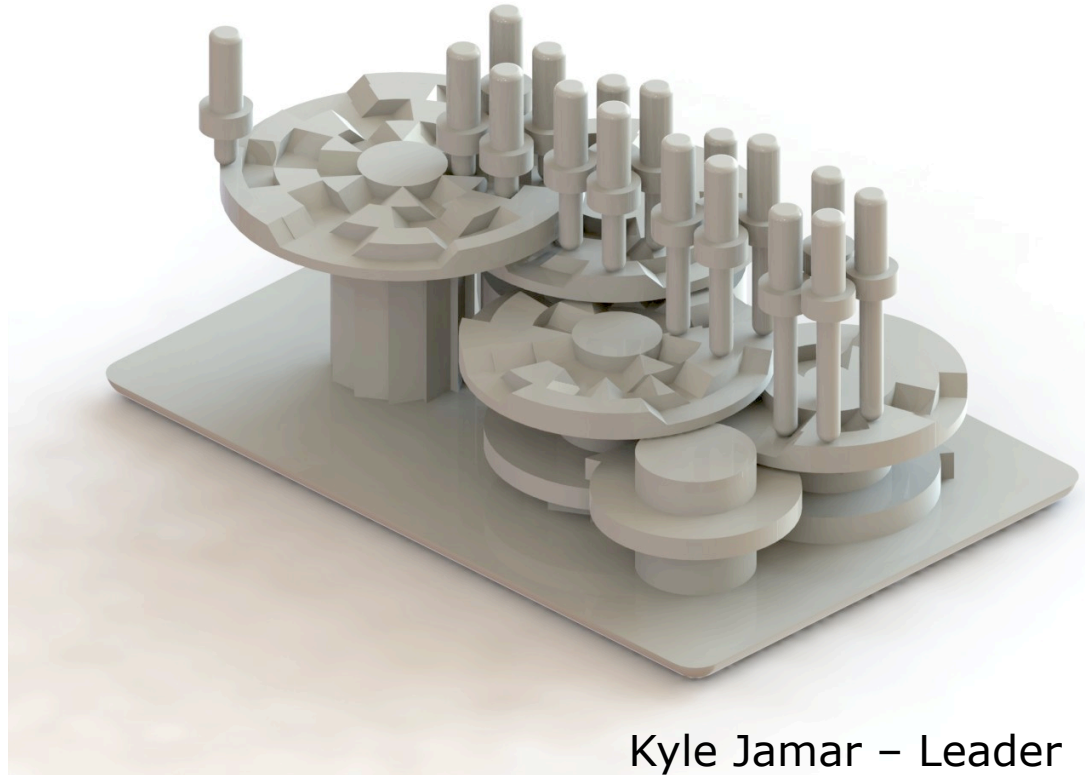


Digital Braille Watch



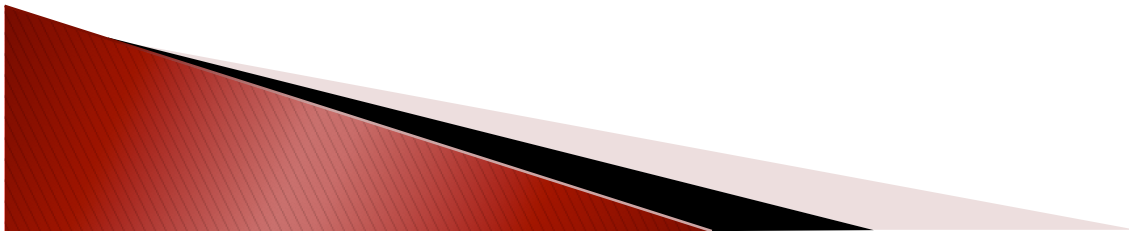
Kyle Jamar – Leader
Nick Anderson – Communicator & BWIG
Luke Juckett – BSAC

Clients: Holly and Colton Albrecht
Advisor: John Puccinelli, Ph.D.

March 9, 2012

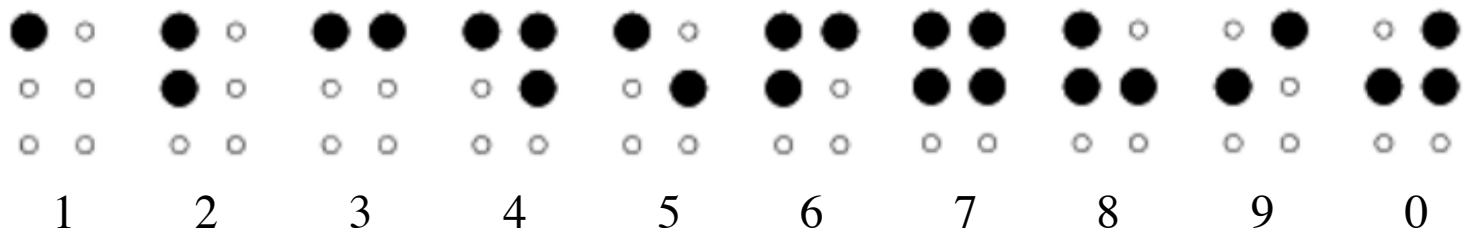
Overview

- ▶ Braille Background
- ▶ Current Methods
- ▶ Problem Statement
- ▶ Design Summary
- ▶ Design Animation
- ▶ Prototype
- ▶ Fabrication
- ▶ Motor Design
- ▶ Future Work



Braille Background

- ▶ Size standards
 - Each character consists of 3x2 grid
 - Dots at least 2.34 mm. apart
 - Characters at least 6.22 mm. apart
- ▶ Four characters needed to display time
- ▶ Braille numbers use only top 4 positions



Current Methods

- ▶ Talking Watch
 - Disruptive
- ▶ Tactile Watch
 - Fragile
 - Difficult to read
- ▶ Various Concept Watches
 - No mechanisms



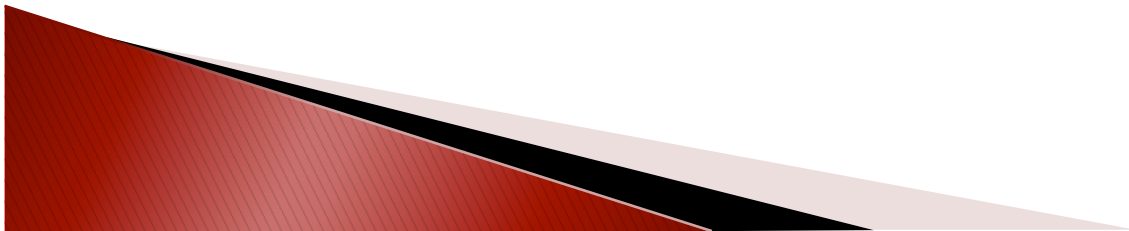
<http://watchluxus.com/braille-watches-by-auguste-reymond>



