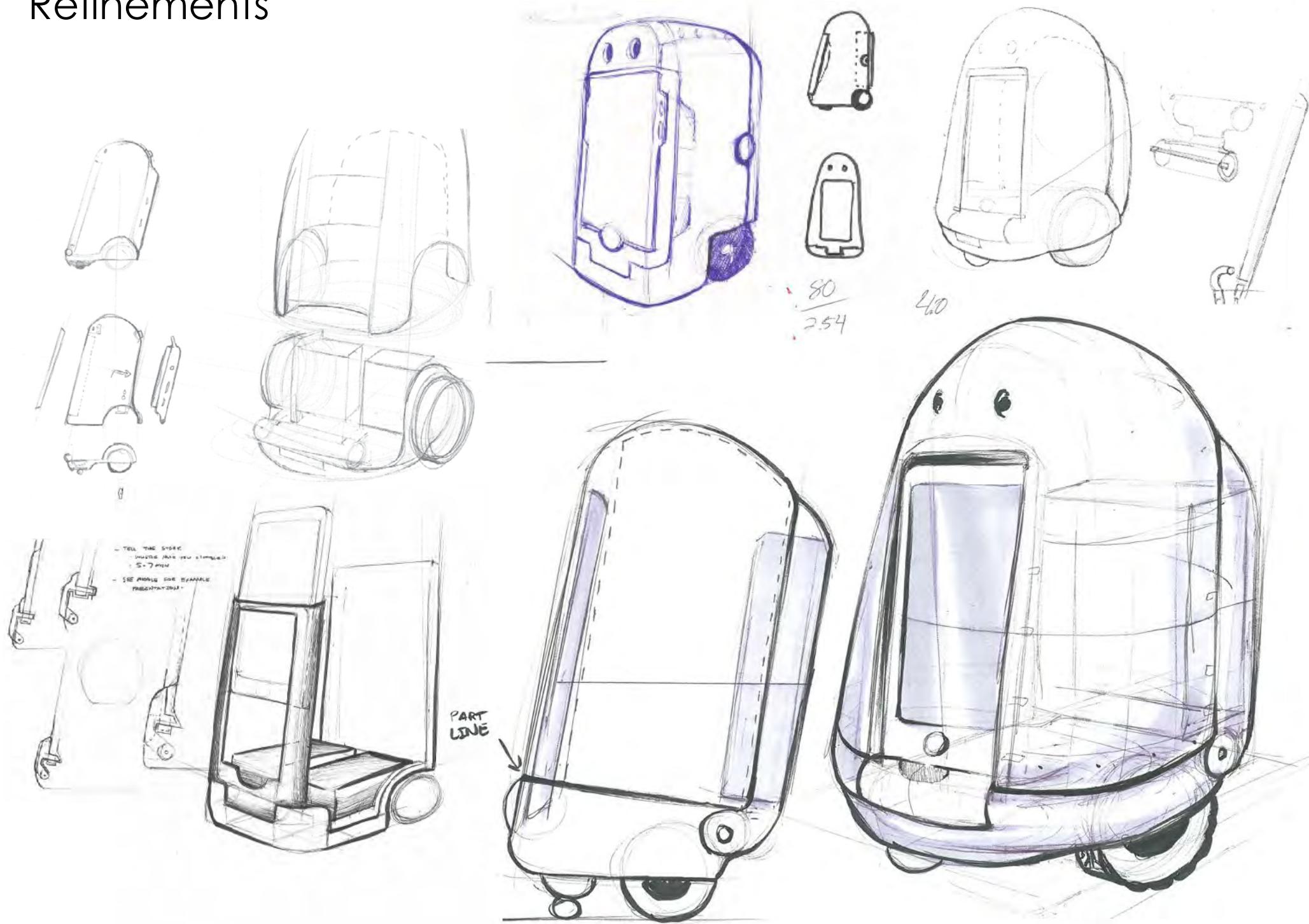


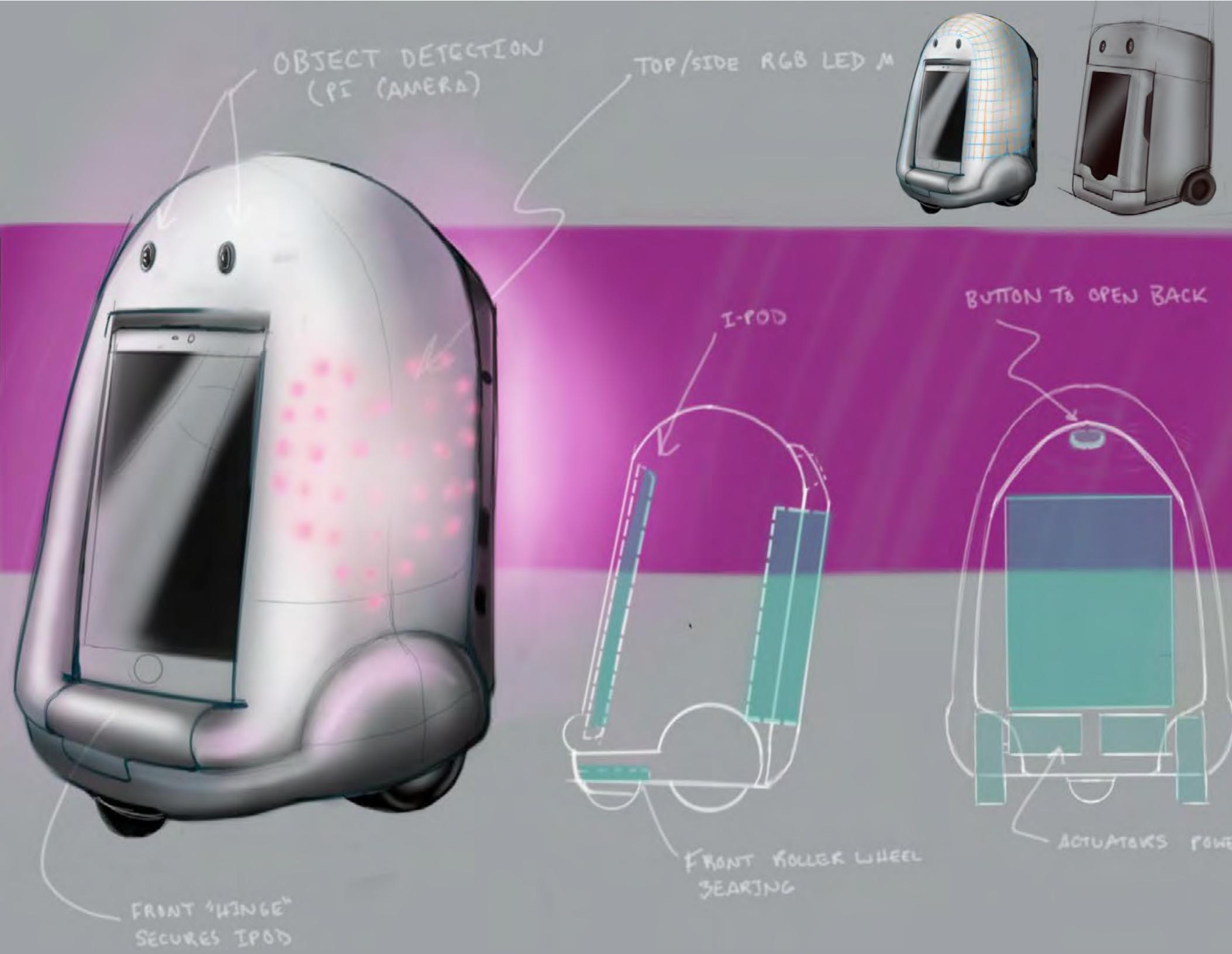
Take-away: Kids want a fun element and need to immediately see it initially. Want something more like a toy. What if kids do not have watch or iPad? Robot not moving as much is a let down.

## More ideation



# Refinements





# LOW-COST SOCIAL ROBOT FOR TEACHING CHILDREN STEM

Dr. Andrew B. Williams, John C. Williams, Tiffany Do, Matthew Unger



## RESEARCH

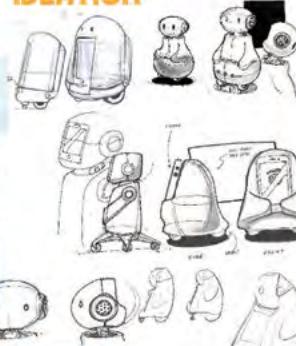
### Empathy Study



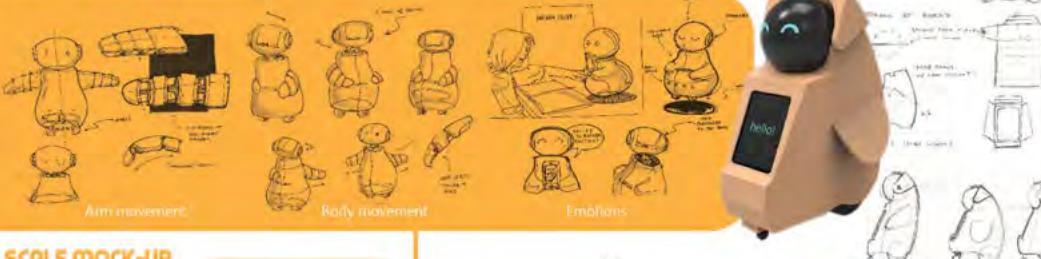
### Market Research / Inspiration



## IDEATION



## FORM AND MOVEMENT



### 1/4 SCALE MOCK-UP



A scaled down model was built out of foam core and cardboard to better understand the robot's form and the components inside. Building the scaled model for the first time helped visualize the robot 2D layout.

### INSIDE COMPONENTS



FINAL PROTOTYPE

## Human-Centered Design of a Low-Cost Social Robot for Teaching Children STEM

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## ABSTRACT

This paper describes our ongoing efforts to use a human-centered design methodology to create a low-cost social robot to help children learn science, technology, engineering, and mathematics (STEM). In this project, we interviewed tutors and students to discover learning needs and preferences, sketched potential robot designs, created storyboards of human-robot interactions, developed prototypes, and received user feedback. Our proposed human-centered design approach for social robot design seeks to develop emotion and conversation interfaces suitable for interactions with children.

## KEYWORDS

robotics, child-robot interaction, learning, education, STEM

### ACM Reference format:

Andrew B. Williams, Tiffany Do, Matthew Unger, and John C. Williams. 2017. Human-Centered Design of a Low-Cost Social Robot for Teaching Children STEM. In *Proceedings of HRI Workshop Child-Robot Interaction, Vienna, Austria, March 2017* (HRI'17) 3 pages.  
DOI: 10.1145/nnnnnnnn.nnnnnnnn

## 1 INTRODUCTION

There is a learning gap that exists for children, including underrepresented populations and girls, in science, technology, engineering, and mathematics (STEM), and robotics. Data shows that children attending schools in economically under-served districts have less access to robotics. Although in the U.S. there are national and regional K-12 robotics programs, few, if any, address education educating STEM students in co-robotics, or collaborative robotics, design and programming. Although there are existing robotics programs for K-12 students, there are few, if any, that provide low-cost, affordable social robots that can interact to help children learn. The focus of this project is to design and develop a commercially viable,

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HRI'17, Vienna, Austria

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DOI: 10.1145/nnnnnnnn.nnnnnnnn

low cost co-robots to help students learn STEM. Our project builds on previous work in developing robots with emotion and conversation interfaces [3] [5]. Our goal is to provide this low-cost social robot to be used in conjunction with our culturally responsive social robotics curriculum [6]. This paper describes the development process for designing robot interactions with children.

## 2 HUMAN-CENTERED DESIGN OF CHILD-INTERACTION ROBOTS

For a child-friendly robot designer using the human-centered design process, the designer begins by investigating the needs of the child users through interviews and observations [2] [1]. The designer uses these expert opinions and insights to determine the archetypal child user and frames the problem for further investigation. The design team uses this problem statement to begin ideation of solutions to the problem. For robot designers, sketching the potential robot and storyboarding interactions between the robot and the user provides the basis of a prototype [4].

## 3 NEEDFINDING

In needfinding, the designer conducts interviews and observations of the user to determine the pain points or opportunities to provide a gain of some sort. This section describes what we uncovered in our interviews. We started our user centered research by interviewing several students who were involved with tutoring—either tutoring others or being tutored themselves. During these interviews, we compiled empathy charts and particularly paid attention to contradictions, surprises, and tensions that each person felt during the traditional process of tutoring. This step is important in the design research phase, as it helped with framing the problem at hand. From our research we found that students who felt insecure about their own skill set in a specific subject was less likely to go to a tutor for help. There are also negative connotations that are linked with tutoring. However, the most important thing we concluded from our user interviews was that people all learn differently, and that people learn better when arts group-led exercises. Times where students were able to empathize with each other, showed us that learning in a group environment were more poignant experiences. From

HRI 2017 VIENNA·AUSTRIA





# Hunab Ku

An Ancient Maya timepiece  
showcasing the complexity of their  
writing and history.



# Ancient Maya Writings

## Diego de Landa

De los pueblos otros y mas cercanos a Saborio en su fundacion de uno se podian ver en el momento mencionado. Los quinientos diez leza y casas con el pais corriendo le con sus casasas uniendo las misiones. Se ha observado que con las bocas lo convivian ellos conviviendo a la apariencia de la fe. Lo vacante que nacido de si reca y en esto no faltaron personas que querian ellos de su convivencia. Ejemplo.  despues al cabo lo regalo la peste grande que quisieron sacar gente por la boca tierra o la madera de la peste ellos al principio con el gran calor de este invierno. Tambien lo convivian a personas de la otra y de la otra parte de la tierra y no practicaban mas cultos de los de sus padres antepasados. De los mas de la gente. Muchadas quisieron dejar no tener ellos la convivencia a personas de la otra parte de la tierra.

