

Summer Internship at Integral Enterprises Auroville



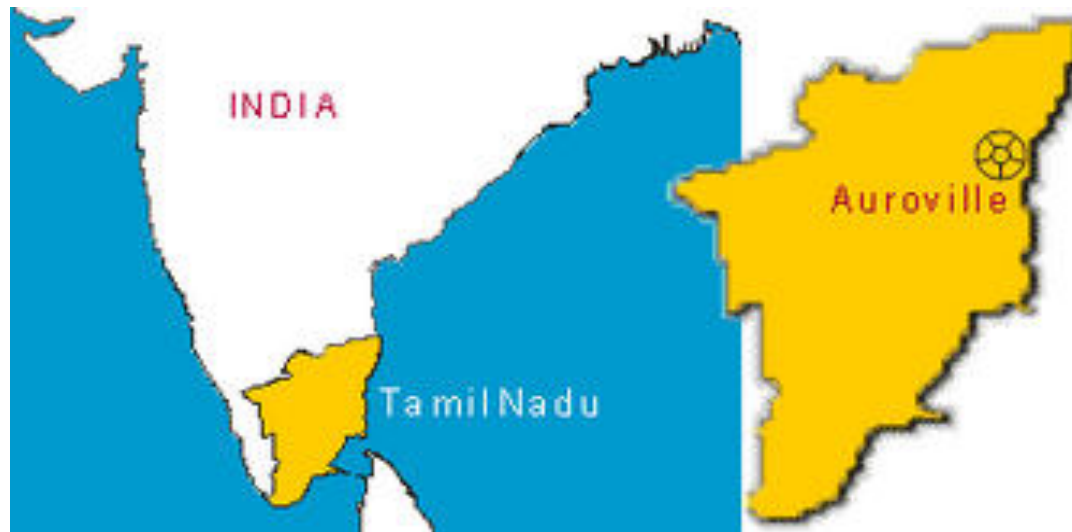
Project- Wee Dryer

Avinash Prabhune | 126130003
Avinash Jayakumar | 126132001
Deepanwita Ghosh | 126130009

Introduction

About Auroville

- Auroville (City of Dawn) is situated along the coast of Tamil Nadu
- This Project town was founded in 1968 by Mirra Alfassa - 'The Mother' and designed by
- The purpose of Auroville is to 'realize human unity '



About Auroville

Auroville has a number of small scale industries which contribute to the economic development of the place.

- candle and incense sticks
- pottery
- gemstone jewelry
- wood and stone work
- construction and architectural services
- printing and graphic design
- fish farming
- cheese making
- leather products



Background

- Internship opportunity found from IDC office records, students have interned here previously
- Worked at Light-Fish product design, reported to Integral Enterprises
- Light-Fish does different products, with a special focus on lighting and interiors
- Integral Enterprises is involved in developing eco-friendly and sustainable projects, providing an incubation space for things like electric vehicles, the Wee dryer, amongst other projects

About LiGHT-FiSH



- Firm is located in the Aurelec Campus
- Managing Partner - Samvit Blass
- General product design, special focus on lighting



Project- Wee Dryer

Objective

A product that

- Can dry 1 kg of wet clothes (~500 grams of water) in 15 minutes
- Consumes less than 1000 W
- Can be feasibly sold for Rs. 10,000 or less

ICONS

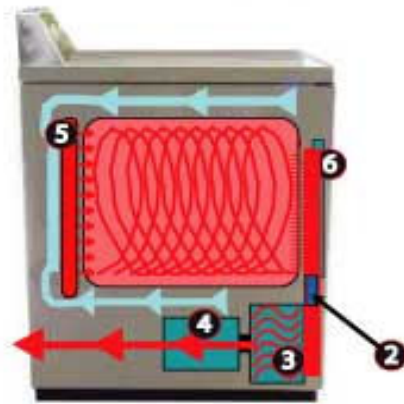
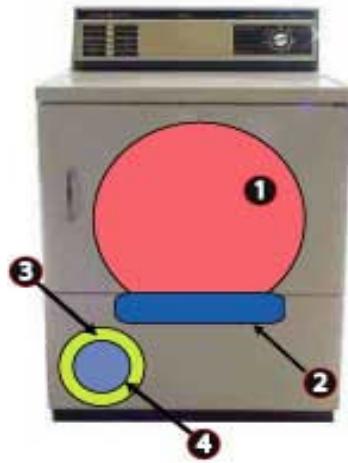
Vision Statement

- The UG Dryer will provide a cost effective means for households to completely dry small articles of clothing
- Used to dry clothing, such as undergarments which are typically dried indoors, in a short amount of time
- Important during monsoon seasons where drying clothing can take longer amounts of time
- For middle class families with small children that go through clothes quickly, student hostels, hotels, etc.
- Essential oil use helps to eliminate contaminants/bacteria on the clothing

Market Study of Regular Dryer

Key Problems

- Occupy a lot of space
- Expensive
- Brute force method of drying (high power)
- Often have bigger than needed capacity



- 1 Tumbler
- 2 Lint Screen
- 3 Fan
- 4 Motor
- 5 Heating Element
- 6 Door



REFERENCES



Compact Spin Dryers

- Cheap
- Unreliable
- 'Gimmicky'



Compact 'Airers'