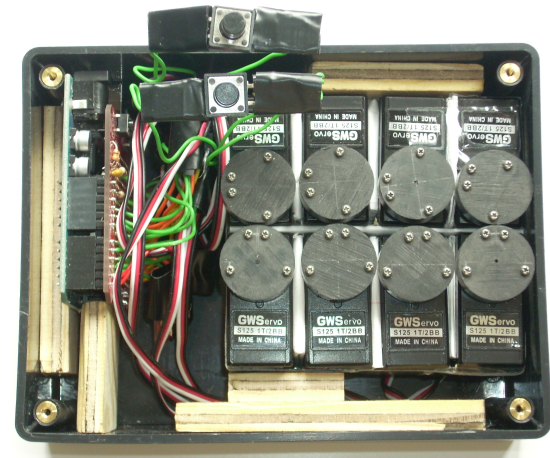
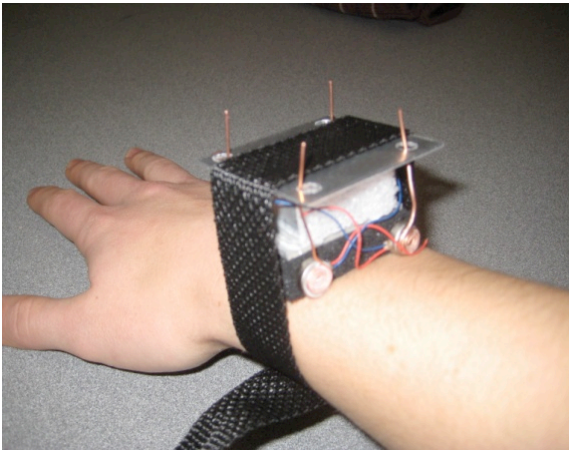
http://ecx.images-amazon.com/images/I/41hK4nPA-zL._SL500_AA280_.jpg

Problem Statement

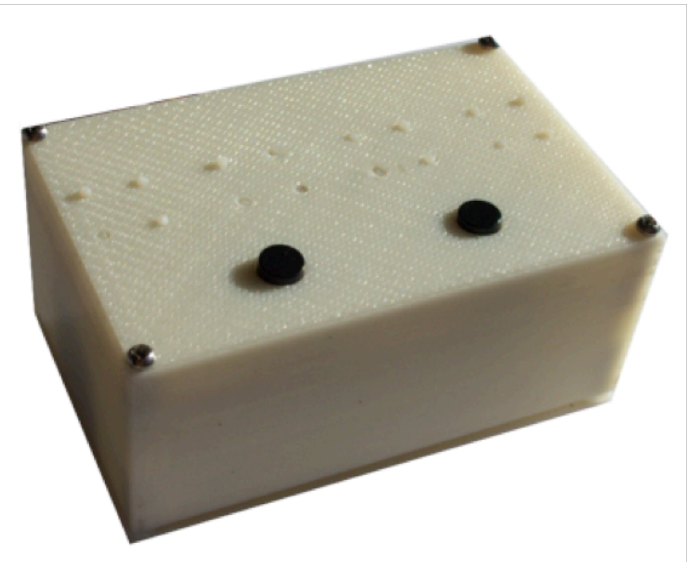
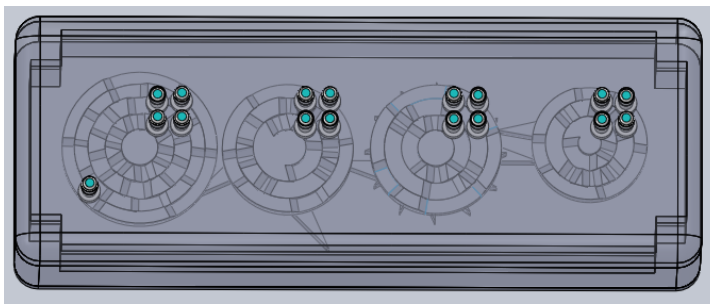
- ▶ Develop a Digital Braille Watch that...
 - Uses standard Braille numbering and spacing
 - Is the size of a standard wristwatch
 - Has a self-contained motor and power supply
 - Can be manufactured accurately and precisely with durable materials



Past Design Projects

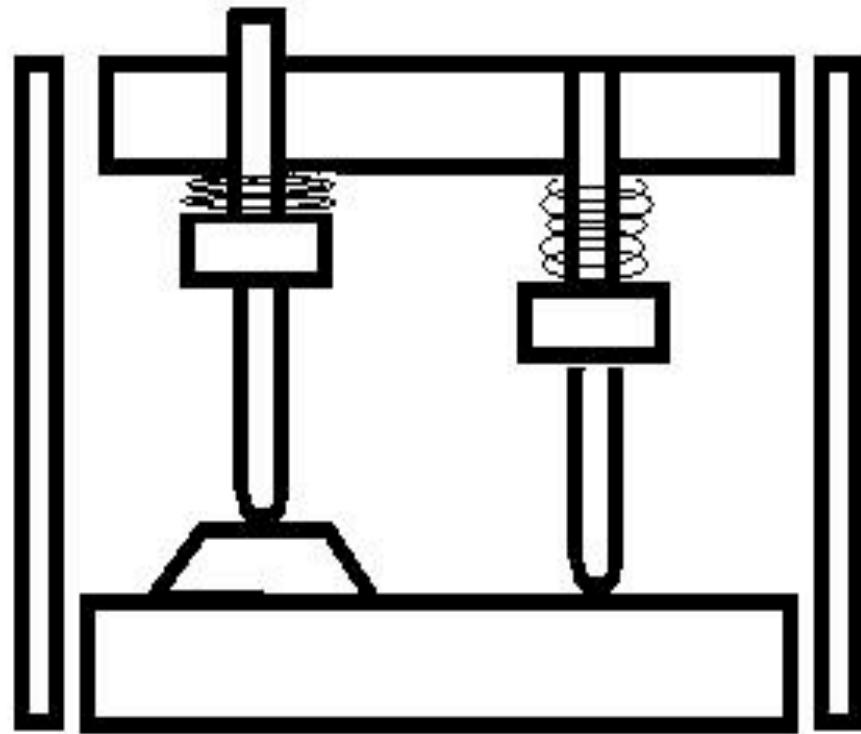


MANY!!!