Siguense en ante. 

De los libros que aqui faltan carece de largos y tiempos otros mencionados de lo anterior para sacarlos y de los mismos y ya se han puesto modo de sacarlos y sacarlos oportunamente. La gente unica fui aprendida los ninos.



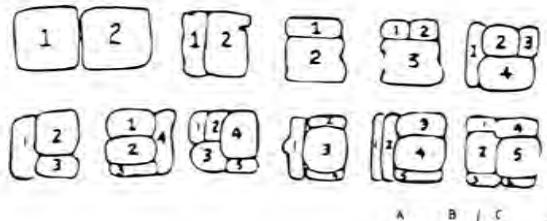
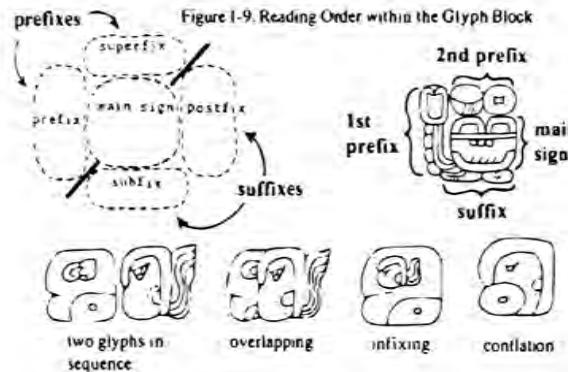
Copan relief



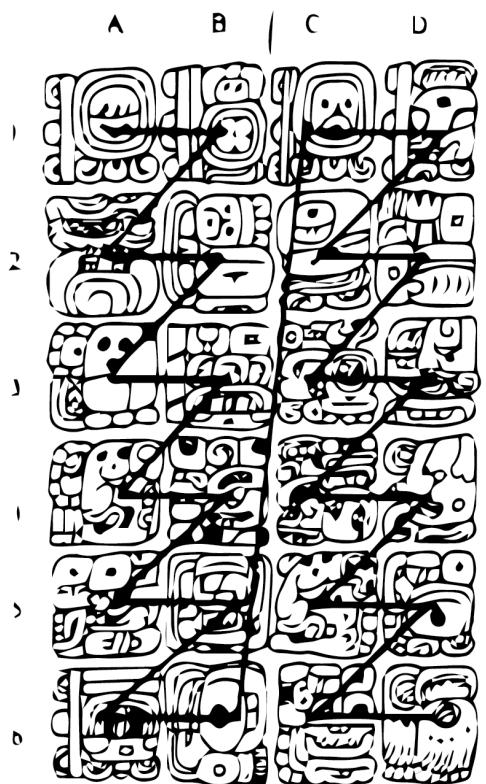
Stelae in Tikal

NO  
TOCAR  
NO  
CAMARAS

# How to read



	b	ch	ch'	h	k	k'	l	m	n	p	p'	s	t	t'	ts	ts'	w	x	y	vowels
a																				
e																				
i																				
o																				
u																				

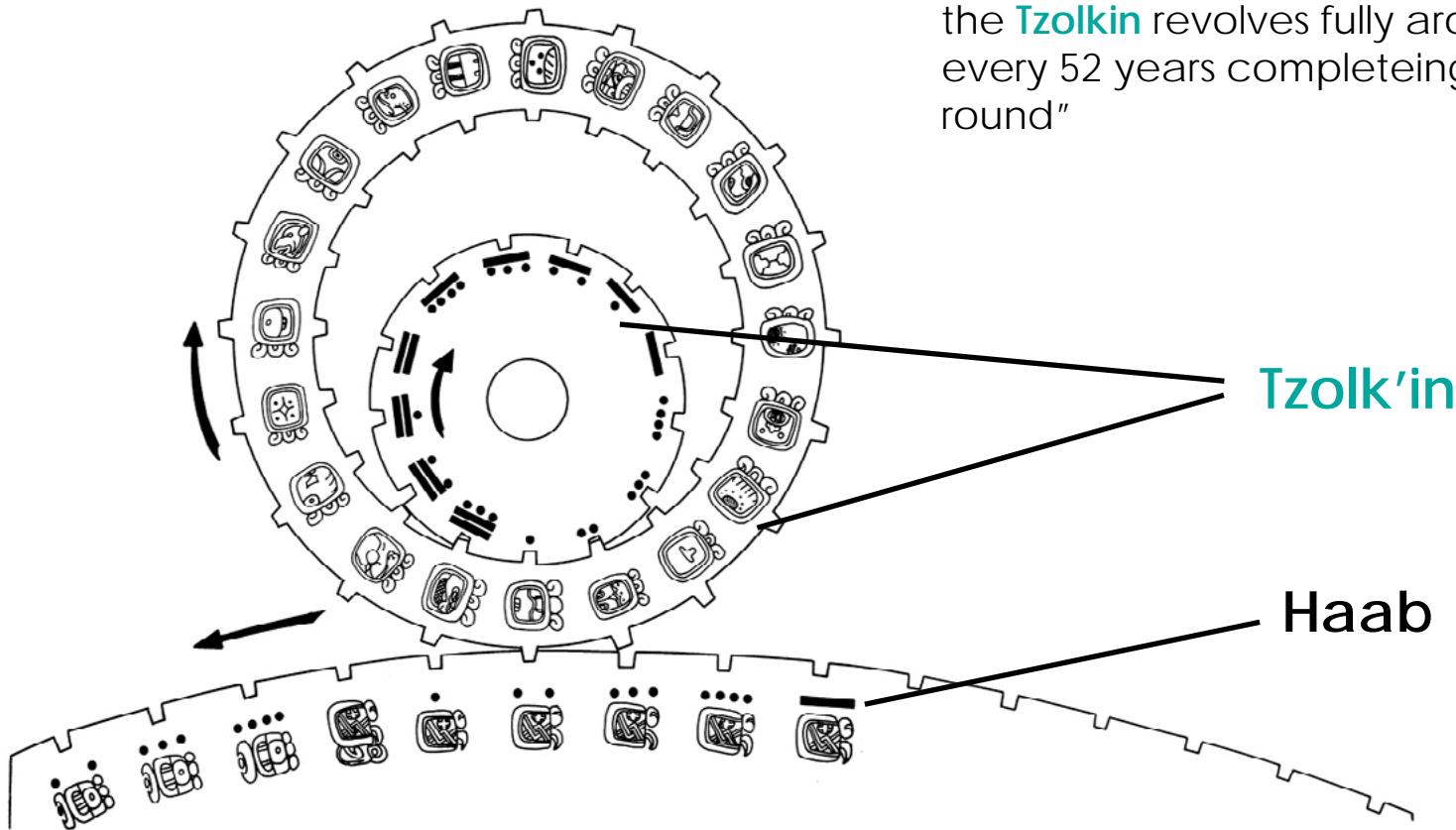


the ancient Mayans had **2** main calendars

## the **Tzolkin** and the **Haab**

know as the **sacred calendar** of the mayans. It is a **260 day** calendar. there are **20 "weeks"** that each have a distinct meaning. The days are numbered 1-13, however the days are not numbered in order.

know as the **solar calendar** of the mayans. it is a **365 day calendar** that was used for the tracking of seasons and cultivation. There are **18 months that each have 20 days**. There is also an added **5 days of "Bad luck"**to account for 365 days a year. The days are numbered in order.

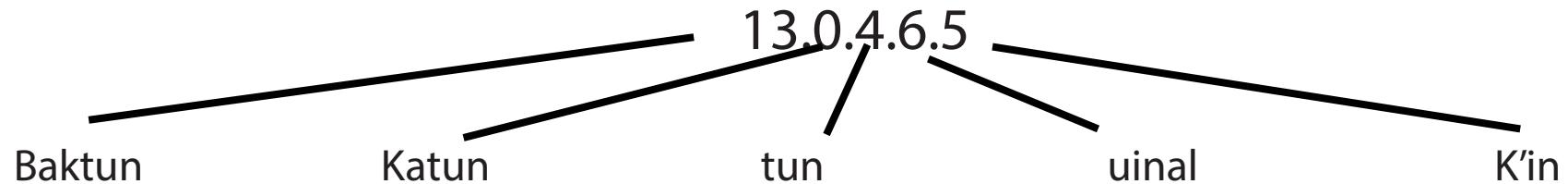


the **Tzolk'in** revolves fully around the **Haab** every 52 years completing the "calendar round"

# Long Count



0	1	2	3	4
	•	..	...	....
5	6	7	8	9
—	—	—	—	—
10	11	12	13	14
==	==	==	==	==
15	16	17	18	19
====	====	====	====	====



KIN= (1 day)

uinal= (1 uinal = 20 kin = 20 days)

tun= (1 tun = 18 uinal = 360 days = approx. 1 year)

katun= (1 katun = 20 tun = 7,200 days = approx. 20 years)

baktun= (1 baktun = 20 katun = 144,000 days = approx. 394 years)

13.0.4.56.5, 9 Chikchan, 2 Pop

is

April 4, 2017

# Haab symbology Row 1 symbols: Pop (Mat), Wo' (Black Conjunction), Sip (Red Conjunction), Sotz' (Bat), Sek (Death), Xul (Dog) Row 2 symbols: Yaxk'in (New Sun), Mol (Water), Ch'en (Black Storm), Yax (Green Storm), Sak' (White Storm), Keh (Red Storm) Row 3 symbols: Mak (Enclosed), K'ank'in (Yellow Sun), Muwan' (Owl), Pax (Planting Time), K'ayab (Turtle), Kumk'u (Granary) The Wayeb symbol is a large, stylized head or face with a wide, open mouth showing numerous small circular holes, resembling a mouth full of teeth or a ravenous appetite. It has large, bulbous nostrils and a prominent, rounded forehead. **Wayeb'** **Five unlucky days** (added to balance the year)