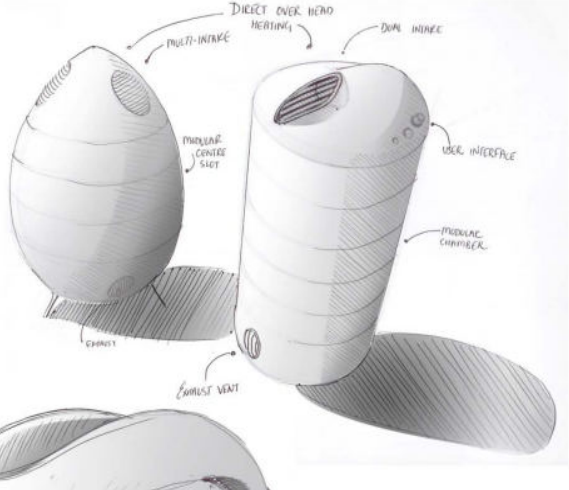
Compact Heat Dryers

REFERENCES

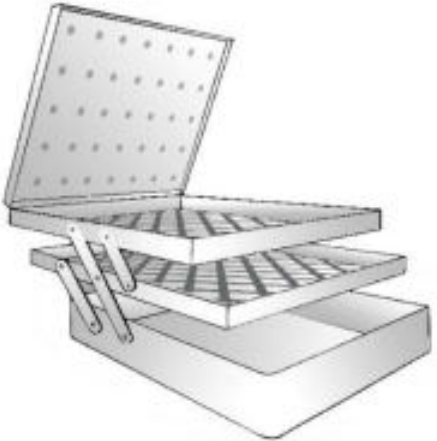
Development History

Ideation Concepts

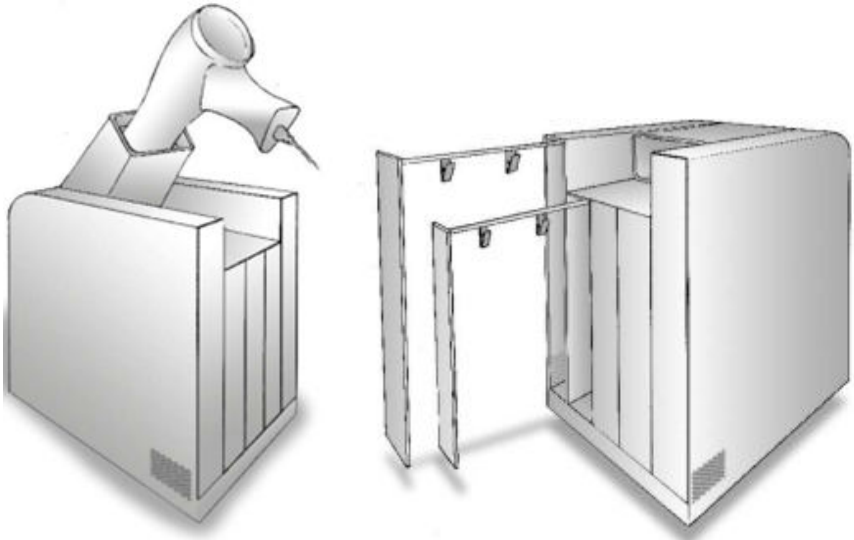
Idli-Steamer Concept



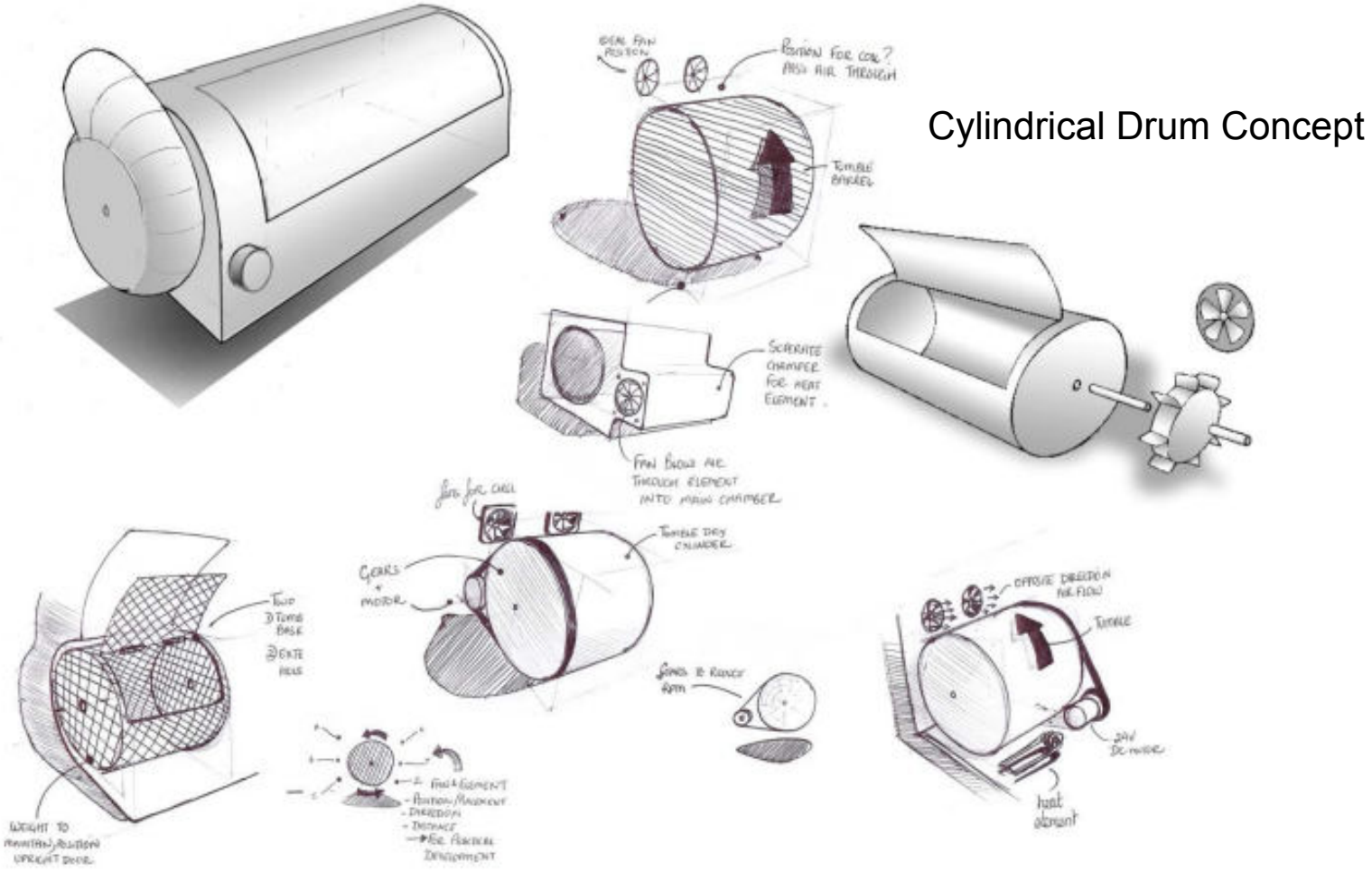
Steam Tray Concept



Drawer/Hanger Concept



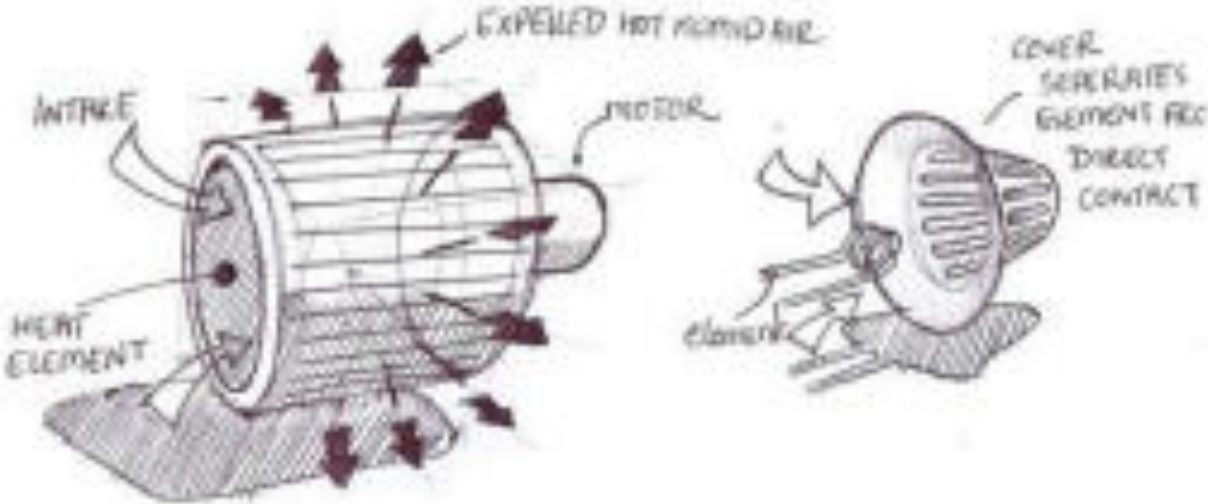
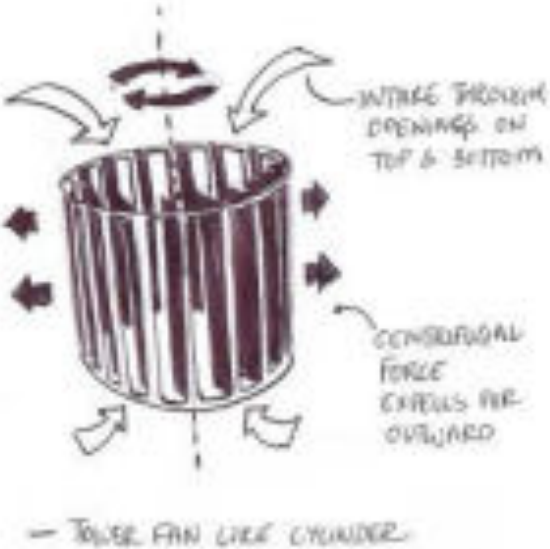
Ideation Concepts



Cylindrical Drum Concept

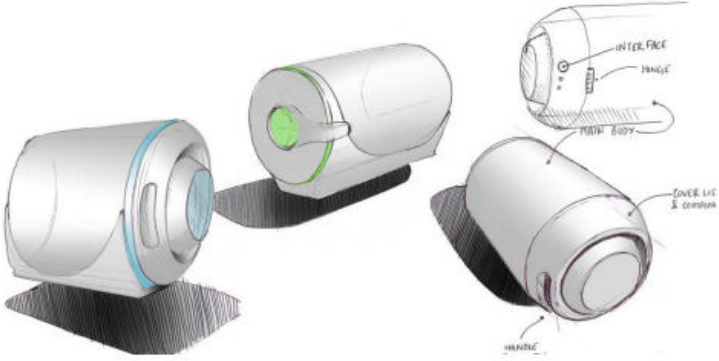
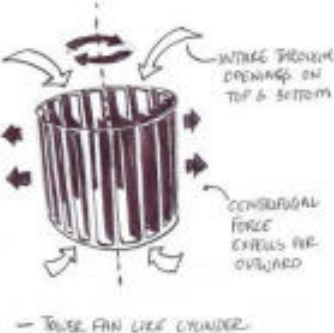
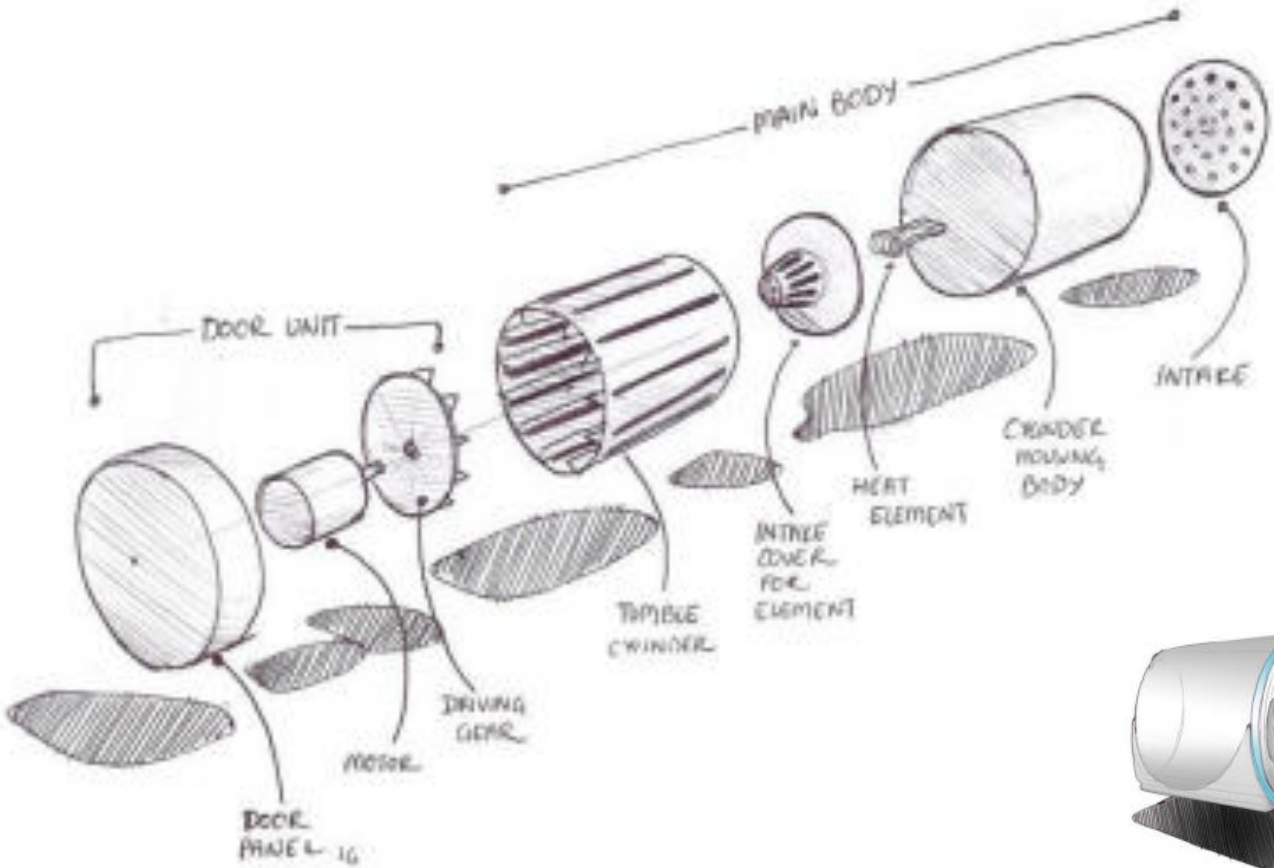
Ideation Concepts