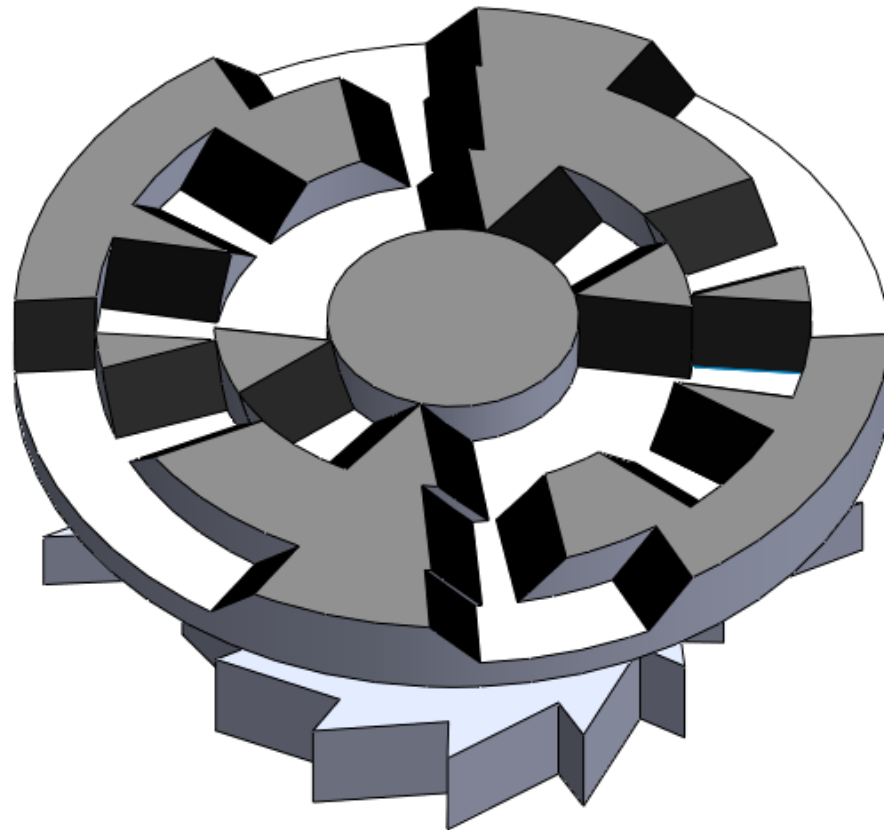
Design Feature 1 – Pins

- ▶ Pins rest atop a disk with raised and lowered surfaces
- ▶ Raised pins can be detected

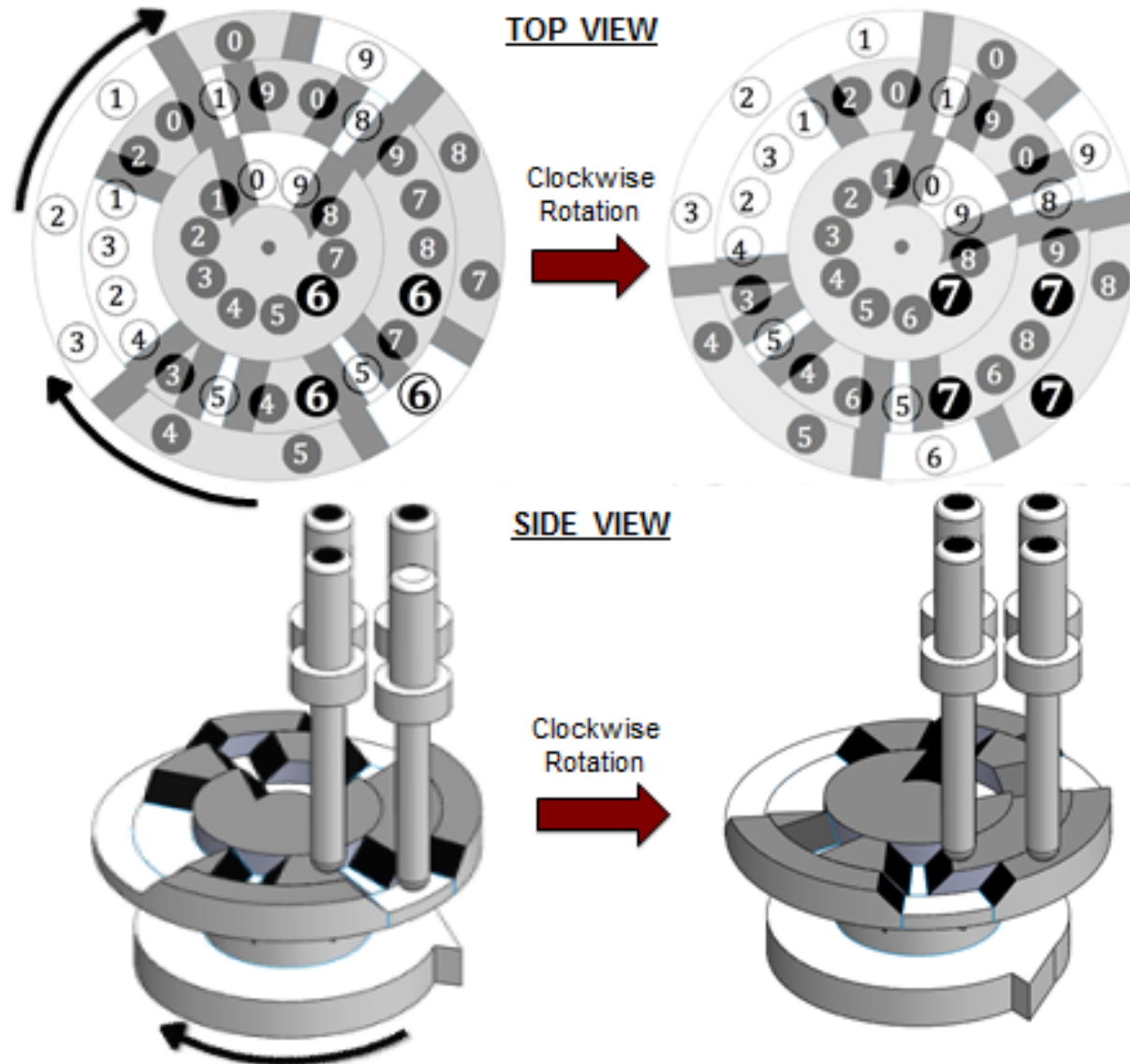


Design Feature 2 – Disks

- ▶ Disks contain raised and lowered surfaces
- ▶ 4 pins rest upon each disk to form number