# Tzolk'in symbology



Imix'  
Waterlily,  
Crocodile



Ik'  
Wind, Breath,  
Life force



Ak'b'al  
Darkness,  
Night



K'an  
Net, Sacrifice



Chikchan  
Cosmological  
Snake



Kimi  
Death



Manik  
Deer



Lamat  
Venus, Star,  
Maize seed



Muluk  
Jade, water,  
offering



Ok  
Dog



Chuwen  
Howler  
monkey



Eb'  
Rain



B'en  
Green,  
young, seed



Ix  
Jaguar



Men  
Eagle



Kib'  
Wax



Kab'an  
Earth



Etz'nab'  
Flint



Kawak  
Rain Storm

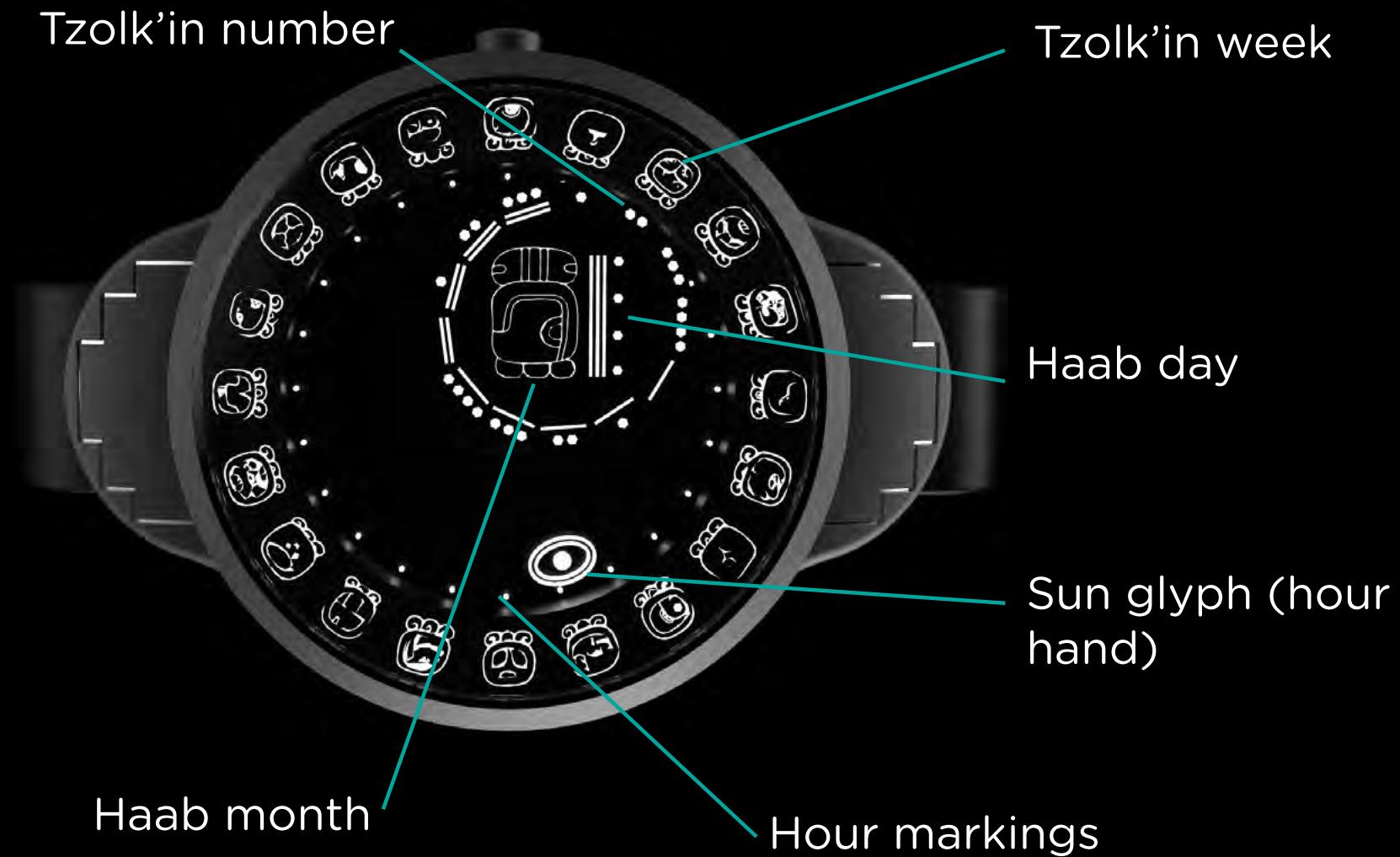


Ajaw  
Lord, ruler, sun

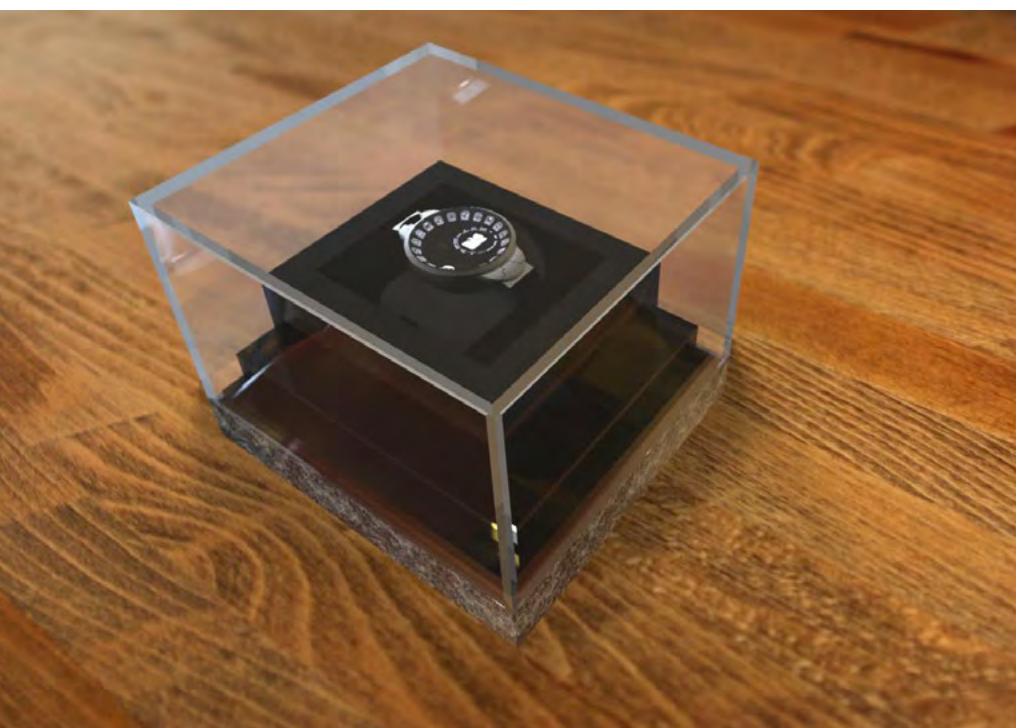


Chuwen

Howler Monkey



Hunab Ku



A close-up, angled view of the Fiskars SPIRA shape cutter. The device is primarily orange and white. The top lid is orange with a white circular base featuring the "FISKARS" logo. The main body is white with orange accents. On the side, there's a slot labeled "Flower" with a small flower icon above it. Two orange decorative elements resembling stylized flowers or leaves are attached to the side panel.

FISKARS®

# SPIRA

Next generation  
shape cutter for craft  
consuming

# Users

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**Yolanda**  
Age: 61

- custom paper cards
- uses stampin' up primarily
- likes the stamps so much that she uses all thier tools
- works on a card table
- the punches that push down on a table don't work well on her table, not sturdy enough



**Danielle**  
Age: 27

- DIY party decorations
- wall hangings, banners
- mostly uses scissors and printed out templates
- doesn't want to invest in tools because they are more for scrapbooking



**Katie**  
Age: 24

***"Die Cutting Machines are king"***

- Layering (this is huge). Scrapbooking is all about layers.
- Has been scrap booking for 8 years, got more serious when she got a die cutter machine
- no manual tools besides x-acto blades, straight cutters and a circle cutter.



# Testing

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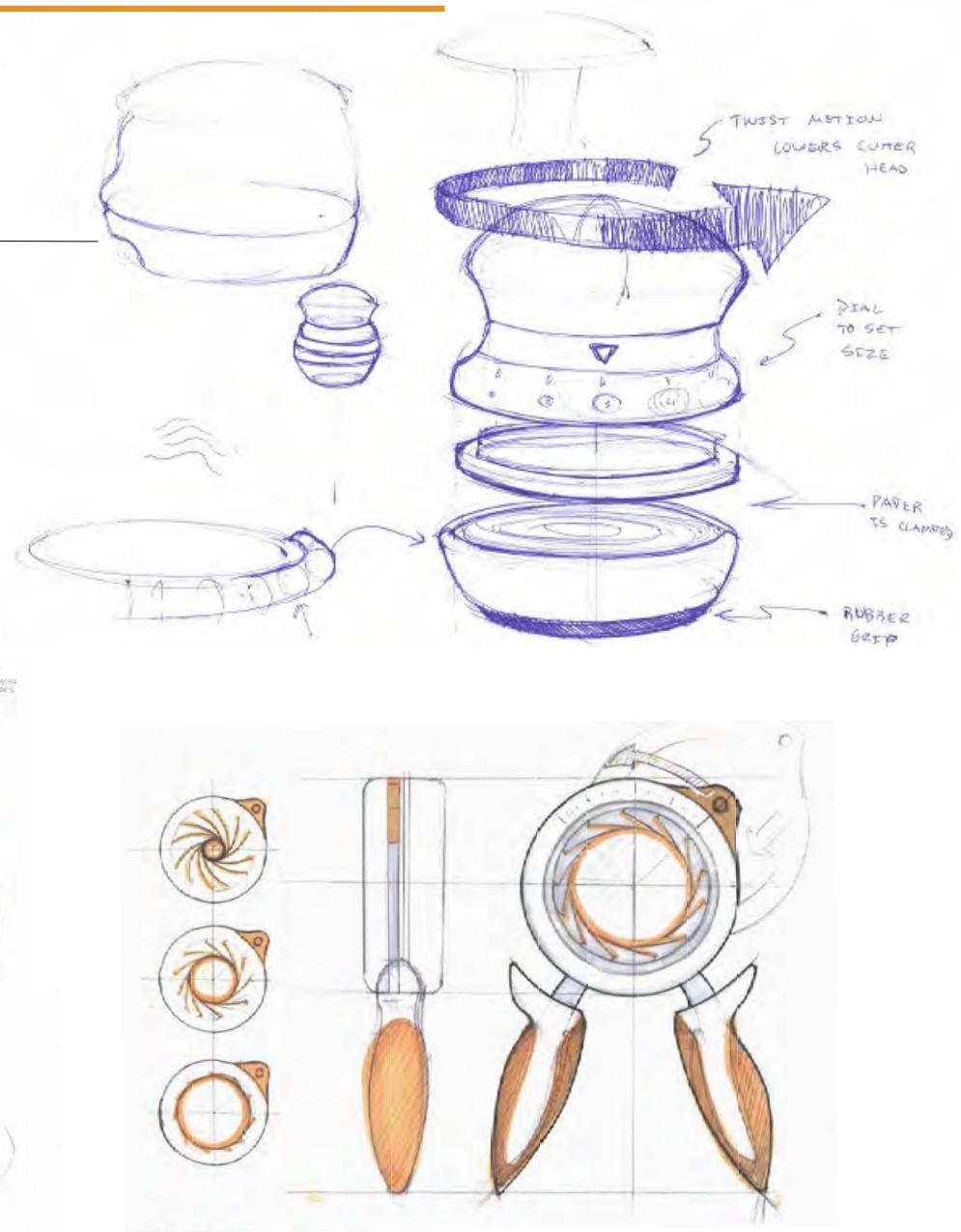
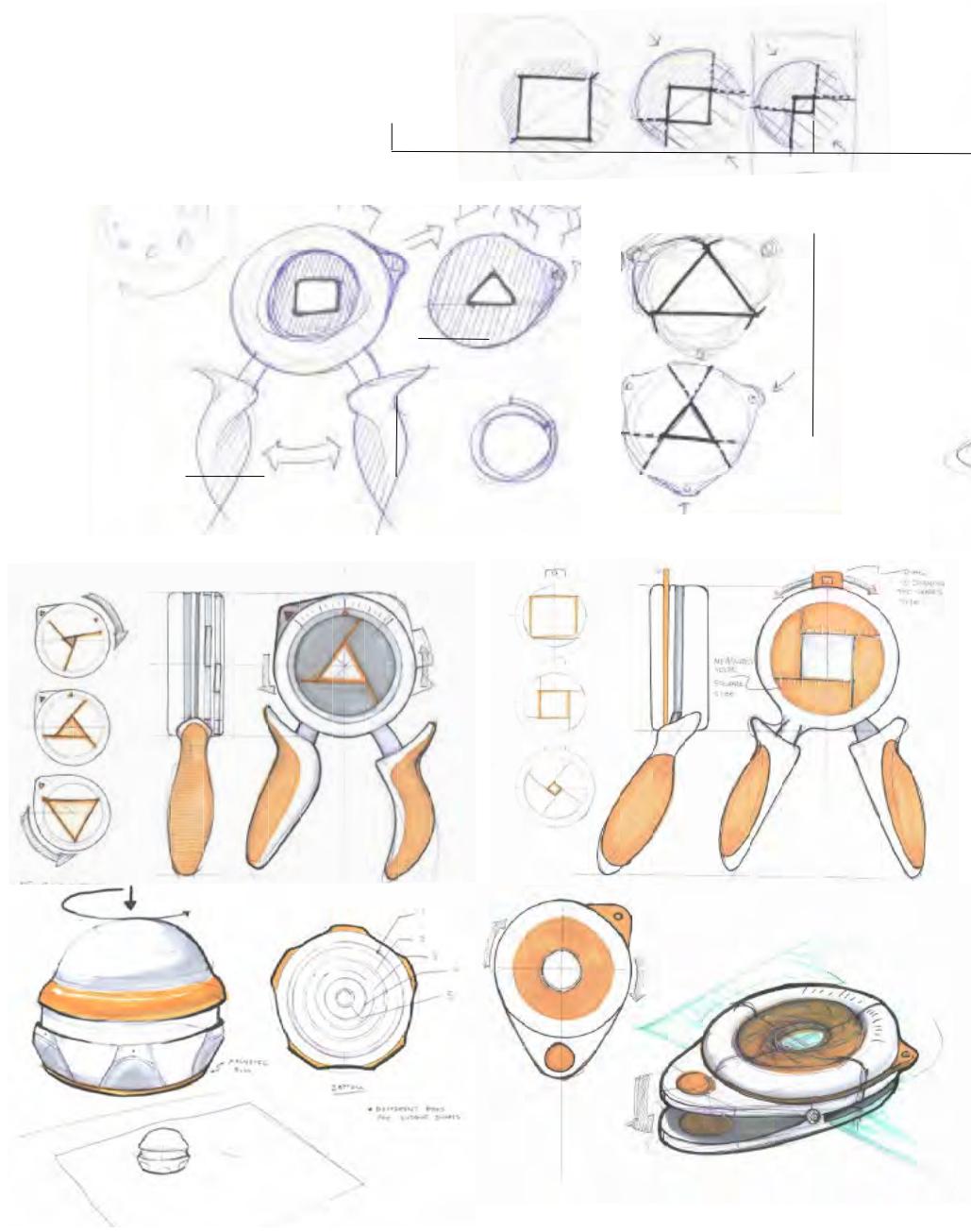