Cylindrical Drum Concept



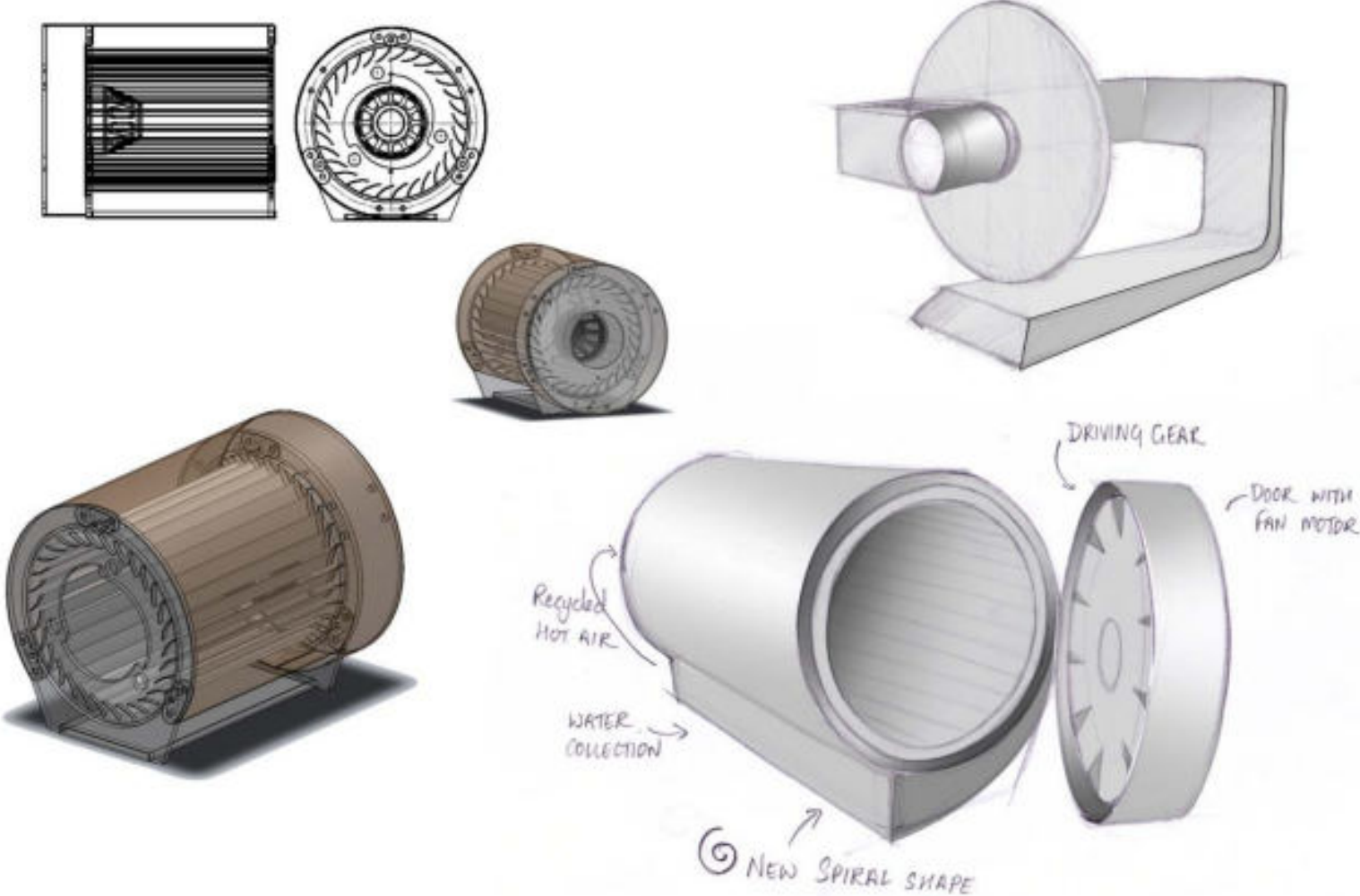
Ideation Concepts

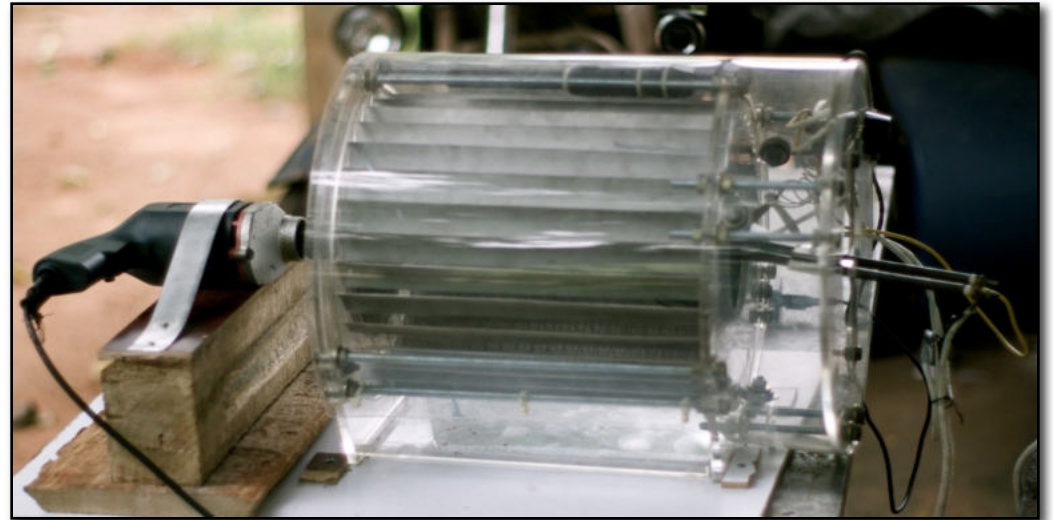
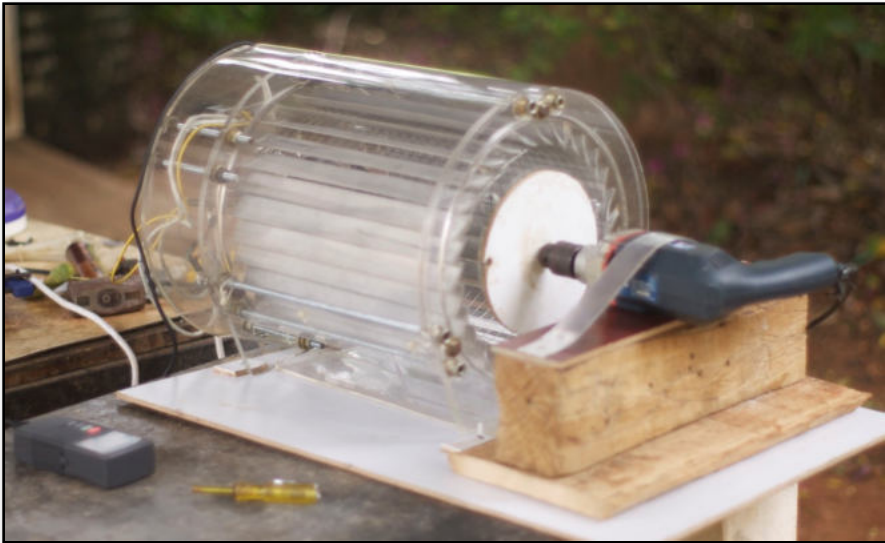
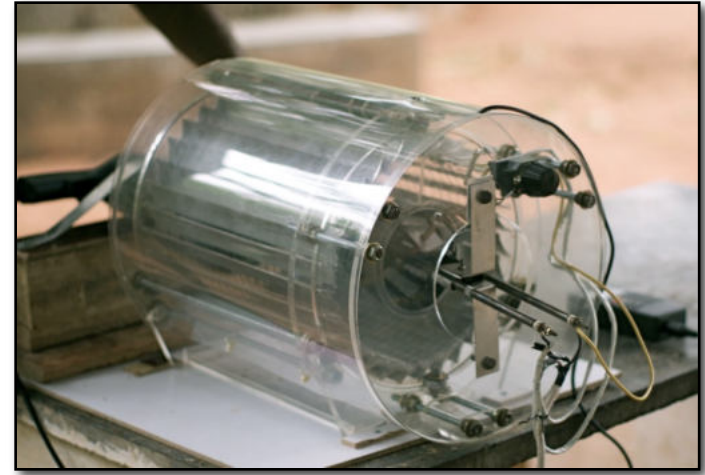
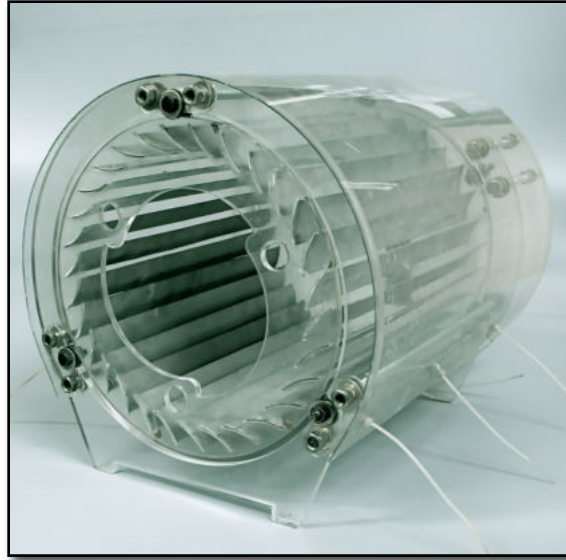
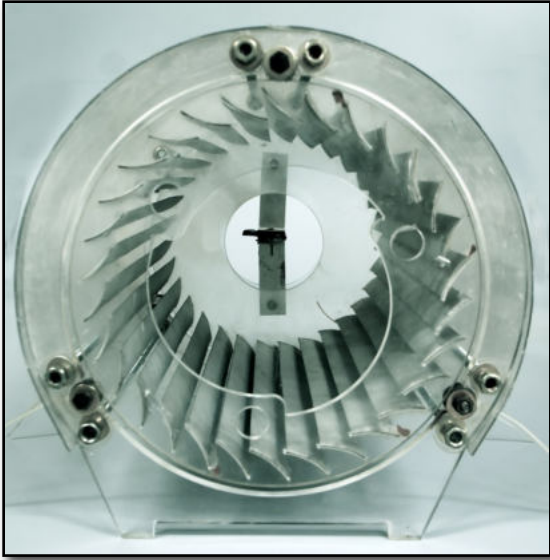
Cylindrical Drum Concept