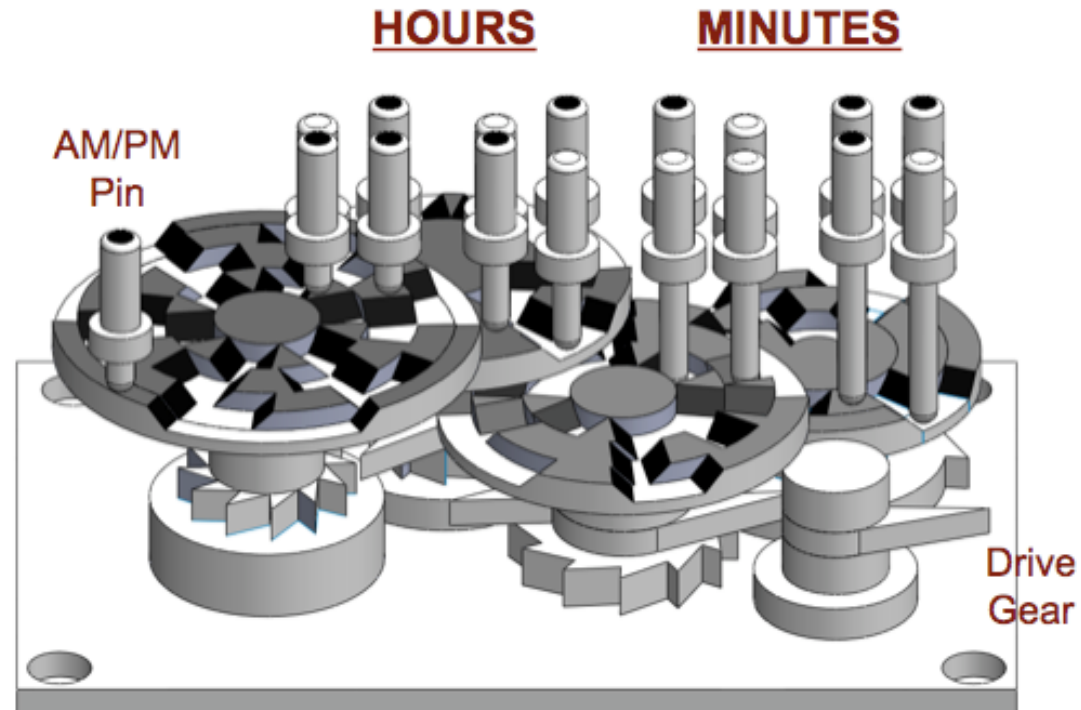


Design Feature 2 – Disks



Design Feature 2 – Disks

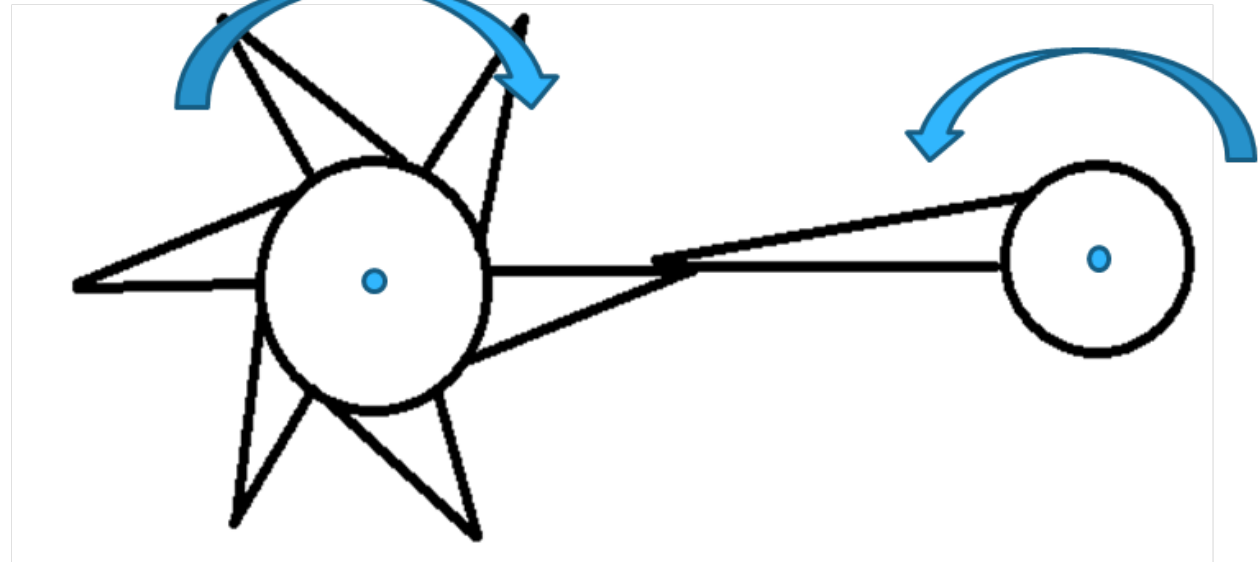
- ▶ Each disk surface is designed differently to correspond with the numbers it must display