# Market Gap

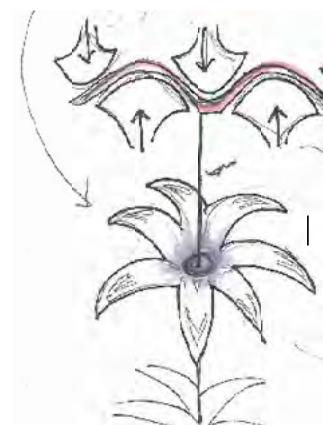
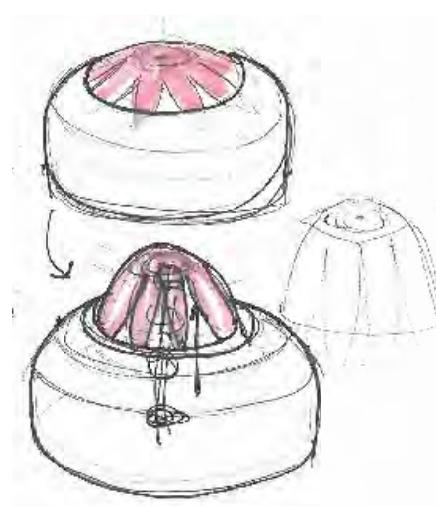
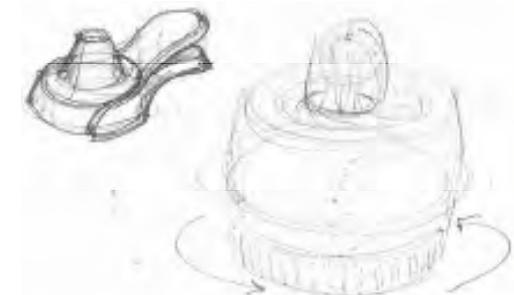
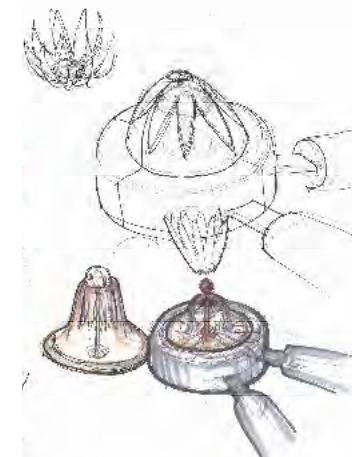
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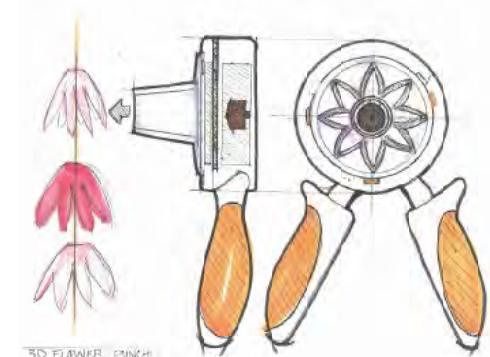
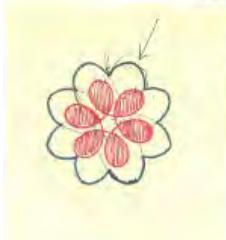
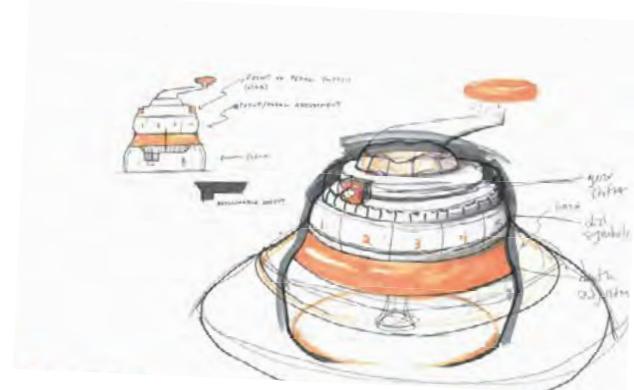
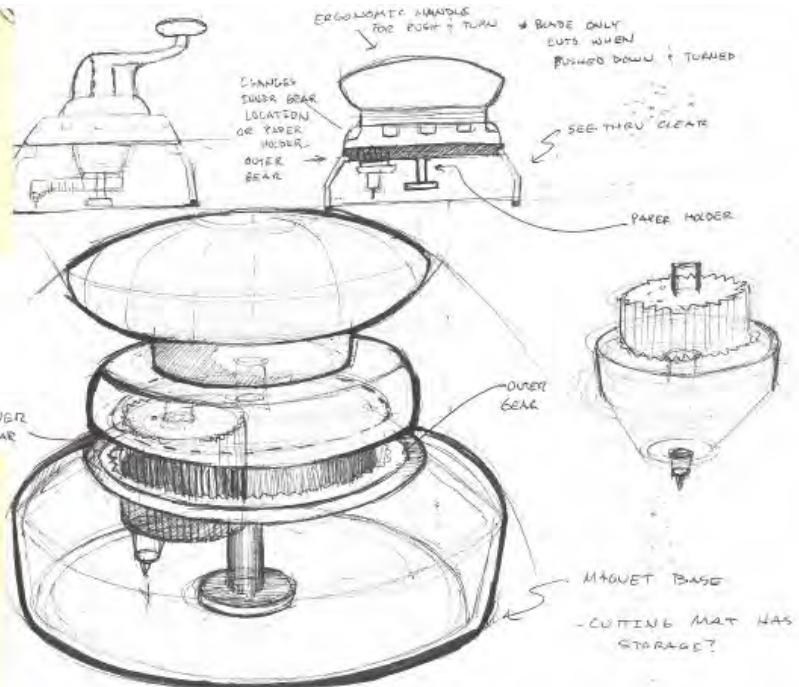
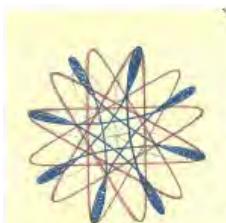
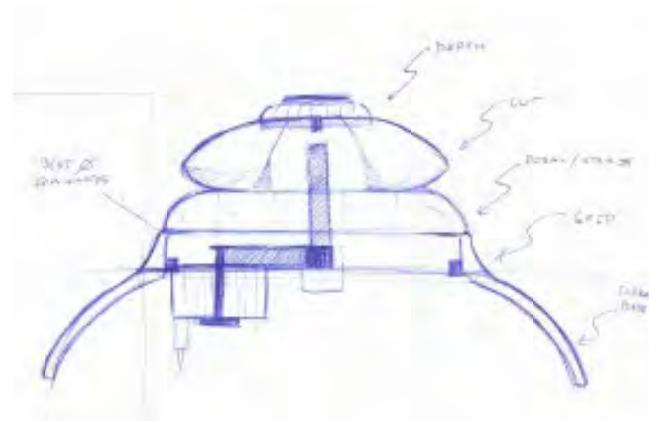
# Phase 1 Concepts



# Trends

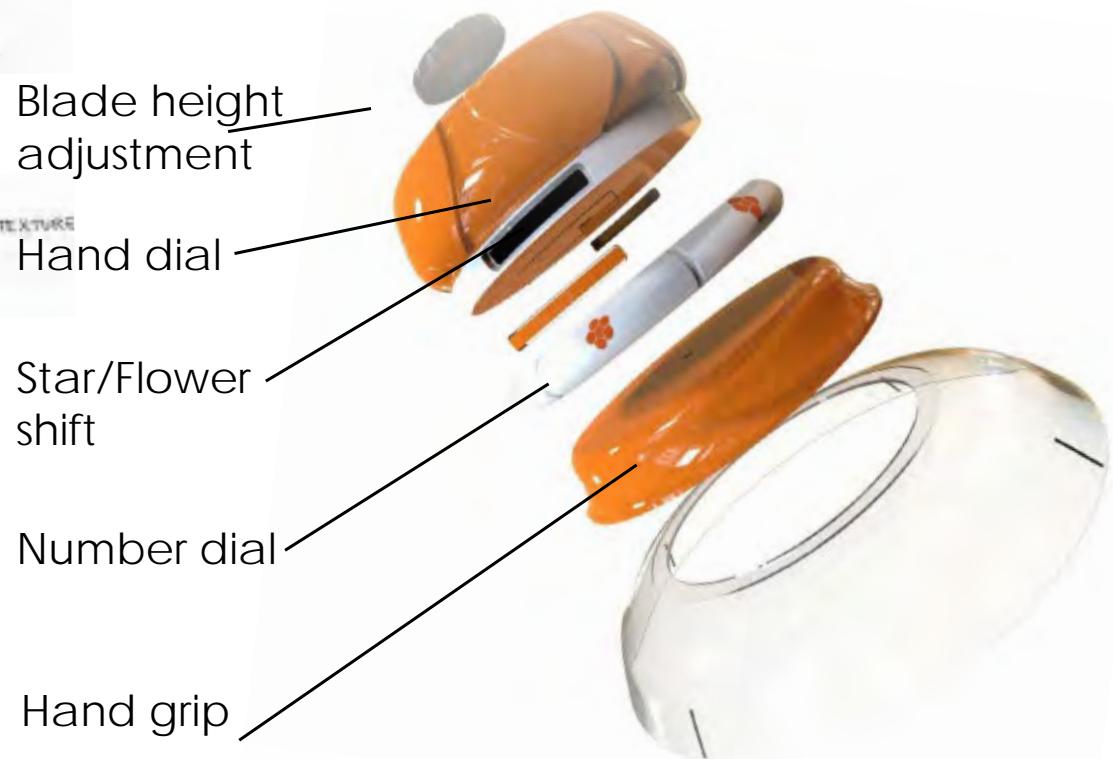
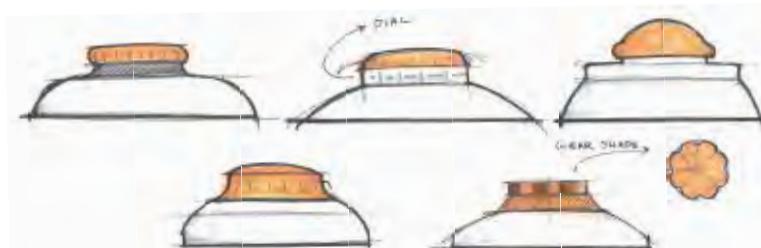
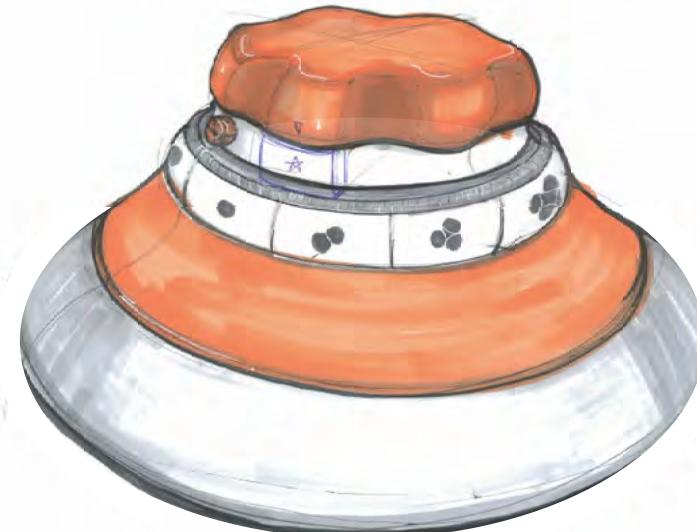
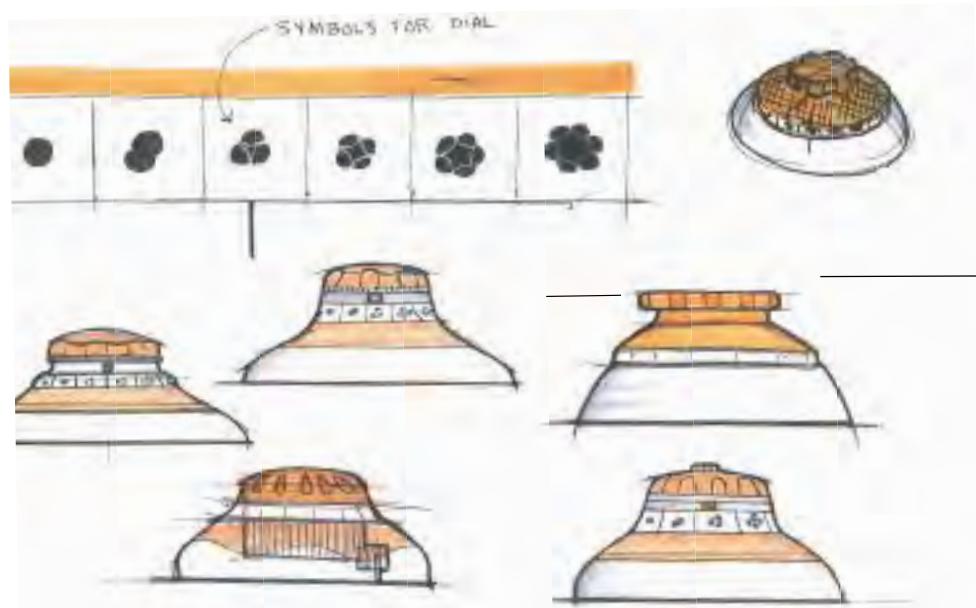