Ideation Concepts

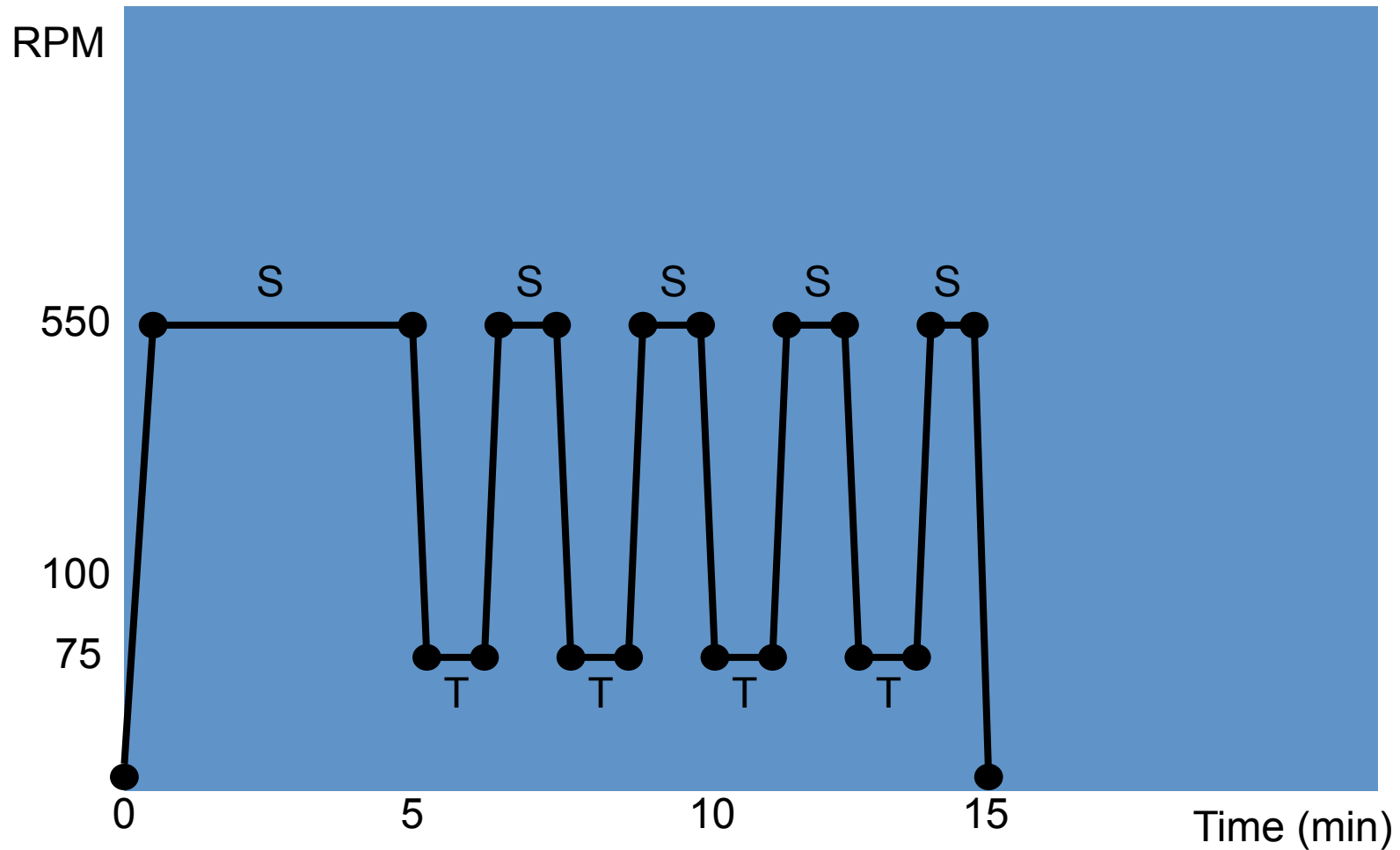
Cylindrical Drum Concept





Testing & Validation

Basic Test Cycle



Testing

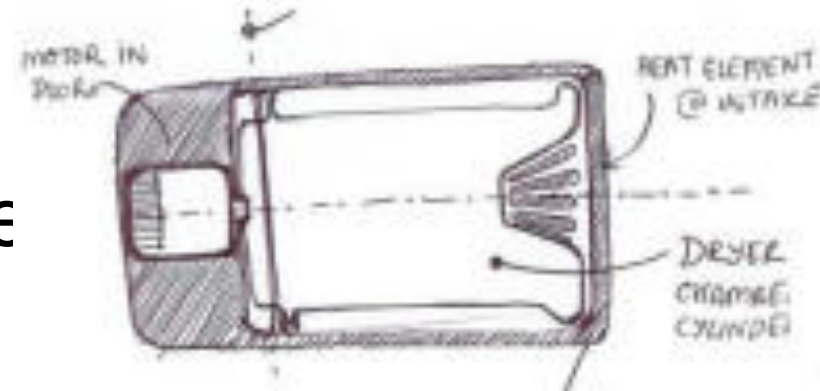
- Conducted several test cycles varying different factors
- Measured temperature, Relative Humidity % during test cycle
- Varied spin / tumble cycle times
- Created tumble-slow spin cycle to increase contact area with air
- Studied effects of external forced airflow

Drying Process

- Three Factors
 1. Heat
 2. Airflow
 3. Drum Rotation
- Drum Volume – Recommended is 25L for 1kg (Miele)
- Present volume is 15L (only 60% optimal)

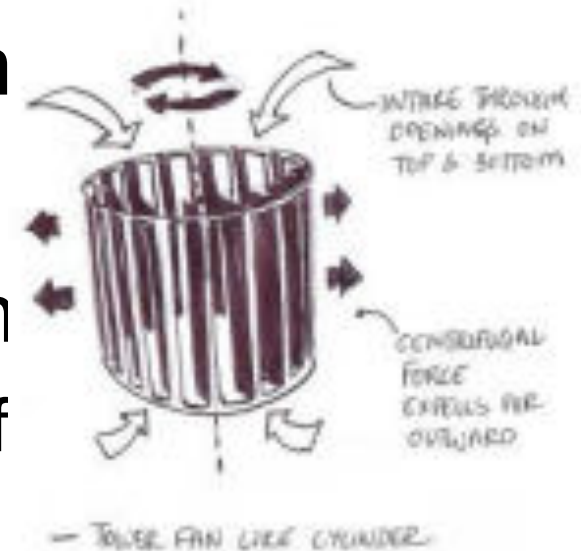
Heat

- Easily reaches 70 - 75 degree
- Contact at high temperatures causes toasting
- Heat distribution is uneven across skin wall & chamber
- Heater design (flat coil vs. CFL bulb style)



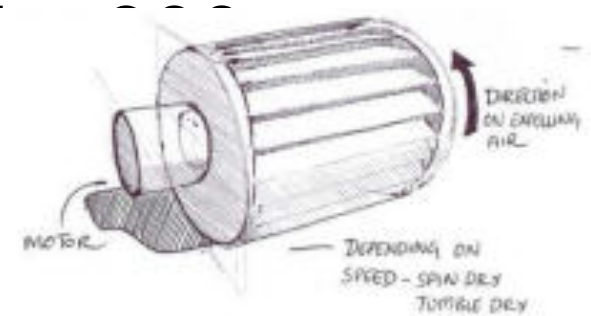
Airflow

- Discovered quick venting to dump humidity
- Need for clear circulation path – currently not adequate airflow inside the drum
- Blade profile optimization for exh
 - Angle blades to push air to back of



Drum Rotation

- G-Factor based on rotation speed and diameter (Electrolux)
- Currently at ~8 G, preferred at least 120G
- Translates to RPM increase to m required



Drum Rotation

- Discovered clothes clump and fall during tumble mode
- Introduced modified tumble cycle:
 - Tumble at 70 RPM for 30sec
 - Slow Spin at 100 RPM for 30sec
- Allows clothes to circulate better, increases air contact area

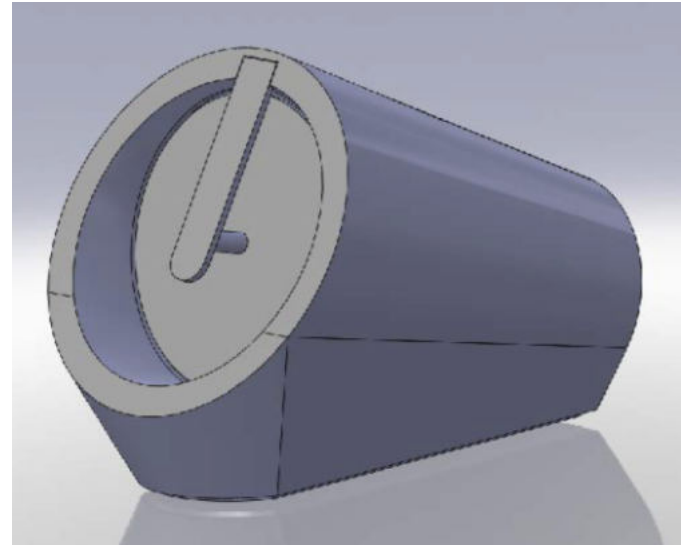
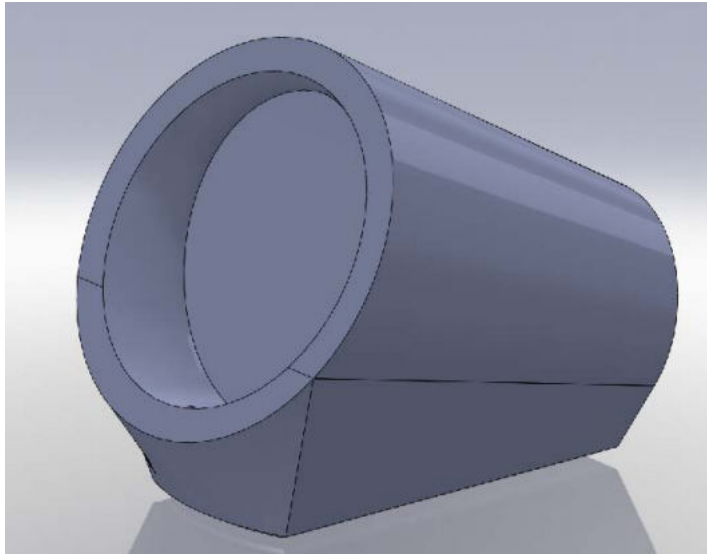
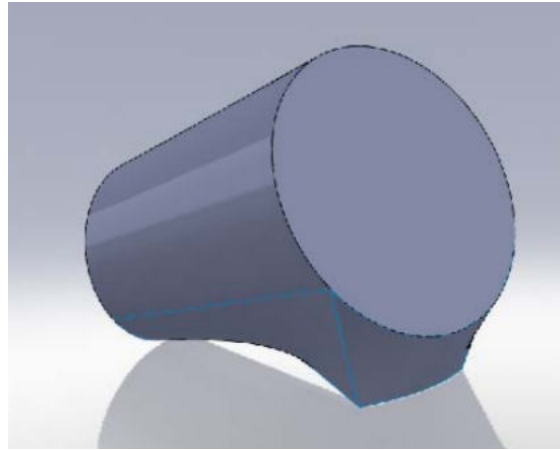
- Realized need for baffles to 'trip' clothes