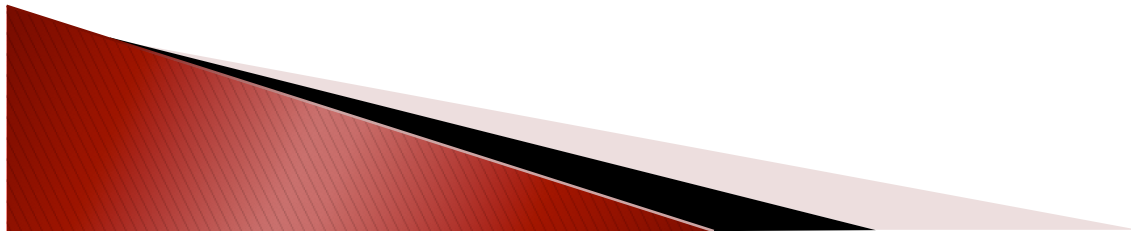
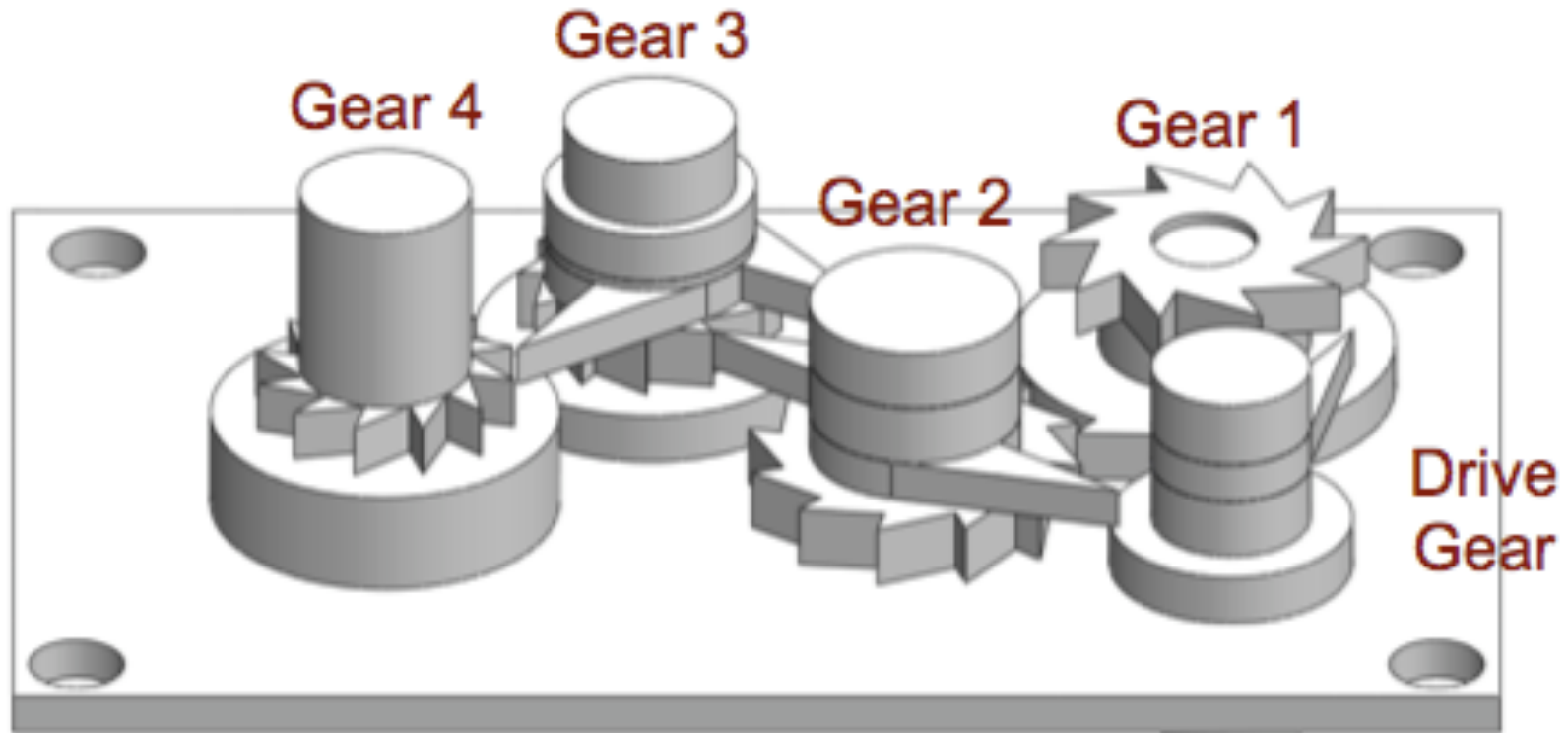
<u>DISK #4:</u>	<u>DISK #3:</u>	<u>DISK #2:</u>	<u>DISK #1:</u>
Displays	Displays	Displays	Displays
0 or 1	1-9; 0-2	0-5	0-9

Design Feature 3 – Gears

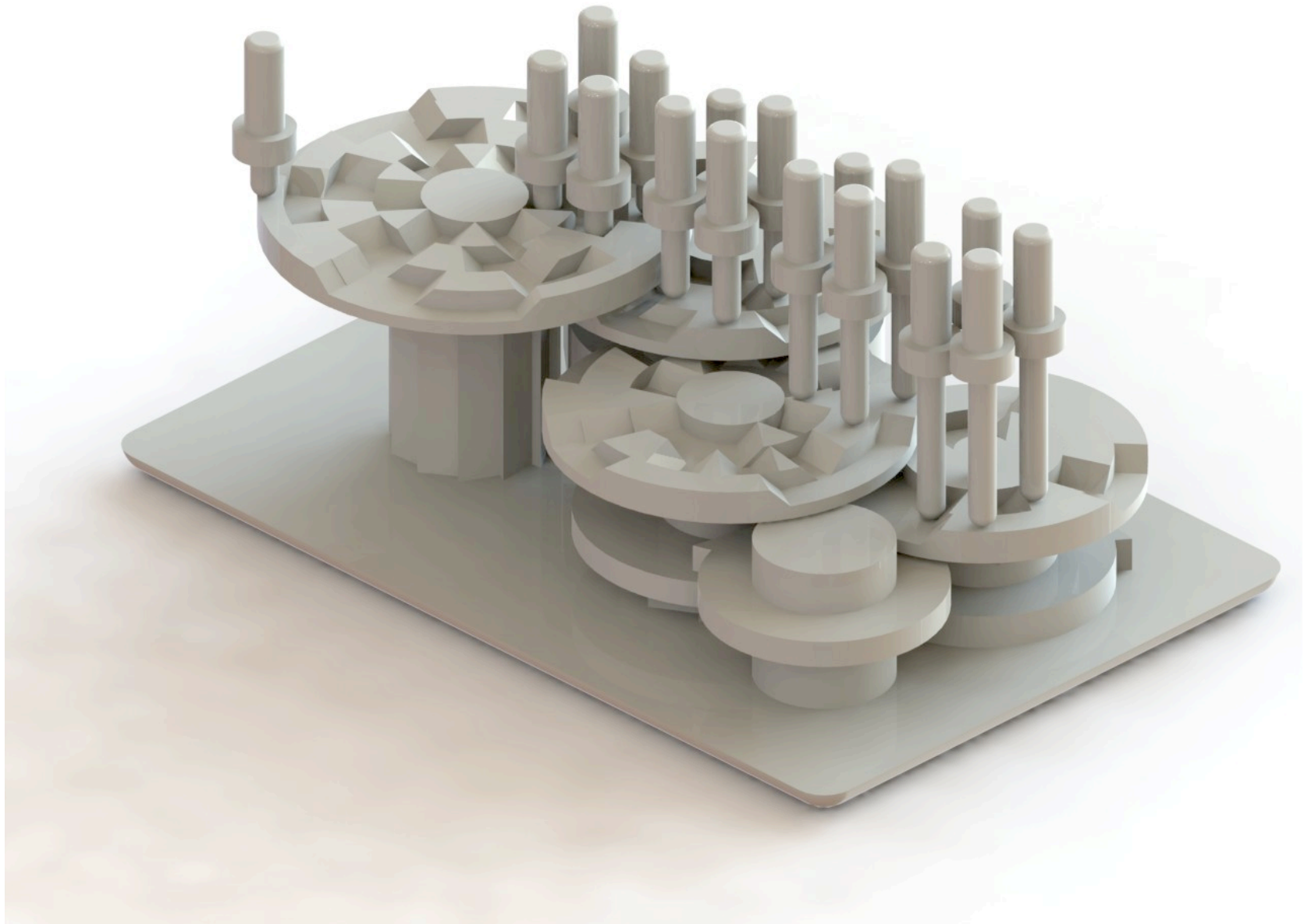
- ▶ Complete rotation of one gear corresponds to a partial rotation of another
- ▶ Creates “odometer effect”