## Phase 2 Concepts



3D FLOWER PUNCH

## Variations and CAD



# Steps





A planter for beginning bonsai enthusiasts

# Every Plant Needs.

# Soil



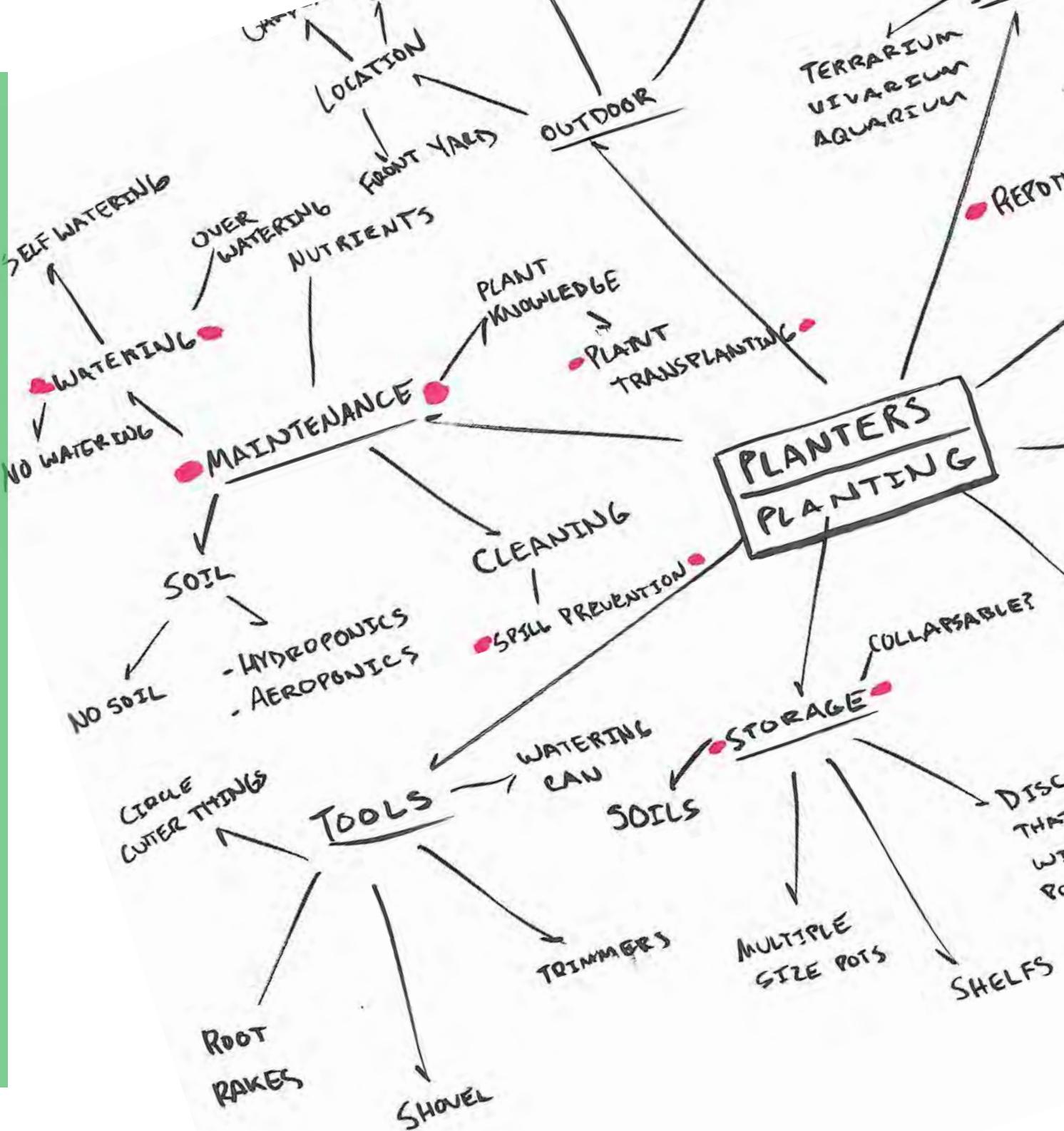
# Water



Air



A surplus or lack of any category is not ideal



# User and Market Research

## Michael (28)

Has perennial plants in the house to "Clean the Air" and for decoraton.

His biggest struggle is repotting plants so often because they do so well

Considers himself the "average user" Doesent have trouble keeping plants healthy

## Jenny (21)

Really loves plants and to put in unique pots.

Her cat will eat and kill the plants, or even worse, knock the plant over, breaking the pot.

Loves a variety of plants, but finds it hard to keep track of the SPECIFIC care they need.

## Crystal (26)

Wants to be more into planting and gardening ( something she can do while working and being a mom)

Claims to "kill every plant" and that one plant even "committed suicide"

Would buy more plants if she could just keep them alive.

## + Pros

	+ Pros	- Cons
 Plastic pot	<ul style="list-style-type: none"><li>-Plastic is neutral to soil</li><li>-Variety of color</li><li>-Low cost</li></ul>	<ul style="list-style-type: none"><li>-Little aeration</li><li>-Hard to tell if watered</li><li>-Harder to store</li></ul>
 Smart pot (PET)	<ul style="list-style-type: none"><li>-Easy repotting</li><li>-Best aeration</li><li>-Washable</li></ul>	<ul style="list-style-type: none"><li>-Fabric can tear</li><li>-Leaks from bottom</li><li>-Can dry out faster</li></ul>
 Clay pot	<ul style="list-style-type: none"><li>-Clay regulates heat well</li><li>-Traditional</li><li>-Semi-porous</li></ul>	<ul style="list-style-type: none"><li>-Clay can break if tipped</li><li>-Heavy</li><li>-Expensive</li></ul>
 Hanging pot	<ul style="list-style-type: none"><li>-Can be hung on ceiling</li><li>-Good for hanging plants</li><li>-Saves ledge space</li></ul>	<ul style="list-style-type: none"><li>Harder to water</li><li>No bottom drainage</li><li>-Hook in way of plant</li></ul>

# Main Problems

Remove plant without damaging roots



Adjusting dirt level to the according to size of plant



Pack dirt into pot, securing plant



Cleanup



Plant knowledge



Space to plant



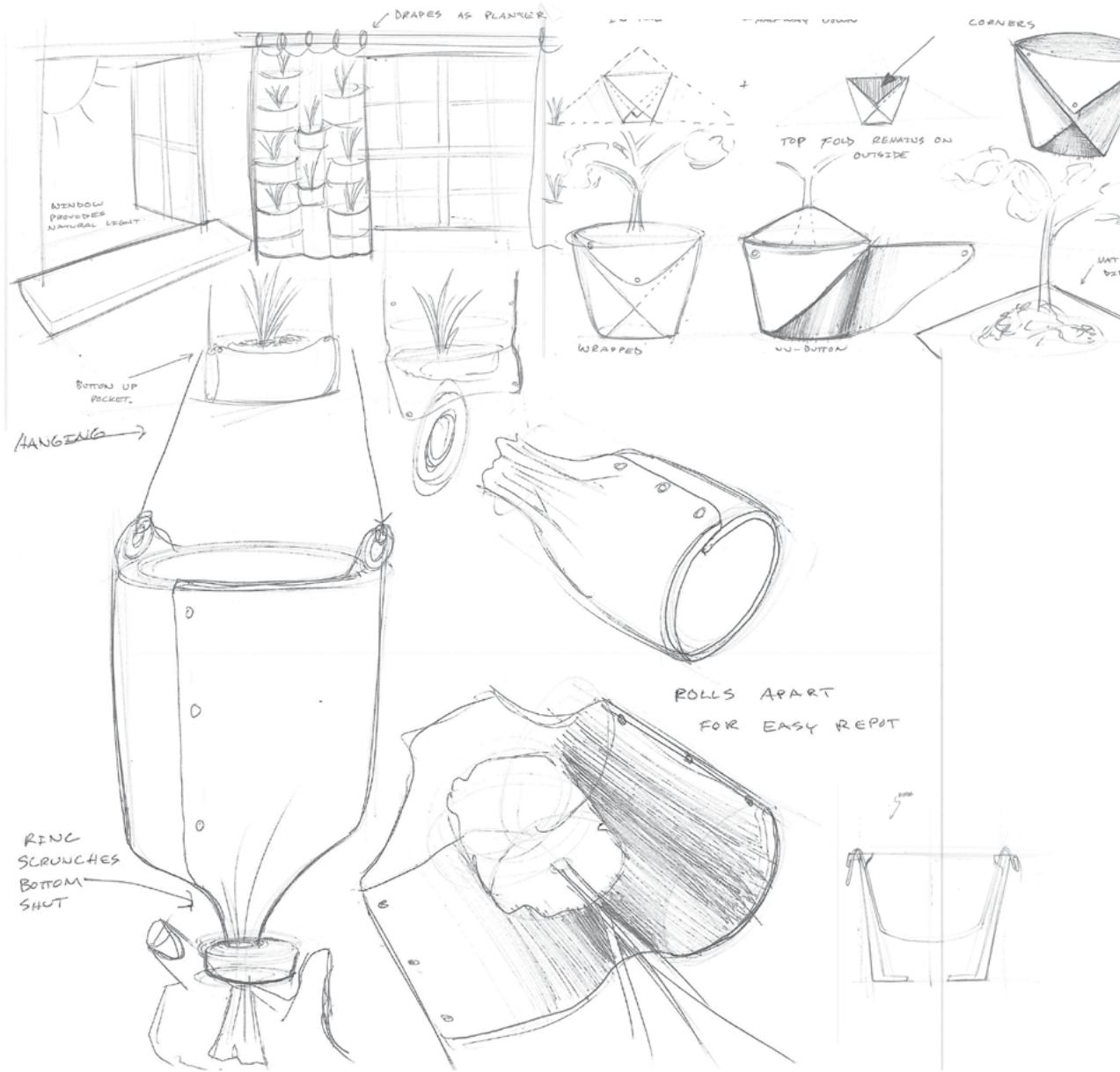
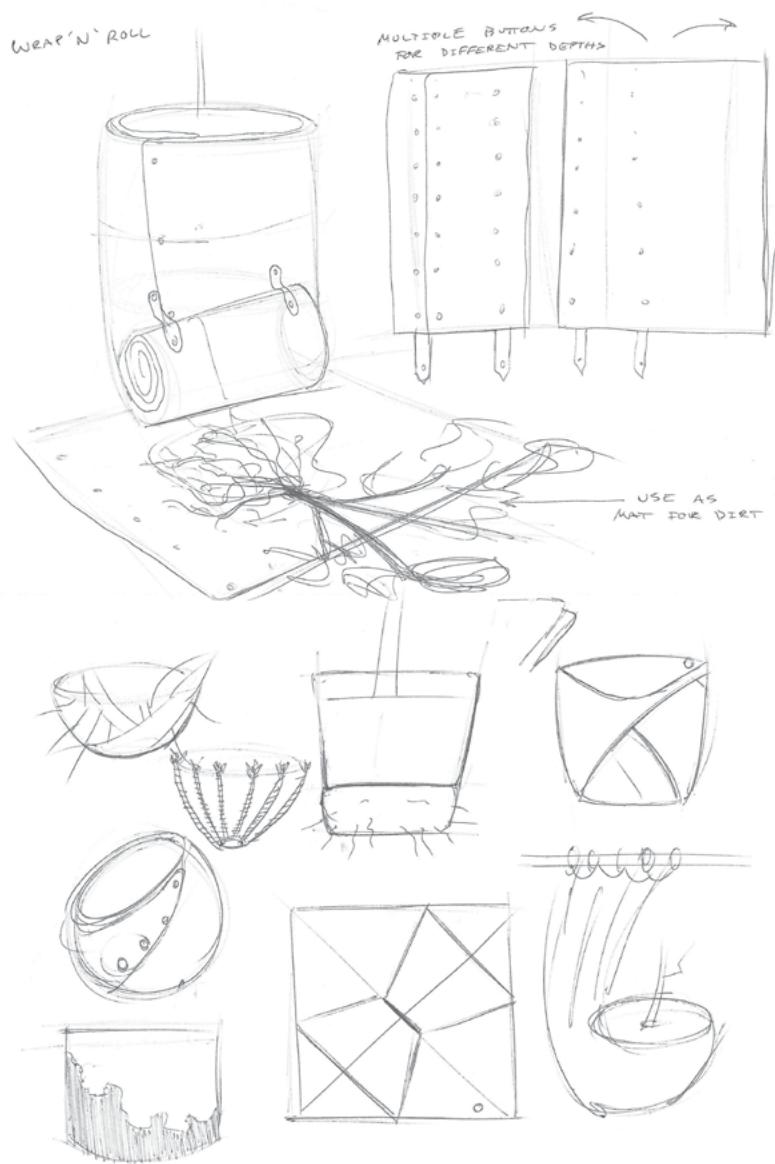
Maintenance & Cleaning



## Benefits of P.E.T. Plastic

- Better root development
- Can loosen dirt for repotting
- Stays more cool in heat
- Can visually see when to repot
- Harder to overwater