Design Recommendations

1. Form factor change to optimize volume, create air flow
2. Chassis structure design
3. Blade profile optimization
4. Component layout for compact packaging
5. External features (Handle, Door Hinge, Fascia, Water Cup, Door Handle)

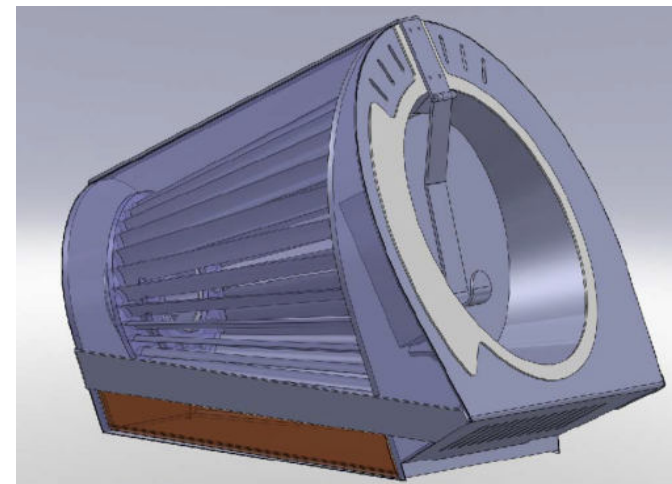
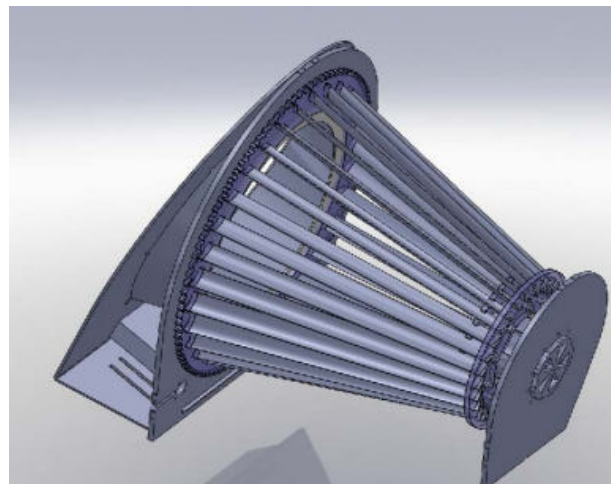
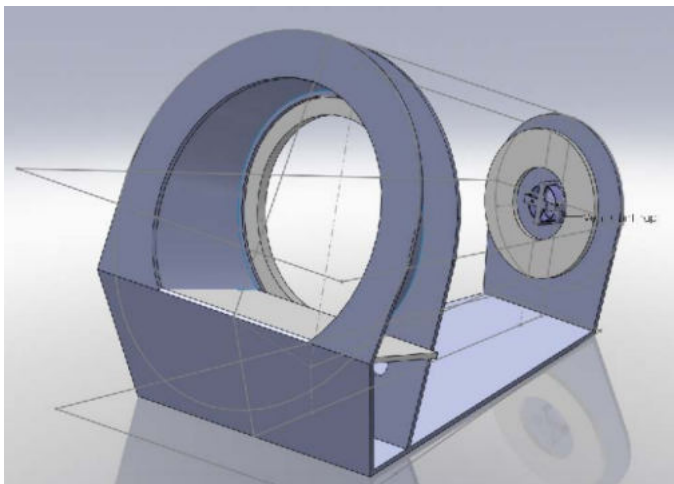
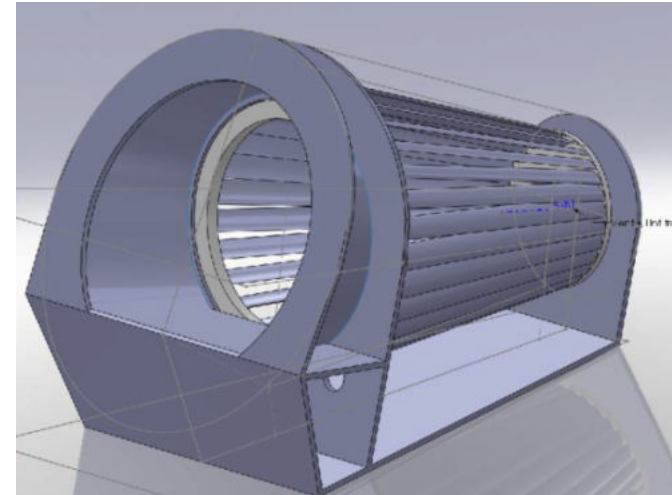
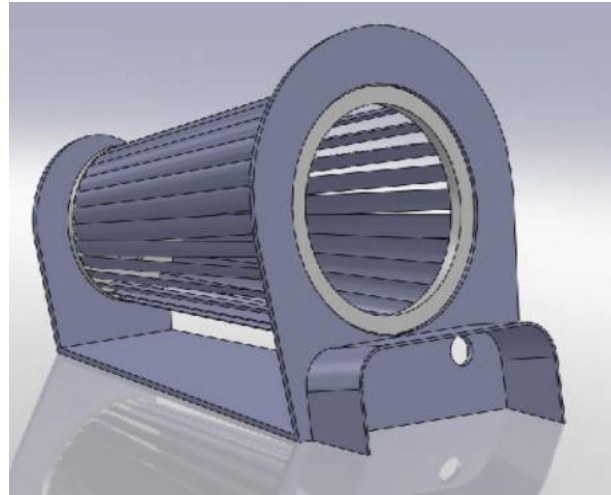
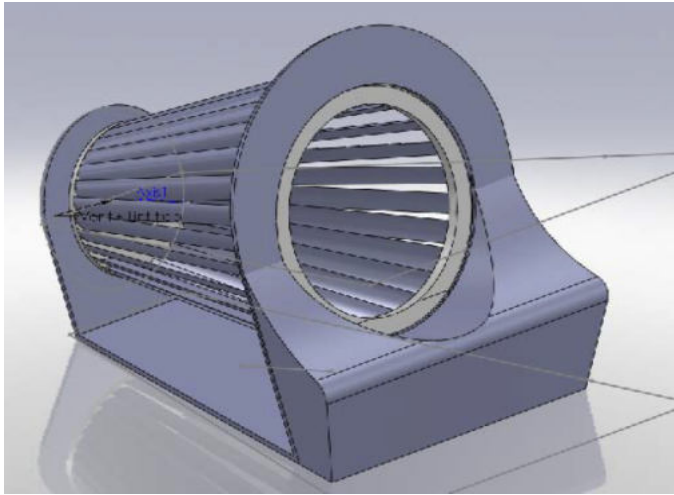
1. Form Factor

1. Form Factor Development



2. Chassis Structure

2. Chassis Structure Design



3. Blade Profile

4. Component Layout

4. Component layout for compact packaging

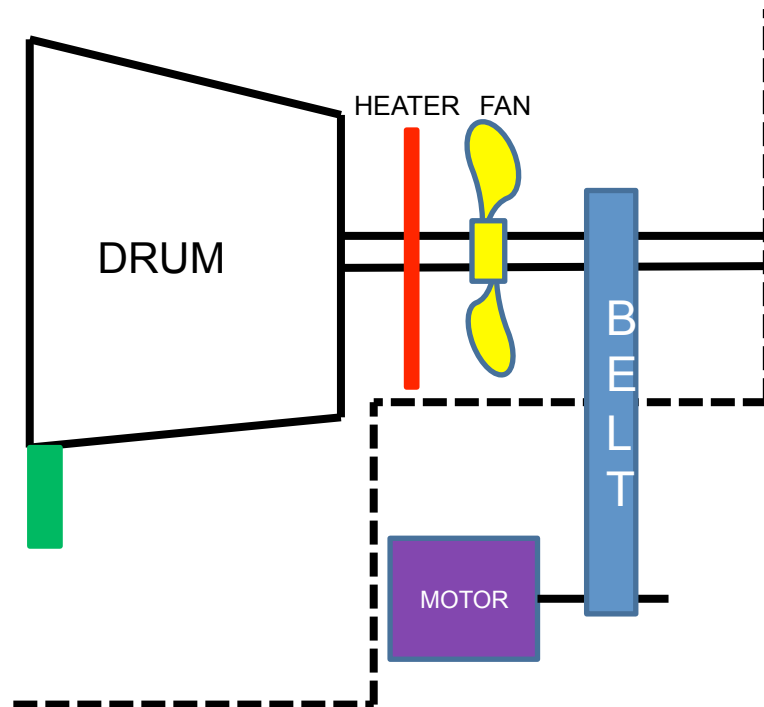
- Proposed Layouts for internal component packaging
- Main design directions are driven by:
 - use of an independently driven fan
 - belt driven fan

Configuration



1 Fan without additional motor

Layout 1 : Single belt



PROS

- ⦿ Most Compact package
- ⦿ Allows high drum speed rotation (1000+ rpm)
- ⦿ Direct airflow through the drum
- ⦿ Lower number of components