Design Feature 3 – Gears



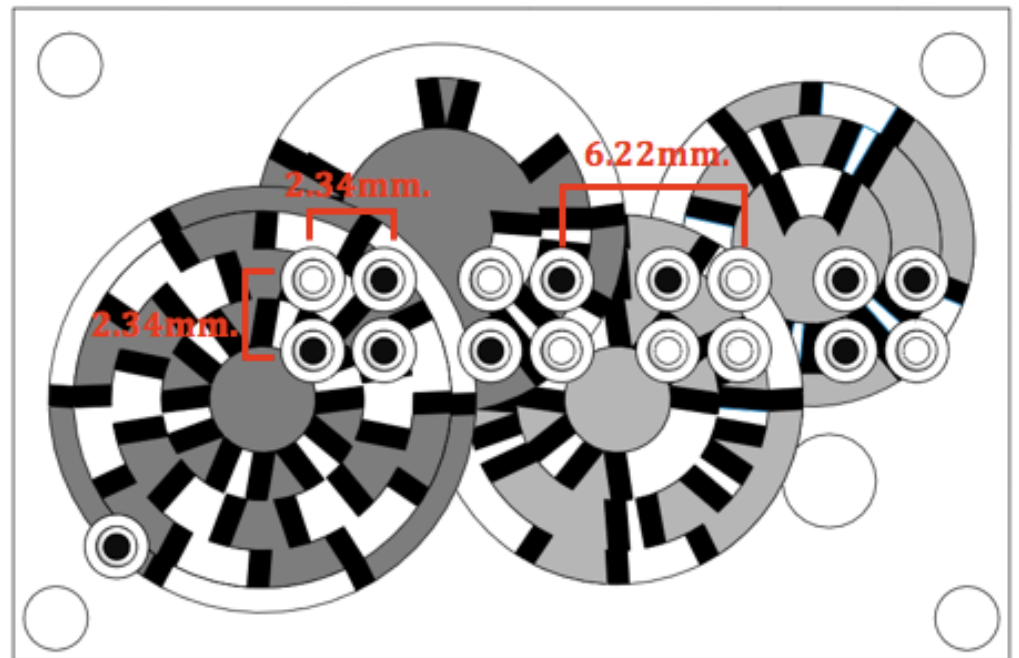
Complete Design Assembly



SolidWorks Animation

Prototype

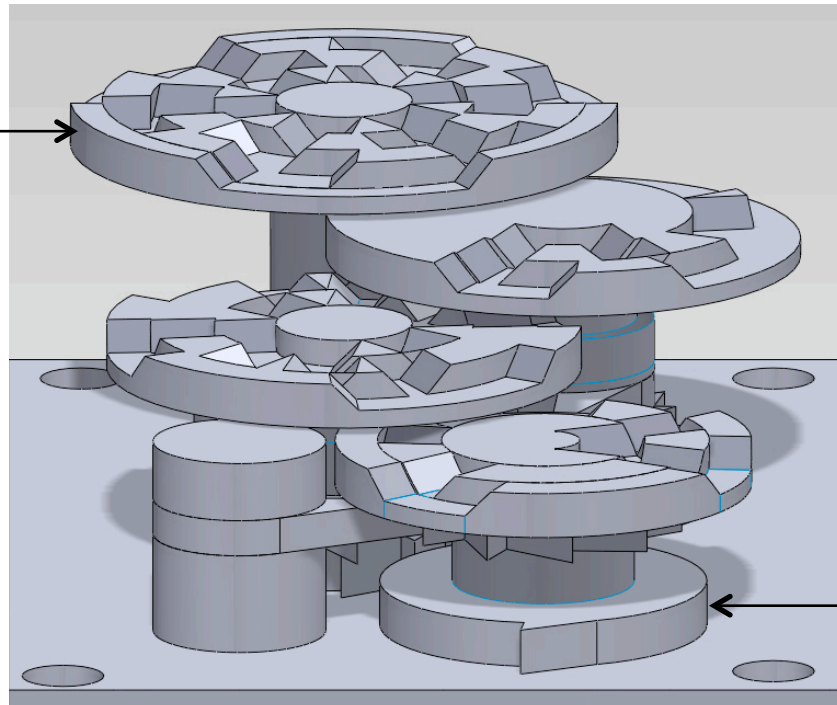
- ▶ Watch-sized
- ▶ Standard Braille spacing
- ▶ Animation verified calculations
- ▶ Many limitations
 - Accuracy
 - Internal friction
 - Material durability
 - No motor