# Ideation - Focusing on cloth planter

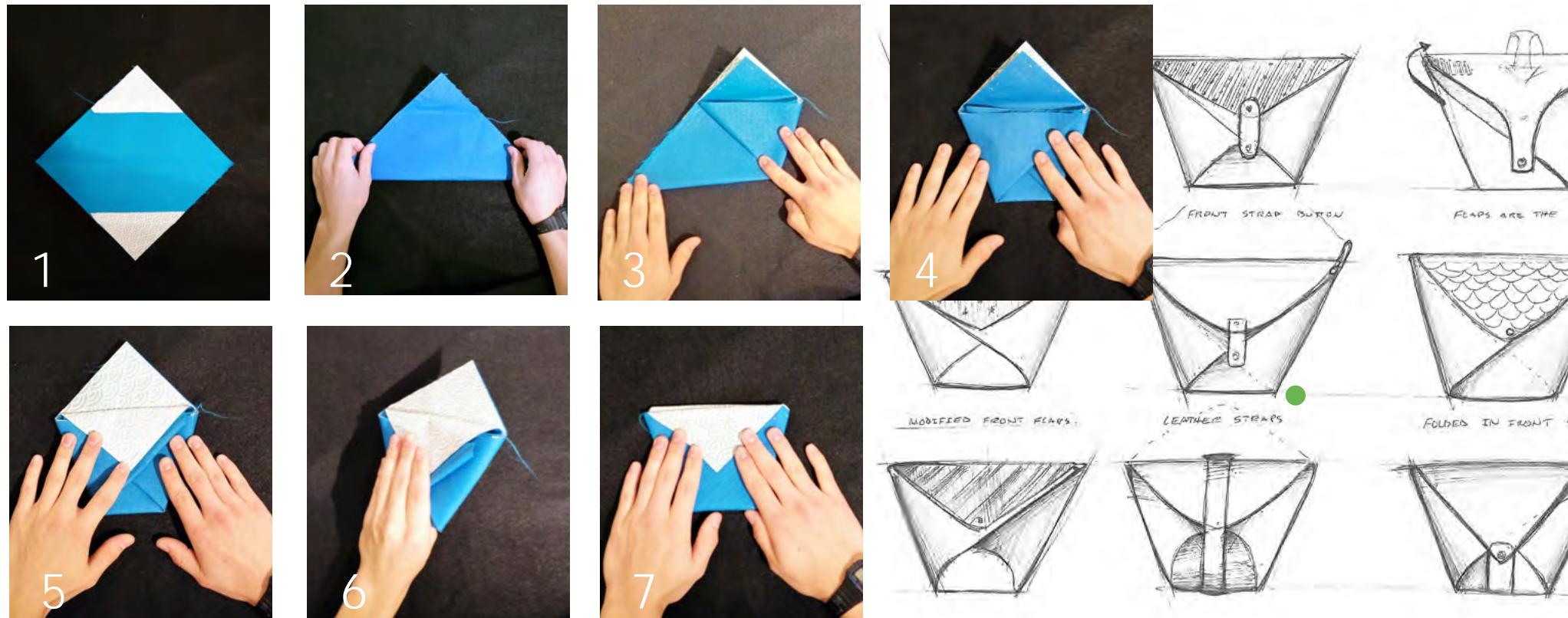


# Prototyping - exploring adjustable fabric

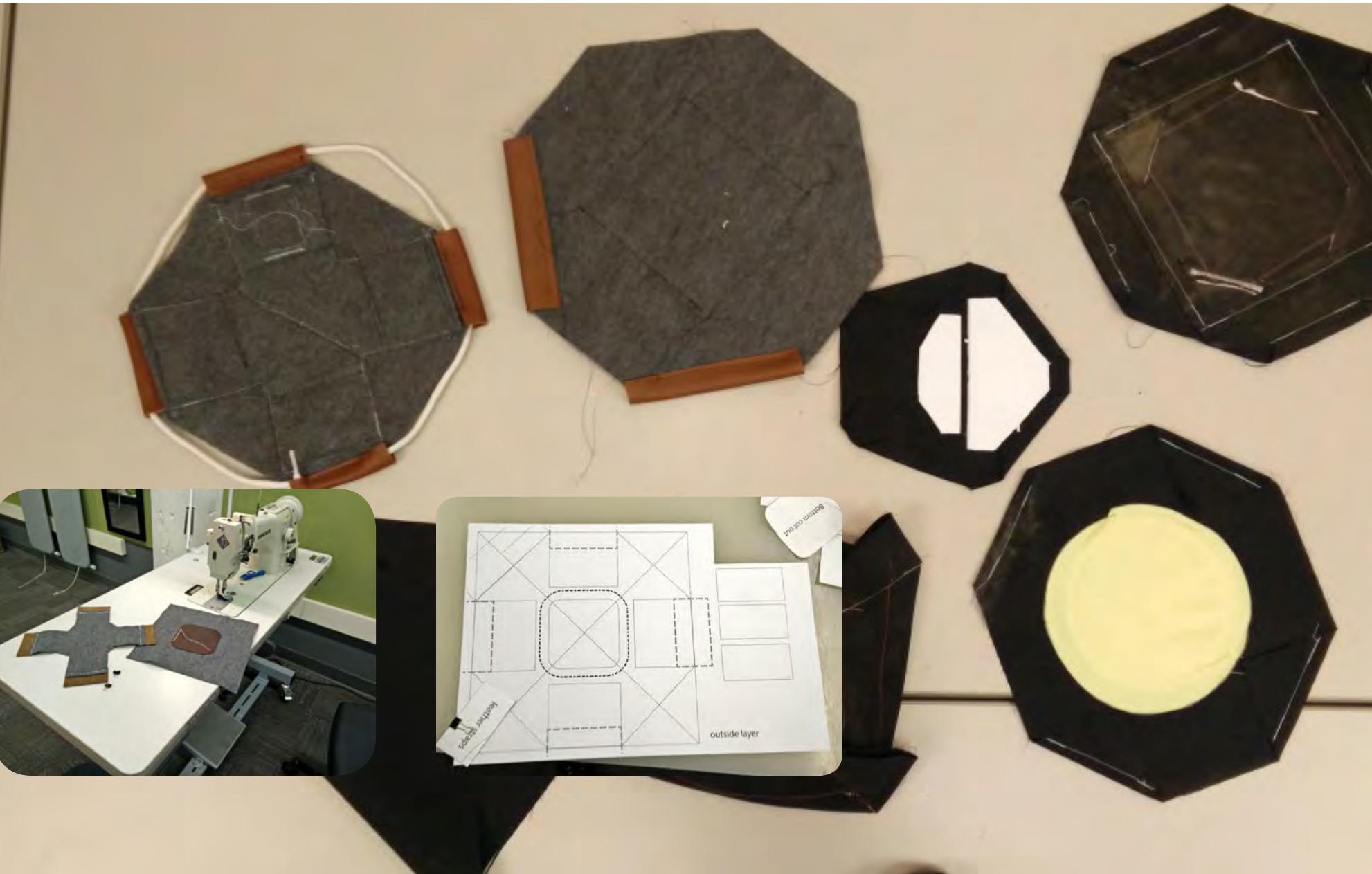
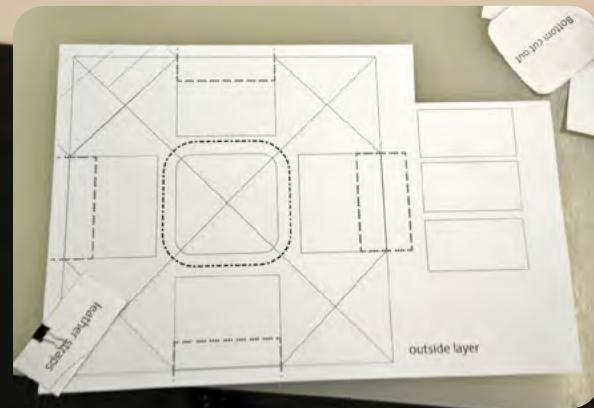
# Mockup 1



# Mockup 2



# More Prototyping



# How to use



Unfolded layout



Placing plant



Tightening pot



Side pouch for string



Internal hook  
for string



String hangs planter



Button sides to  
secure



b·o·n

This product is apartment dwelling planter tool.  
By utilizing fabric, users are better able to care  
for and monitor their plants

# G-Tube feeding device

*A Marquette / MIAD collaboration  
with Bio-engineering students*



# Research

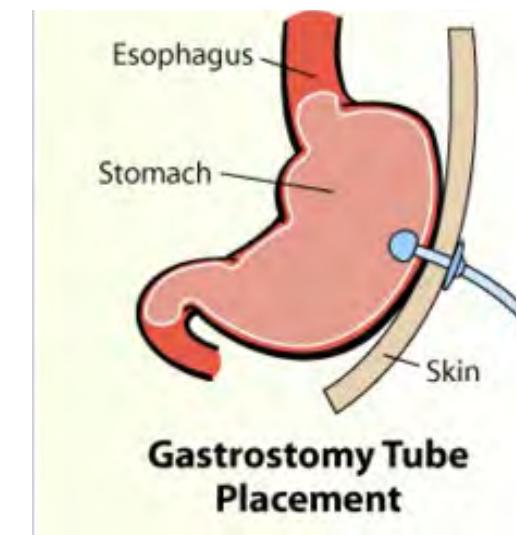
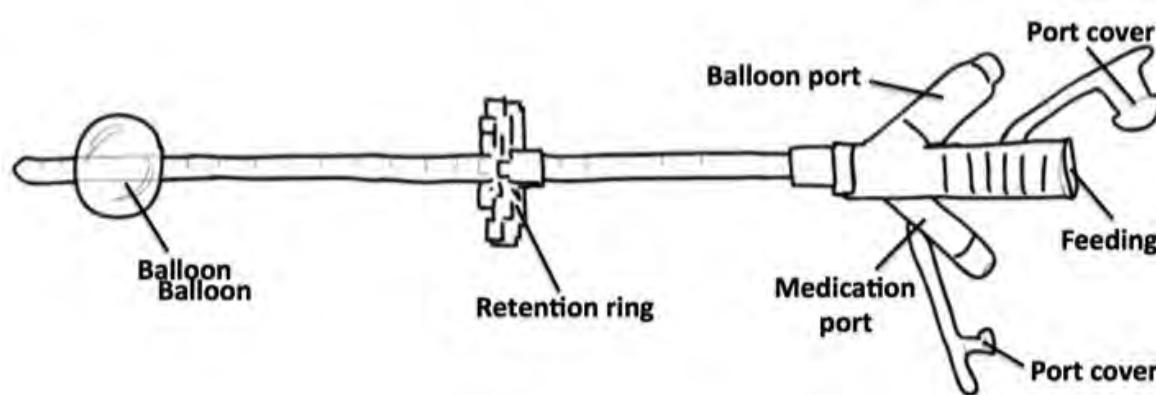
G-Tube Bolster must keep tube perpendicular

There is no standard way to bolster a G-tube

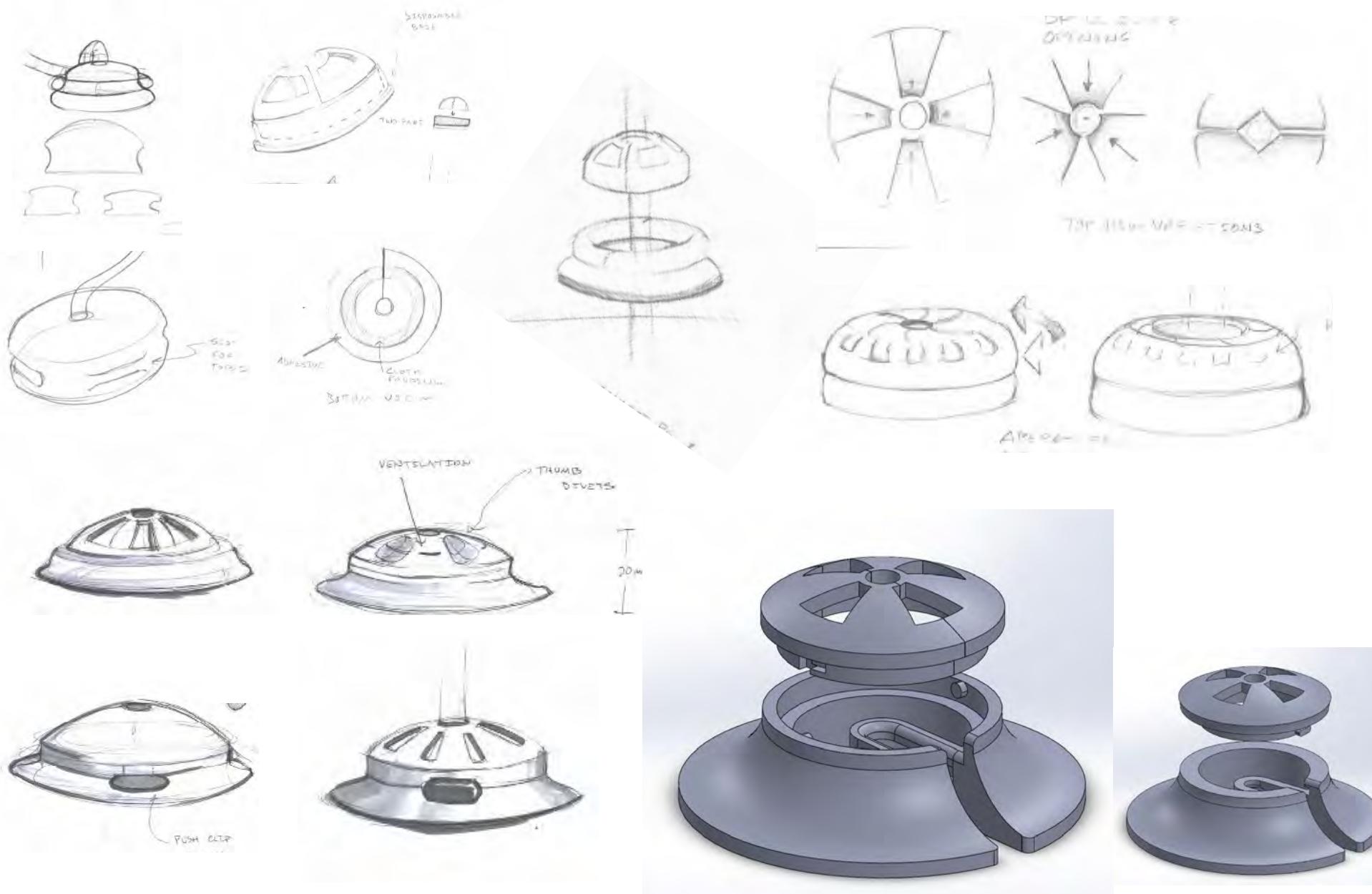
Must maintain integrity of site

Over half of parents bought externals supplies for G-tube

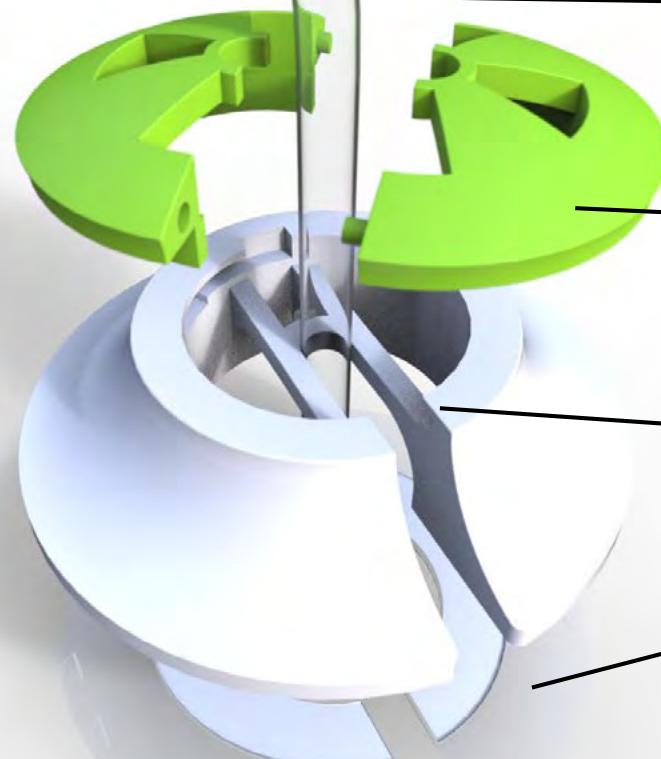
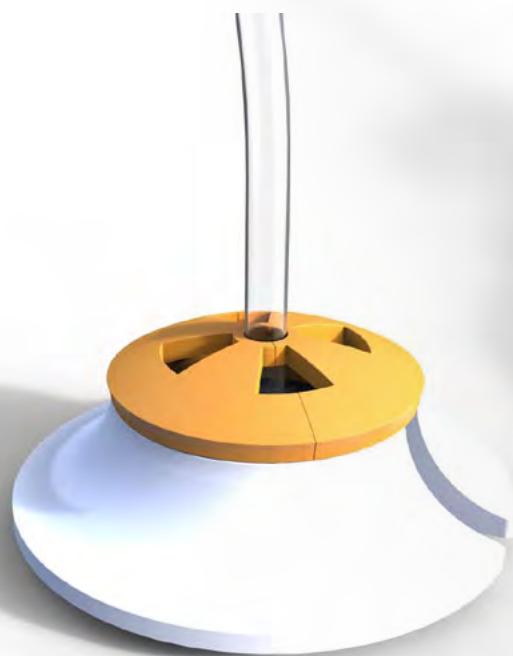
## Existing solutions