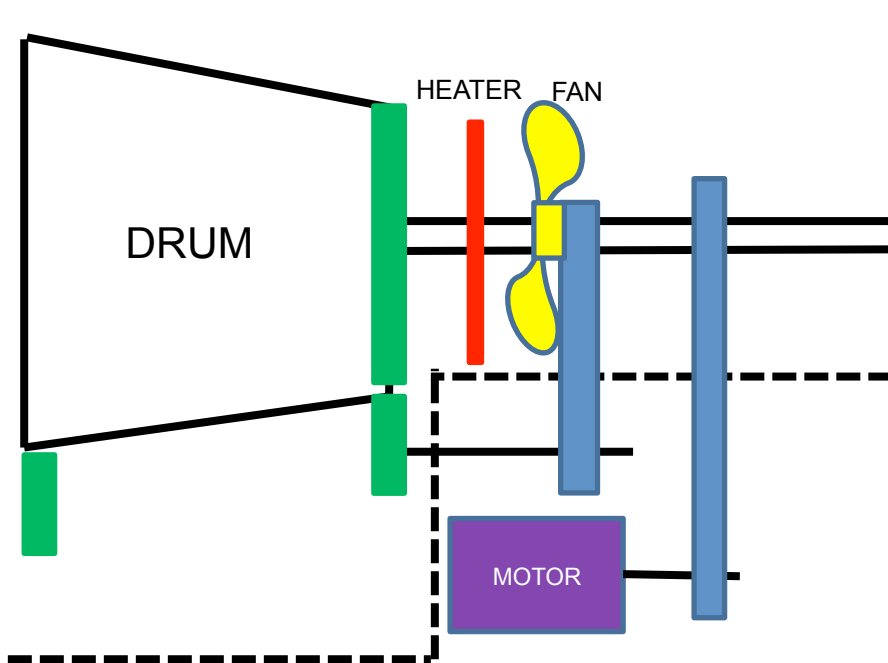
CONS

- ⦿ Fan speed & drum speed linked :
 - Low airflow during tumbling cycle
- ⦿ Custom pulleys, custom shaft required

Configuration



1
Fan without additional
motor
Layout 2 : Dual belt



PROS

- ⦿ Allows high fan speed rotation
- ⦿ Allows high drum speed rotation (1000+ rpm)
- ⦿ Direct airflow through the drum

CONS

- ⦿ Fan speed very fast during spin cycle
- ⦿ Packaging is difficult in given space
- ⦿ Extra components
- ⦿ Custom pulley, Custom shaft required

Configuration



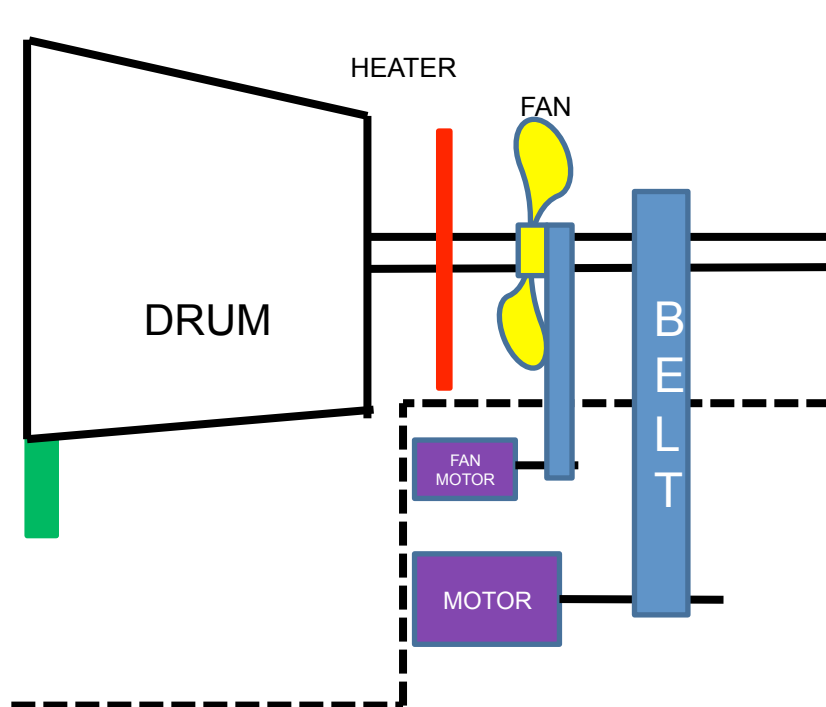
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Fan with additional motor:

- Layout 1 : Dual belt, separate fan motor

PROS

- Separate control for fan
- Airflow through full drum



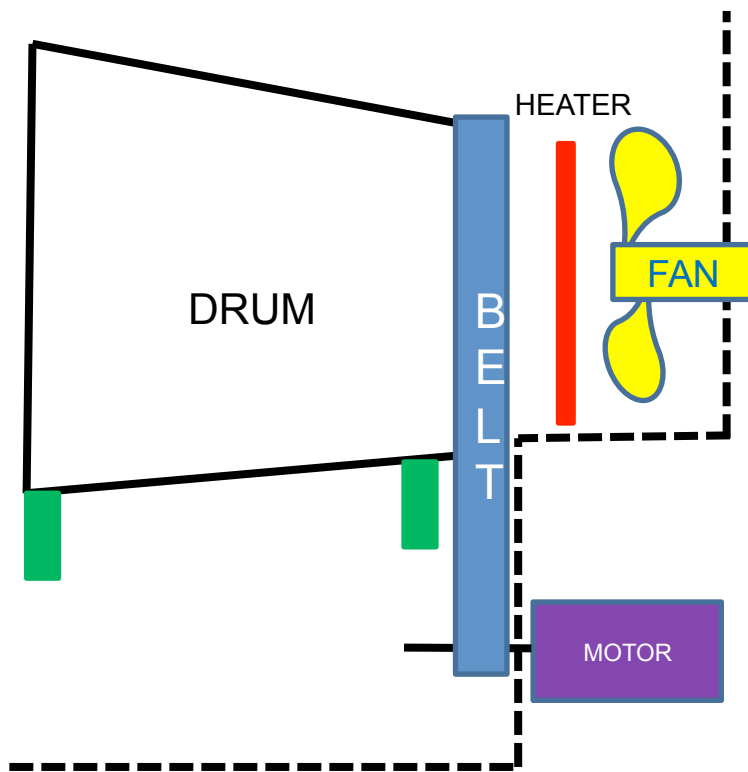
CONS

- More complex packaging
- Higher power consumption
- Expensive
- Difficult to service
- Custom pulleys, custom shaft required

2

Fan with additional motor:

- Layout 2 : Single belt, integrated fan motor



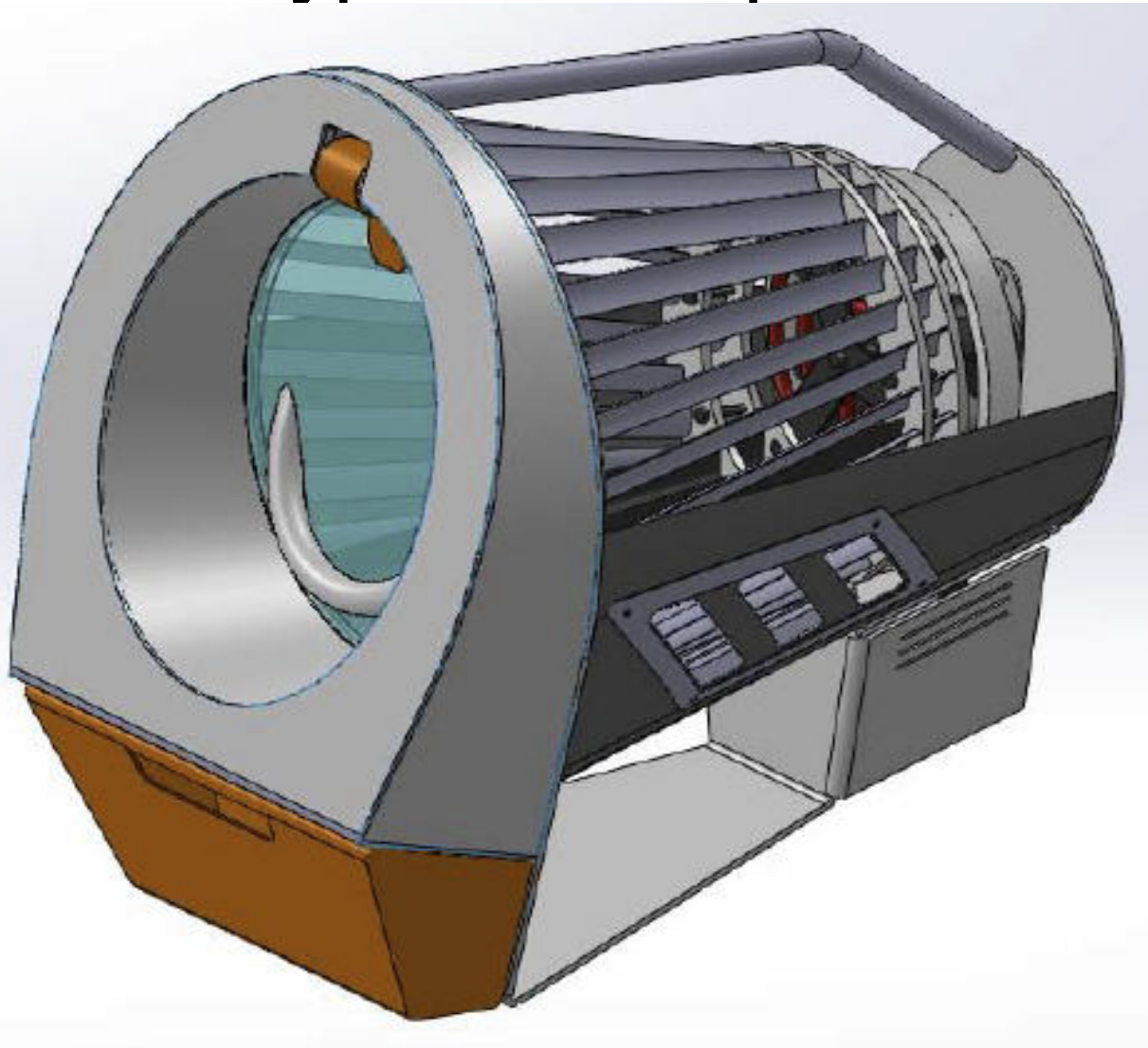
PROS

- Compact
- Less components
- Airflow through full drum

CONS

- Noisy
- Low drum speed
- Rollers add noise / packaging complexity

Prototype Development



DRUM

HANDLE

MOTOR
CASE

VENTS

Prototype Development

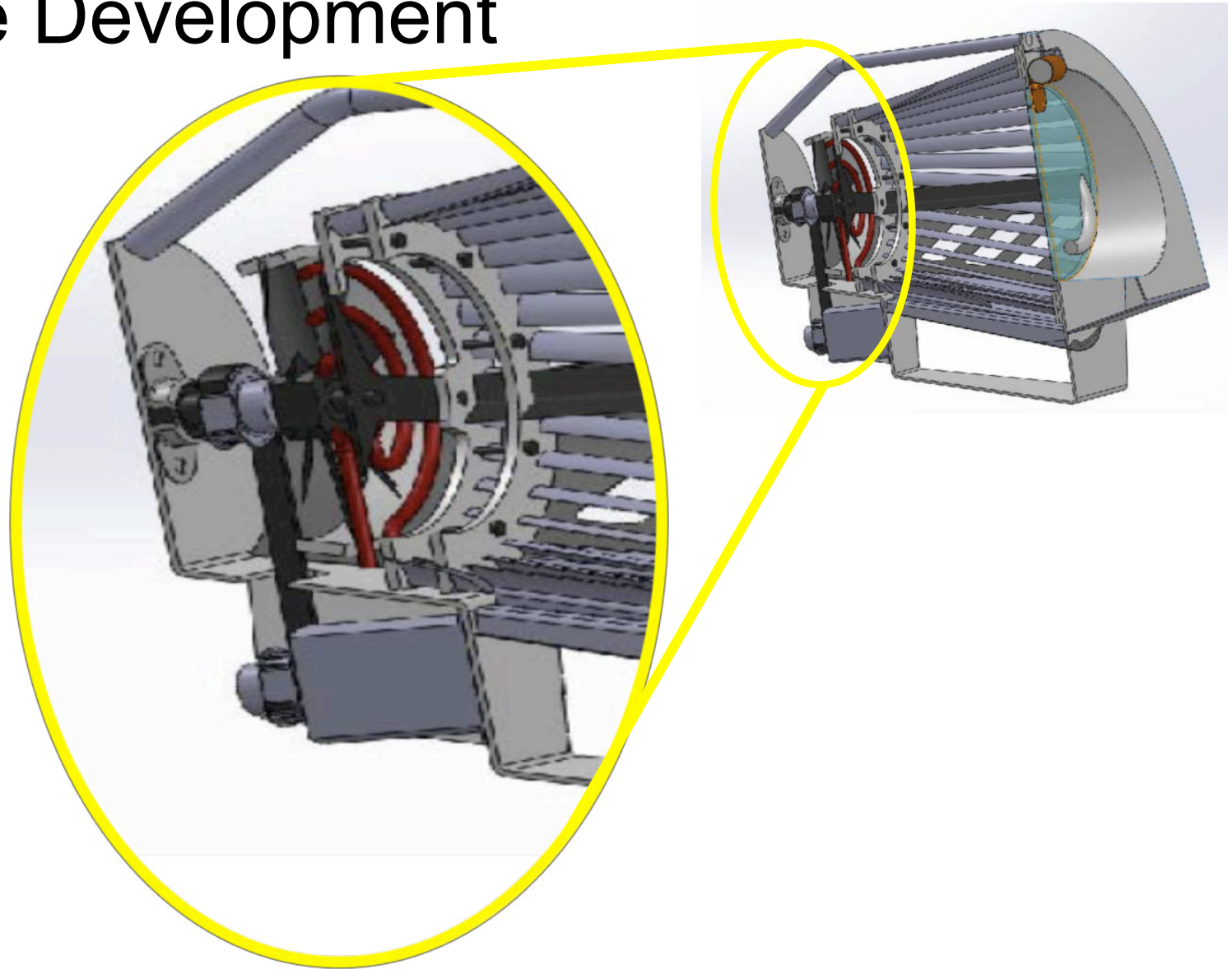
HEATER
COIL

MOTOR

DRIVE
BELT

FAN BLADE

DRUM



5.External Design

Overview

- Proposed designs for external components
- Main components being designed are:
 - Handle
 - Door Hinge
 - Door Handle
 - Water Cup
 - Fascia

Handle Design

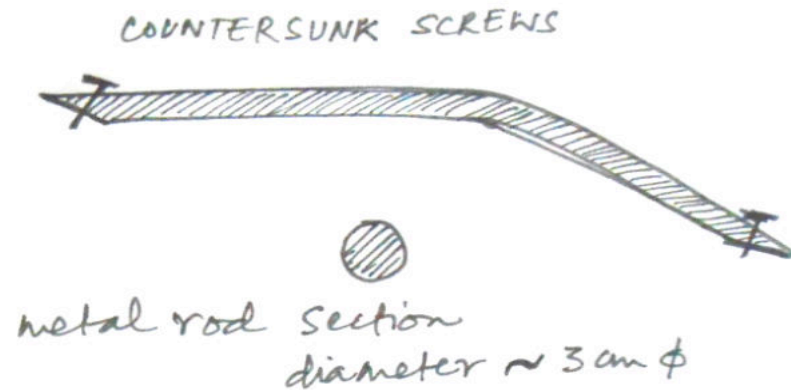
- Requirements / Constraints:
 - Comfortable to hold
 - Acts as a support to chassis structure
 - Balances CG of product adequately
 - Allows drum serviceability
 - Does not allow for leaks
 - Should not increase overall height of product
 - Easy to manufacture for prototype



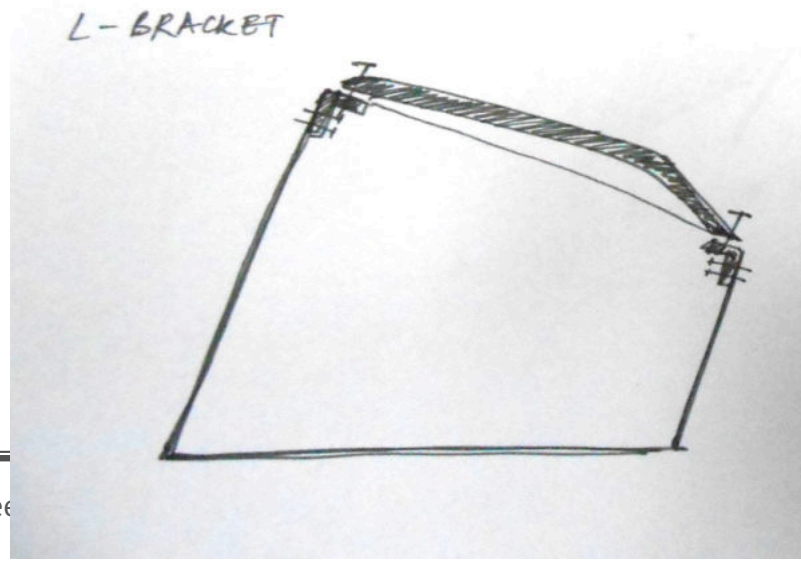
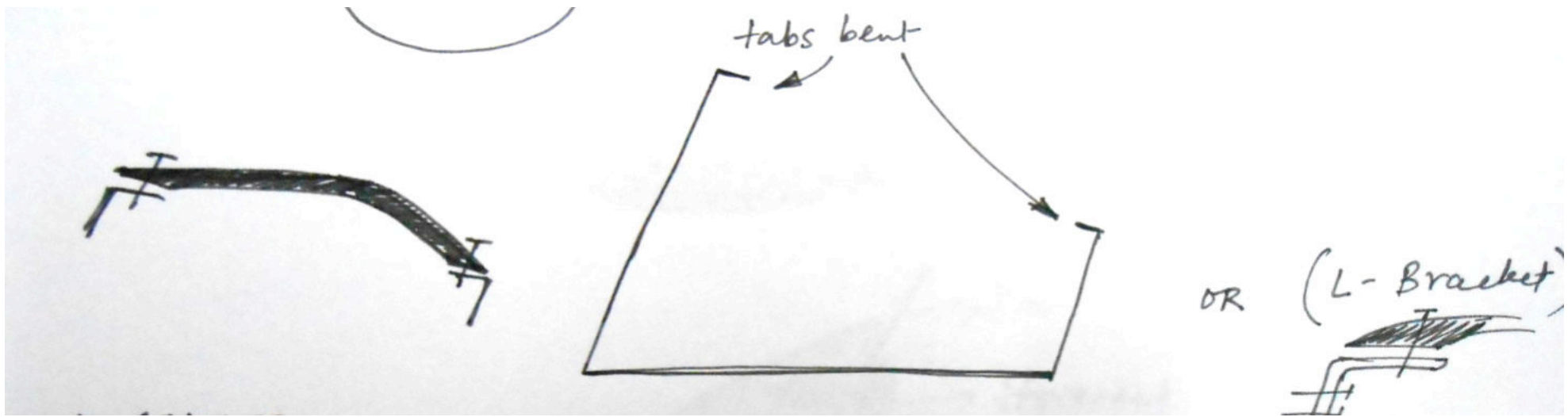
Handle Design

- Areas of Concern:
 - Bending of sheet tabs on chassis for mounting
 - Using mounting brackets undesirable, become extra parts
 - Mounting of brackets on chassis