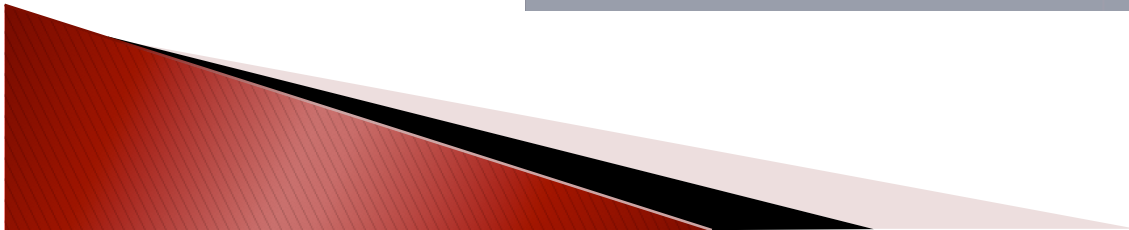
Fabrication

- ▶ 2 main components

Disk
Surfaces

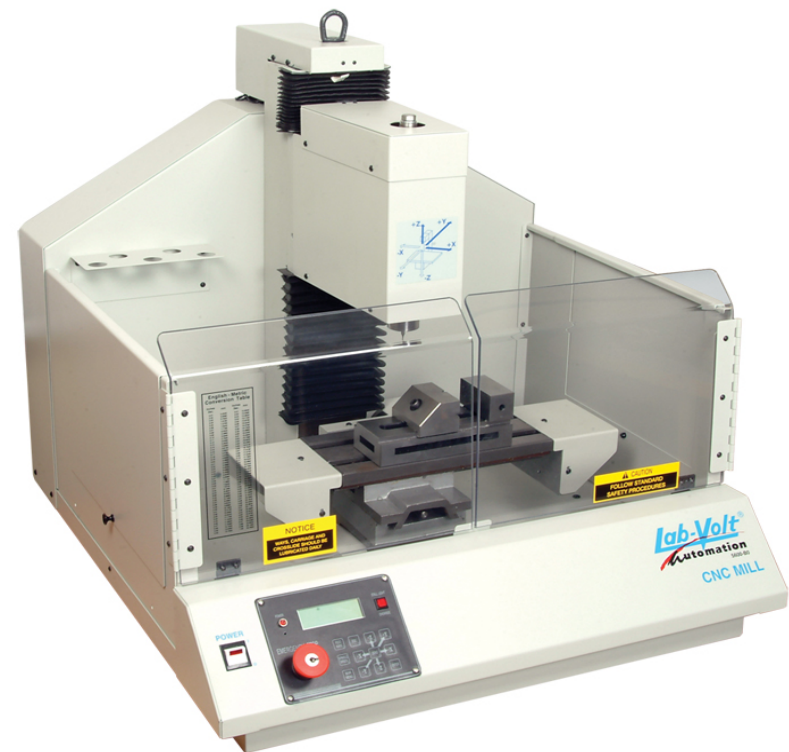


Gear
Layers



Disk Fabrication

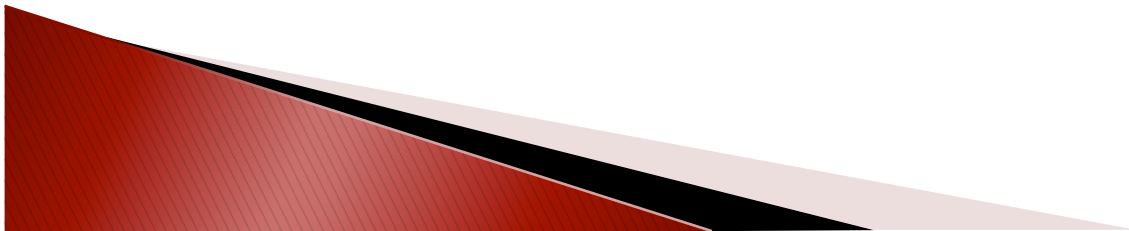
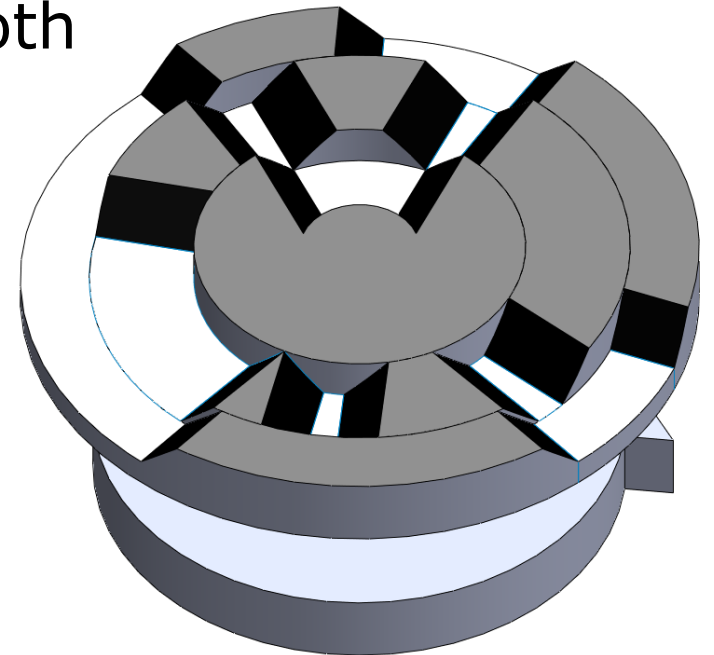
- ▶ CNC milling
 - Computer numerical control to machine solid materials
- ▶ Optional Materials
 - Metal – likely aluminum



<http://www.labvolt.com/uploads/products/full/5600-cnc-millnew.jpg>

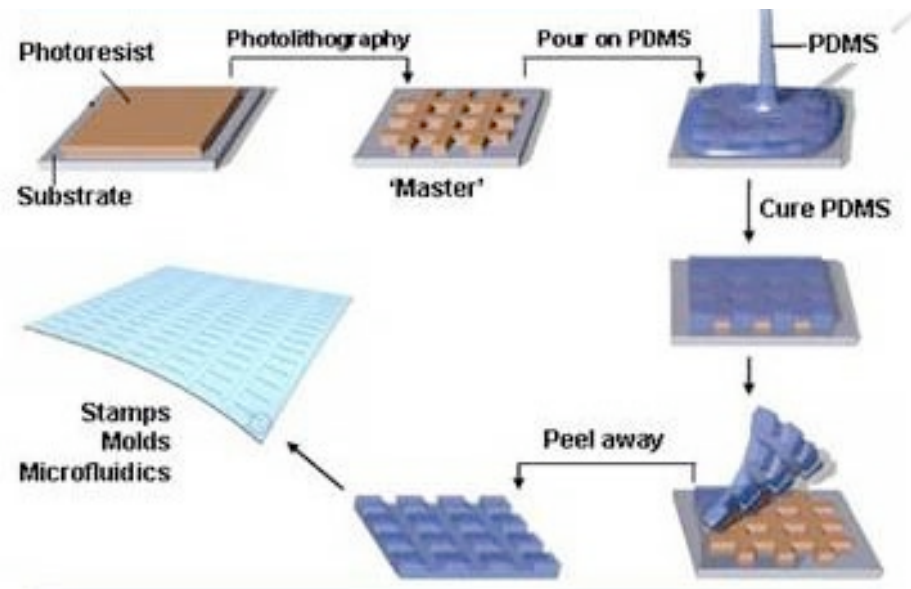
Disk Fabrication

- ▶ UW Physical Sciences Lab
 - May be able to assist
 - Currently determining price estimate
- ▶ Challenges
 - Cost
 - Sloped surfaces must be smooth