# Ideation



# Final Concept



Tubes

2 part top half

Support base

Adhesive Sticker

Exploded view





# BIO-LOGIC



# User and Market Research



Peter and Sharon

- Licensed plumber
- Owner of 4 cats
- Uses hand shower to warm feet in winter
- 2.5 GPM
- Rather spend the money on good showerhead
- Plastic rings crack during installation



Victoria

- Only uses hand shower when she has the time
- Hand shower is mostly used for cleaning
- Dog Owner
- Likes "raindrop" type of flow
- Cheaper the better
- Hard pressure



Andrew

- Uses hand shower daily
- Cleans hair after a haircut
- Cat owner
- Wants a hand shower that has a "forceful" massage
- Student
- Annoyed with cord
- Wants better grip

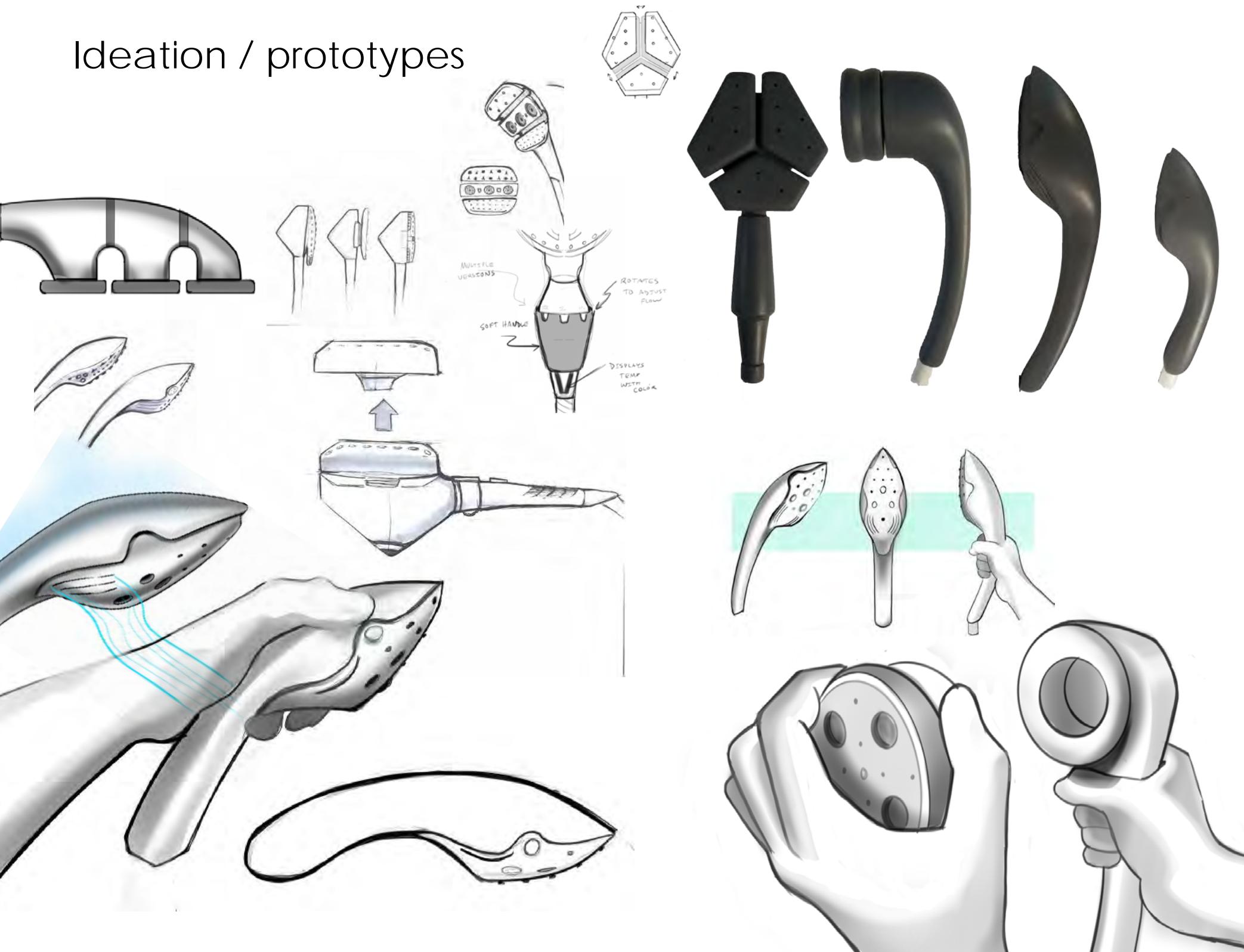


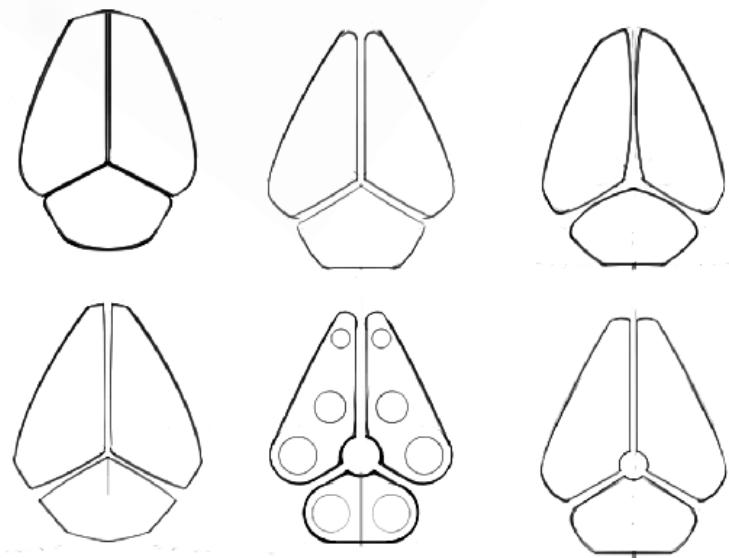
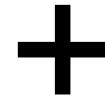
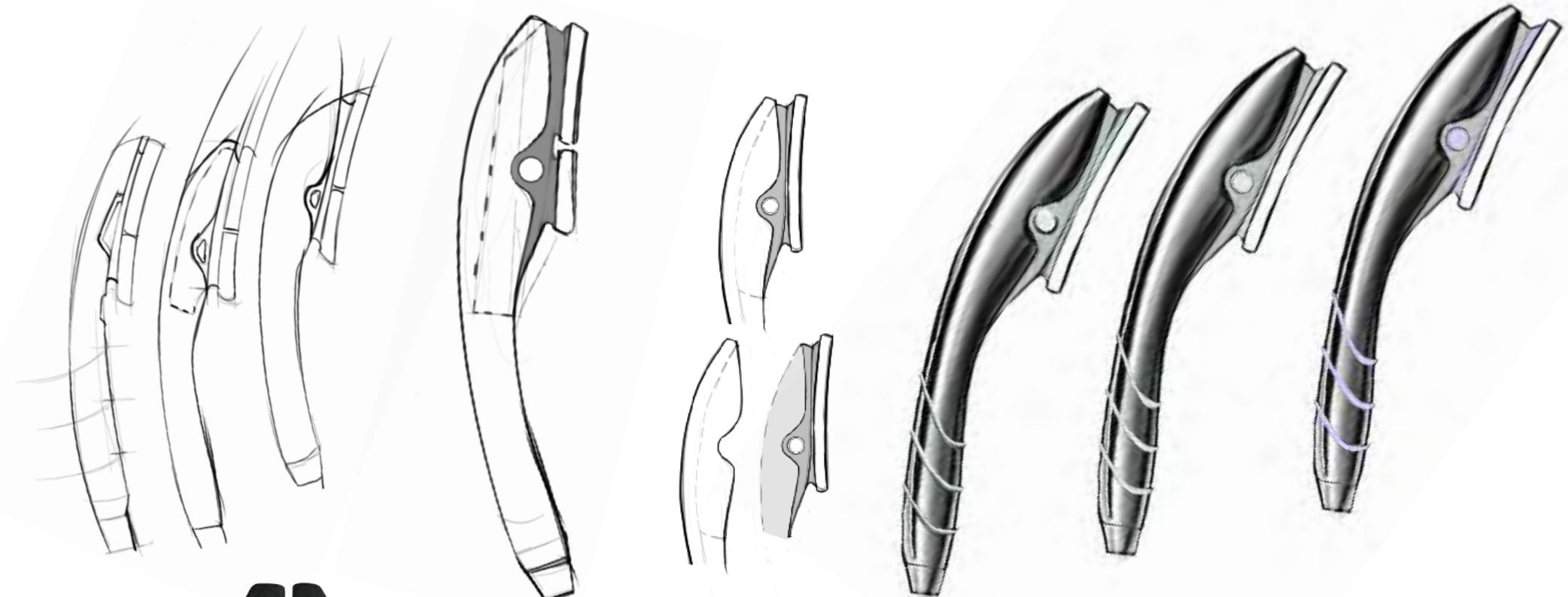
Pete

- Uses hand shower for cleaning
- Wants new features
- Dog Owner
- Hard pressure
- Wants an easy button to shut off water
- "Bored" with current hand shower features



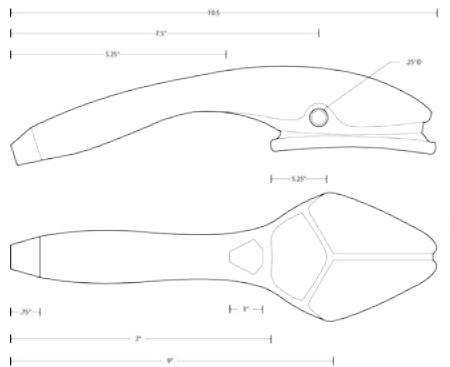
# Ideation / prototypes





Concept lock

# Prototype model



## Waterfall

Utilizes gill shaped sprayers giving a unique waterfall pattern. Front face is tiltable, angling spray direction



## Rainfall

An extra wide spray head that mimcs rainfall. The face can expand, revealing hidden H2O kinetic jets.



## Massage

The massage head uses soft rubber jets combined with pivoting peices to conform to the body.



A foldable lightweight virtual reality headset that  
creates an immersive learning environment

# On the Market

HTC Vive



- 2 motion tracking controllers
- Expensive
- Needs a PC

Google Daydream



- Very lightweight fabric
- Motion controller
- Only works with Pixel smart phone

Google Cardboard

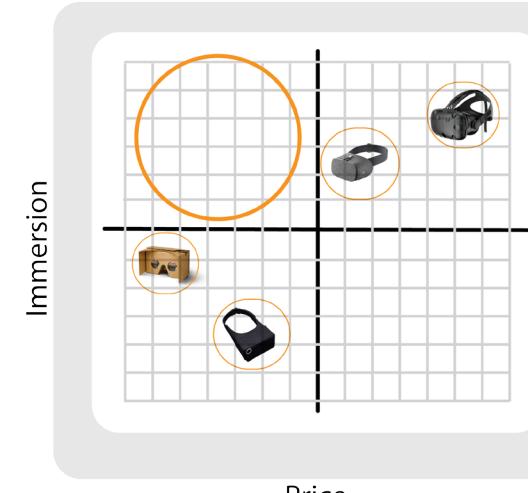
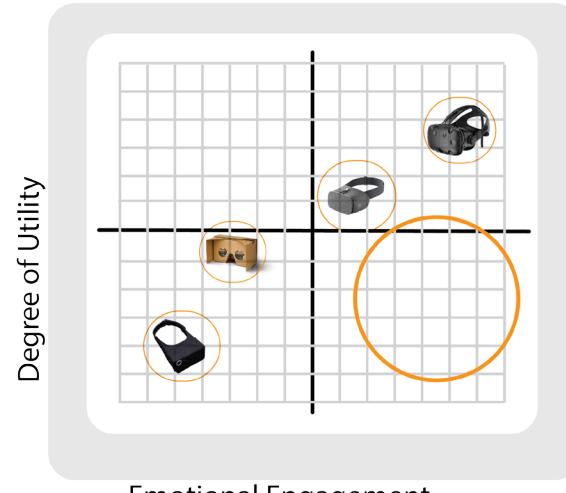


- Very cheap
- User has to hold
- Uses smartphone
- Damaged easily

Mona Mask



- Light weight fabric
- Folds up
- Only works for Iphone
- No button



# User Research



Megan (24):

- Grade school teacher
- Sees potential in VR even though she is new to it.
- Affordability is key.