Handle Design



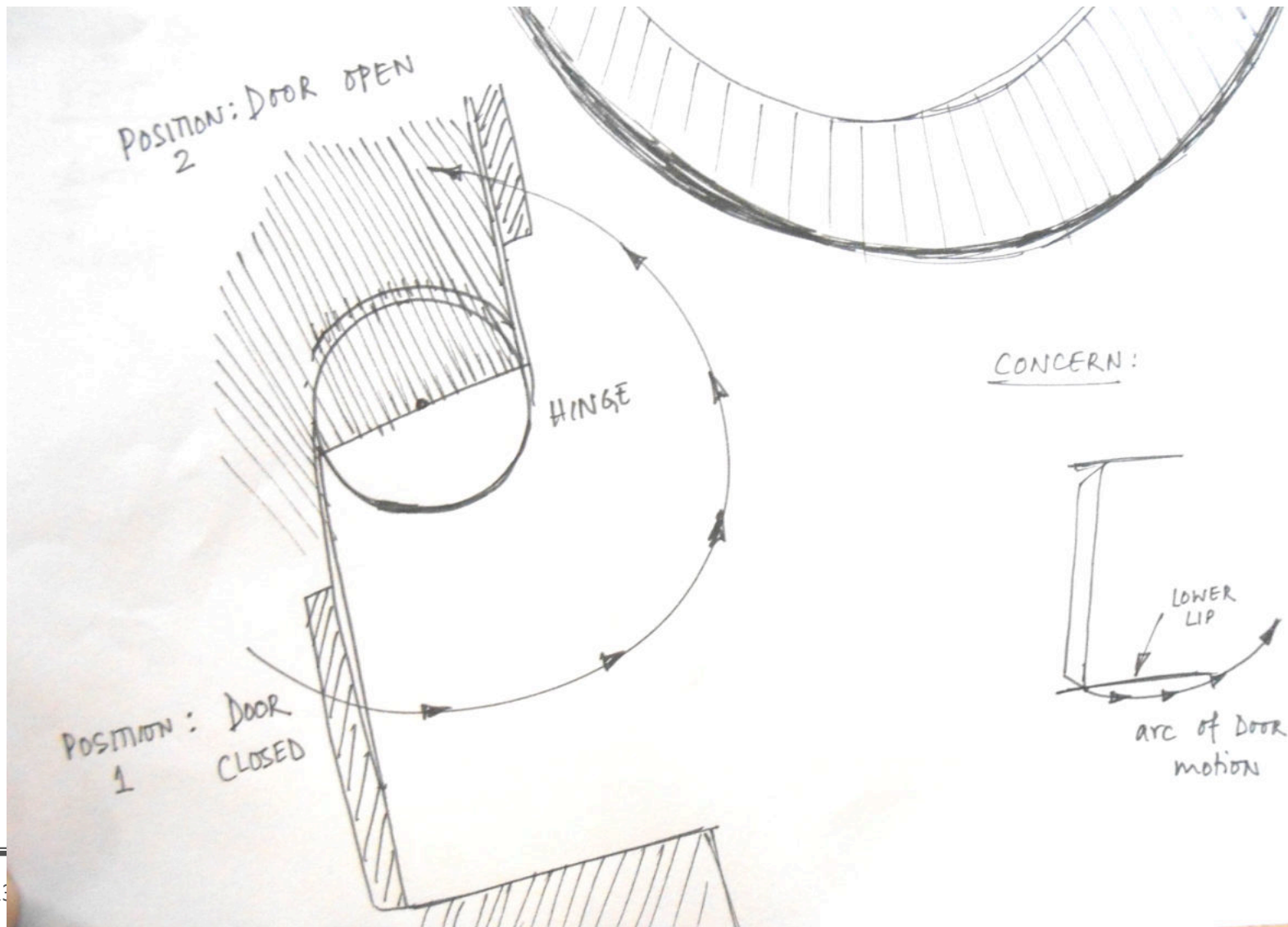
Handle Design



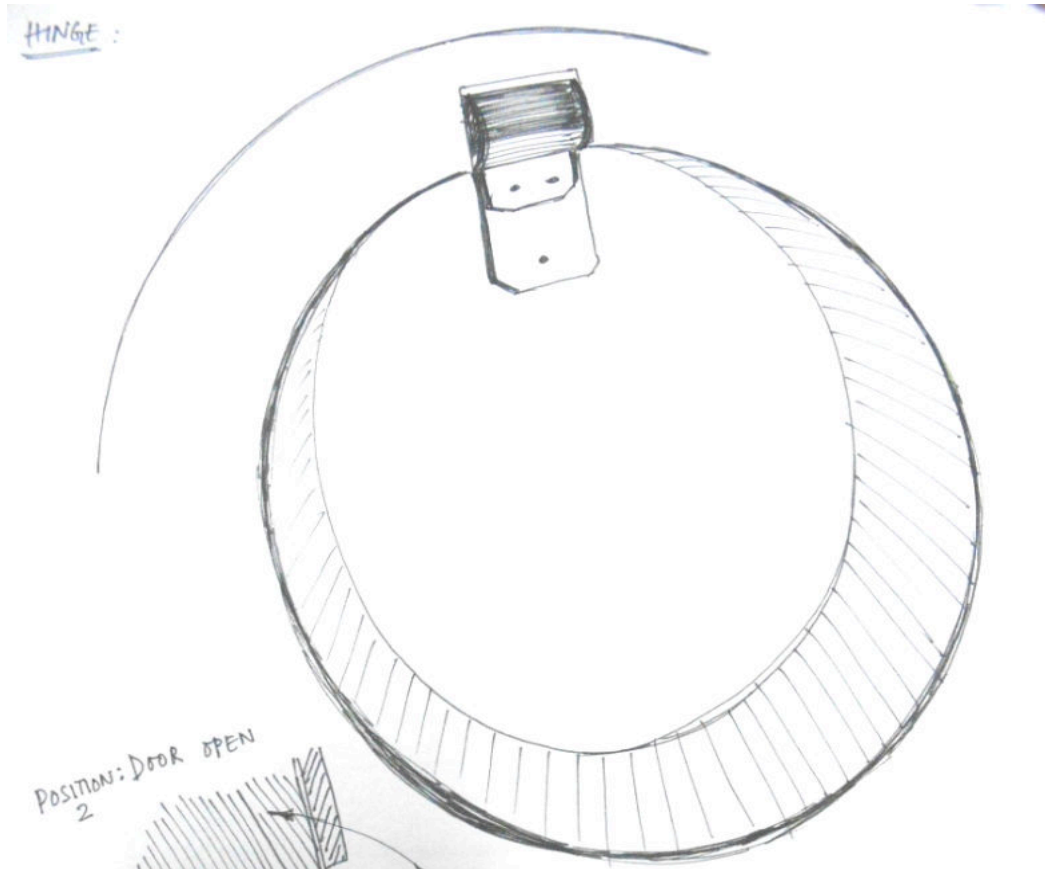
Door Hinge Design

- Requirements / Constraints:
 - Support of main aluminum sheet is required
 - Hidden mechanism
 - Simplify hinge-door mounting interface
 - Should open to 180°
 - No excess overhang of door
 - Door should not fall down once opened

Door Hinge Design



Door Hinge Design

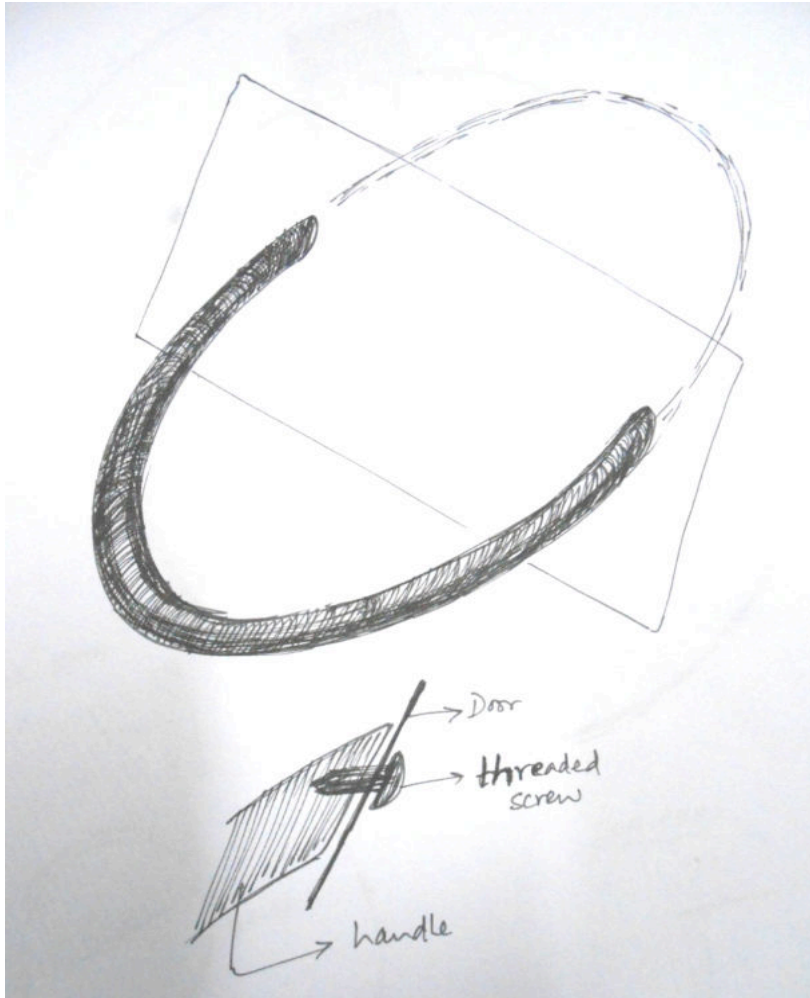


- Areas of Concern:
 - Door colliding with lower lip
 - Hinge operation noise

Door Handle Design

- Requirements / Constraints:
 - Comfortable to hold
 - Bottom scoop grip (fingers under handle)
 - ‘Smiley-faced’ design
 - Neat handle installation on transparent door
 - Easy to manufacture for prototype

Door Handle Design



- Areas of Concern:
 - Maintaining flush contact with door
 - Solid handle to allow mounting from inside of door

Water Cup Design

- Requirements / Constraints:
 - Self guiding
 - Bottom support
 - Secure when dryer is lifted and filled with water
 - Transparent for visual water level indication
 - Easy of use with one hand
 - Orientation – Horizontal or Vertical ?
 - No holes, grooves, drawer mechanisms, small parts like rollers

Fascia

- Considerations:
 - Should be accessible when the door is open position
 - Electronic housing should be away from water
 - Buttons for adjusting the settings should be added

Thank You!