Andrew(24)

- Software engineer
- Wishes VR wasn't so expensive
- Does not want to hold headset



Timmy (17)

- High school student
- Gets bored from lack of app content
- Wants to communicate with classmates



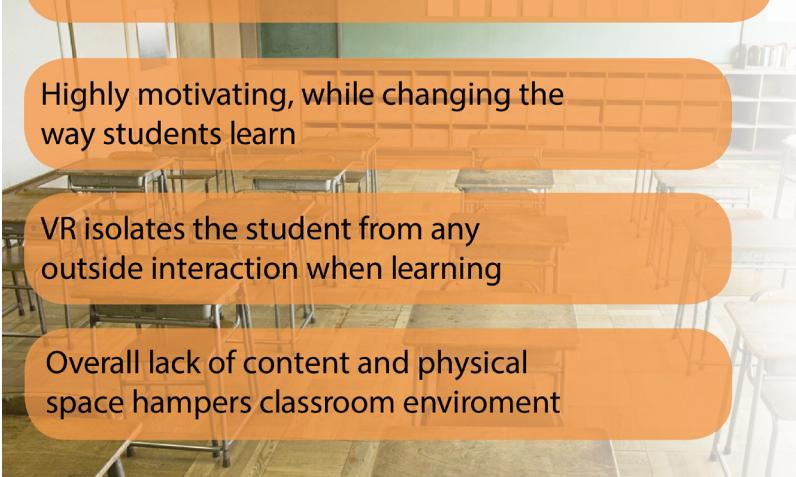
Pete: (55)

- Fascinated by VR technology
- Has trouble with user interface
- Gets motion sick

## Key Points

- Virtual Reality has to be affordable
- Being able to communicate with others
- The lighter the strain on user the better

# VR in the Classroom



Highly motivating, while changing the way students learn

VR isolates the student from any outside interaction when learning

Overall lack of content and physical space hampers classroom environment



Closure from environment and assistance is needed

Clunky attachments crowd the user's head

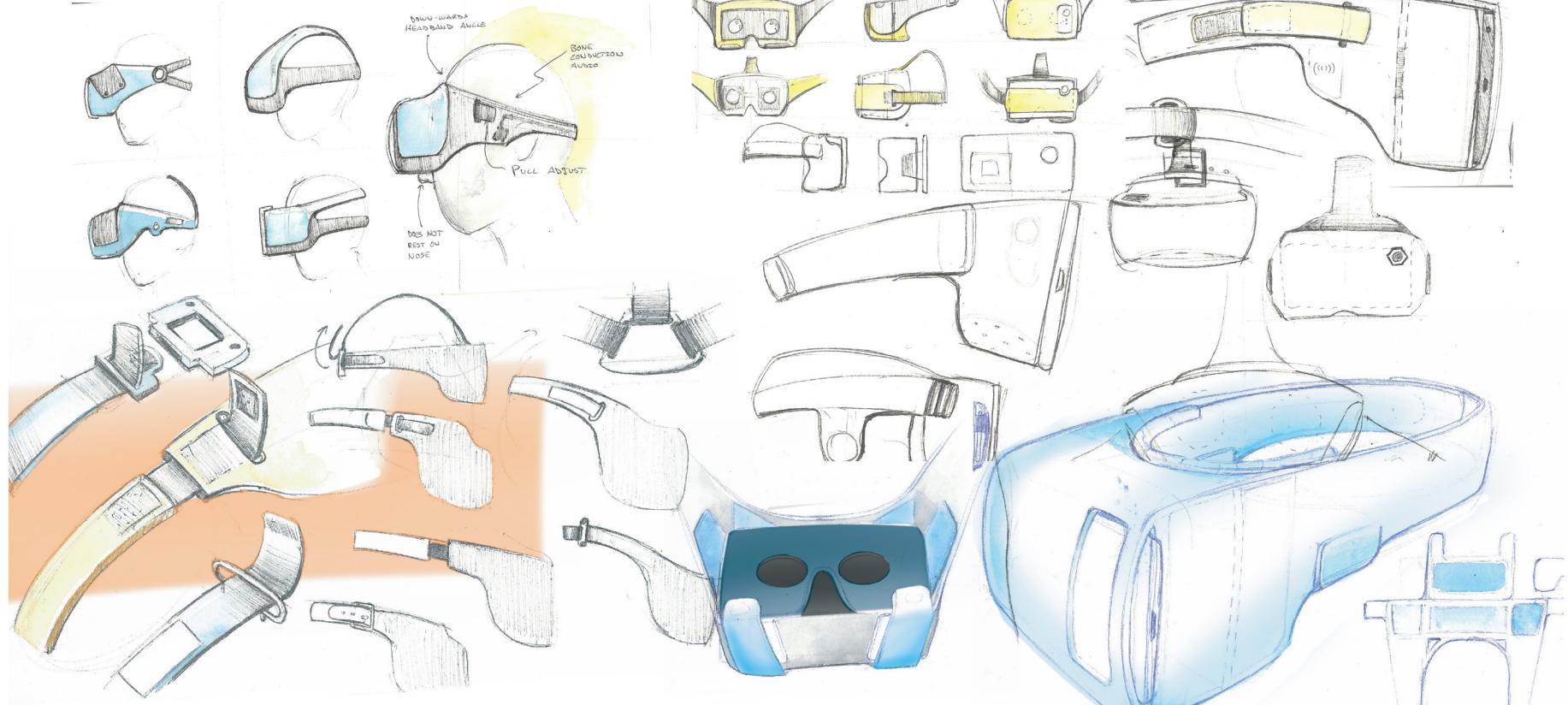


User has a lack of awareness from outside

Expensive cost to power "hi-tech" headsets



## Ideations



## 2D Layout



195mm



127

87mm

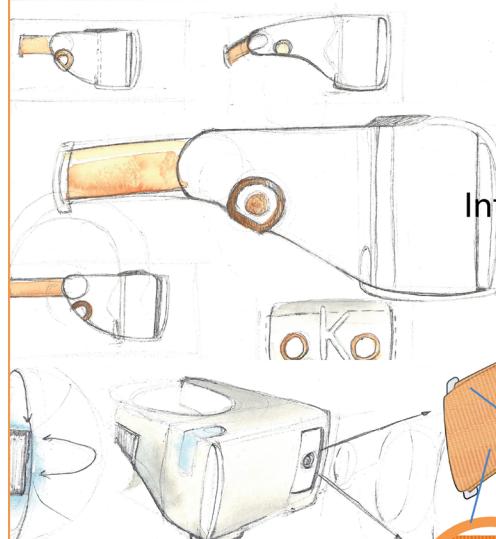
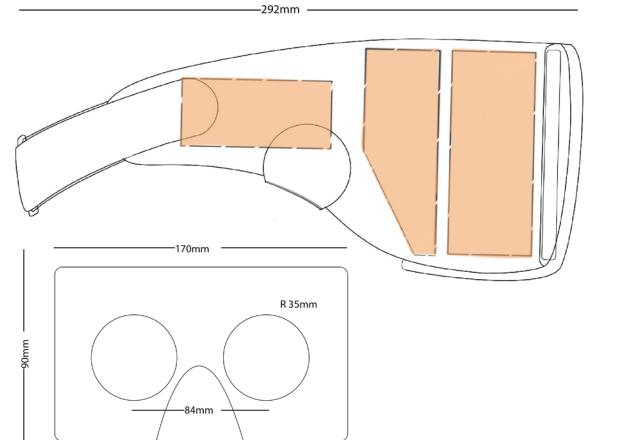
149mm

50mm

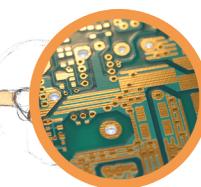
76.2mm

114mm

## Foam Padding



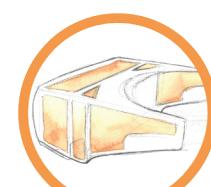
### Internal Components



Bluetooth  
Lithium Ion Battery  
Microphone



Neoprene



Foam Padding

5.5"



5.5"

Smart Phone

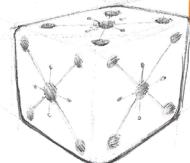
Nylon Web  
Strap

Velcro &  
Buckle

Bone-Conduction  
Audio & Button

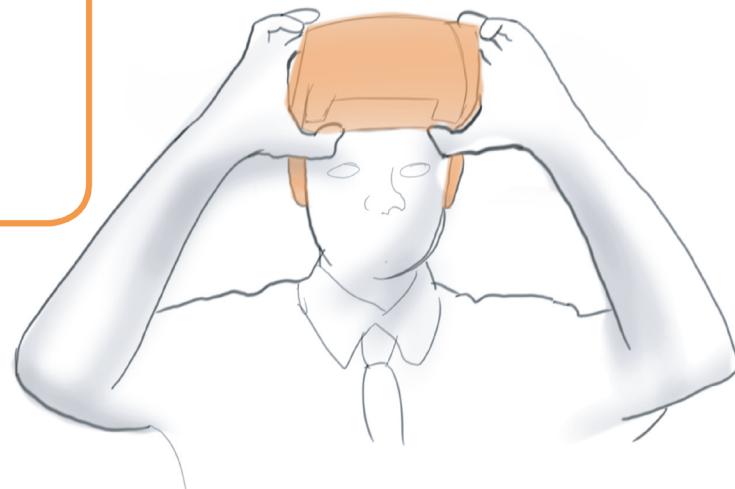


Bi-Convex Lens

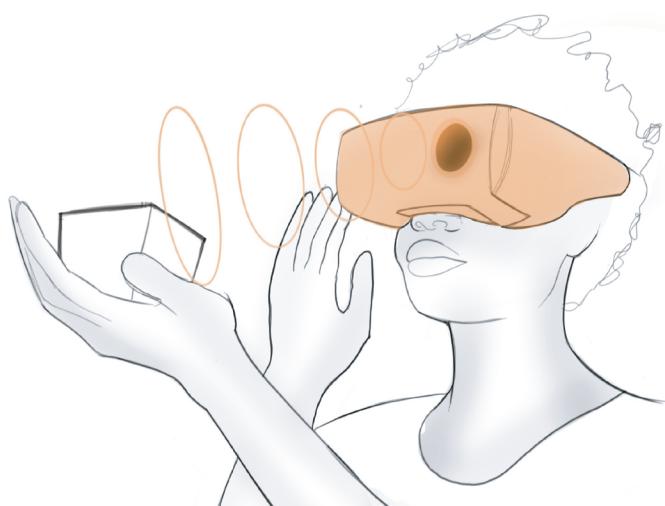


# Uses and Function

Lightweight neoprene comfortably wraps around the users head. Headset is easily adujusted with buckle and strap.



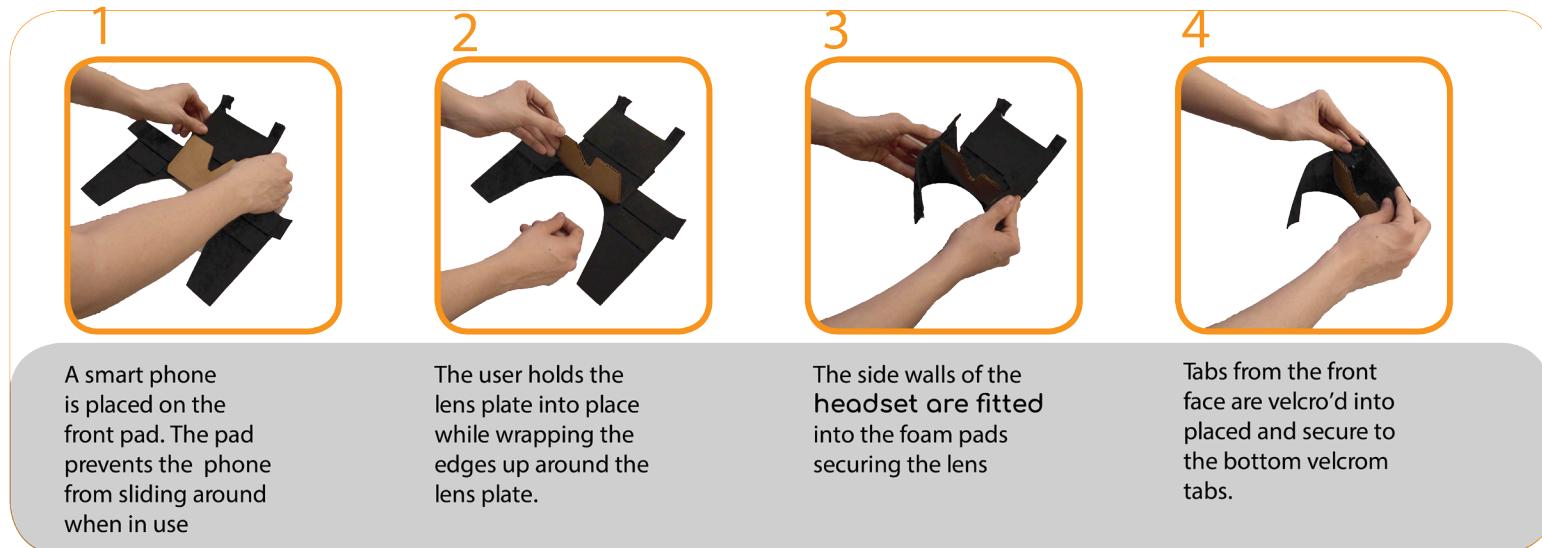
Bone conduction audio and bluetooth microphone communicate to the user with press of a button.



Cut-out in front of headset allows for smart phone to detect objects.

The button can also be used to interact with VR enviroment.

# Folding Process



# App Development