Gear Fabrication

- ▶ Photolithography
 - Shine UV light through photomask to make a 'Master'
- ▶ Soft Lithography
 - Create mold from 'Master'
 - Use mold to make desired part



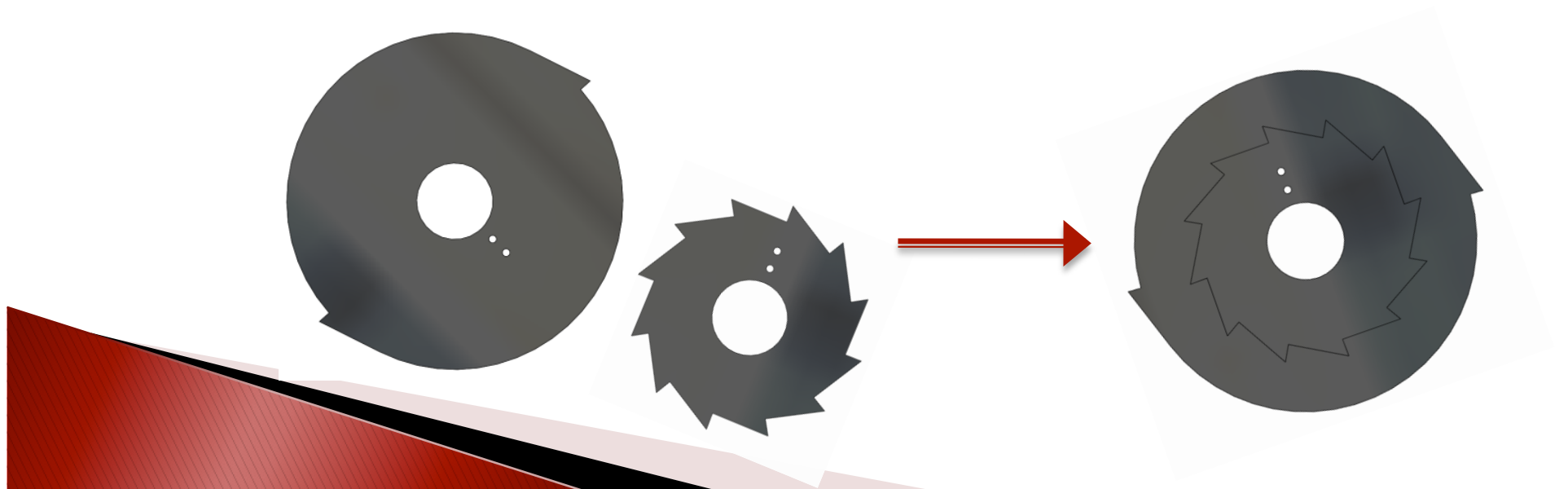
http://www.nanoterra.com/soft_lithography.asp

Gear Fabrication

- ▶ Melting Point Mold > Casting Temp. Gears
- ▶ Optional Materials – Mold
 - PDMS: MP = 200° C
 - PTFE: MP = 327° C
 - Contacted DuPont Chemical
- ▶ Optional Materials - Gears
 - ABS plastic: CT = 105° C
 - Aluminum: CT = 620° C
 - Zinc: CT = 420° C

Gear Fabrication

- ▶ Using photolithography will help reduce overall watch height by $\sim 12\%$
- ▶ Challenges
 - Gears must be manufactured in layers
 - Alignment feature must be added to gears
 - Assembly of layers must be precise



Motor Design

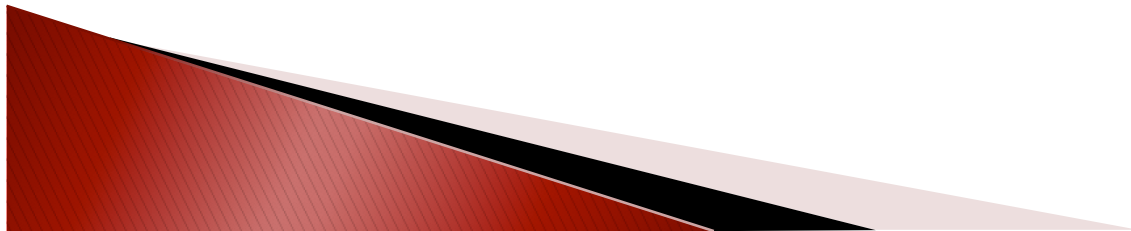
- ▶ Requirements:
 - Able to overcome the maximum internal force
 - Fits within footprint of current design
 - Can be powered by long-lasting, DC source
- ▶ UW Physical Sciences Lab
 - Assisting with micromotor research and implementation



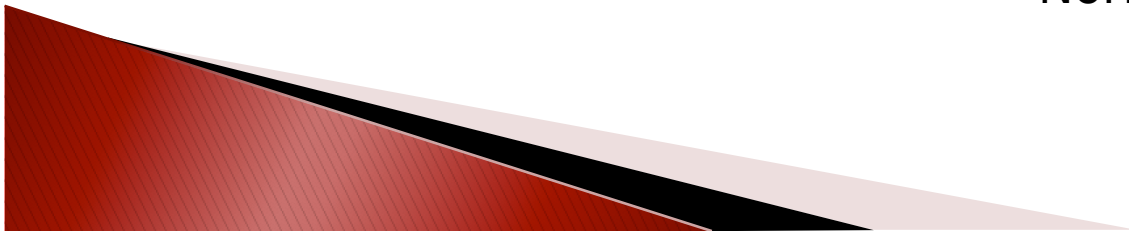
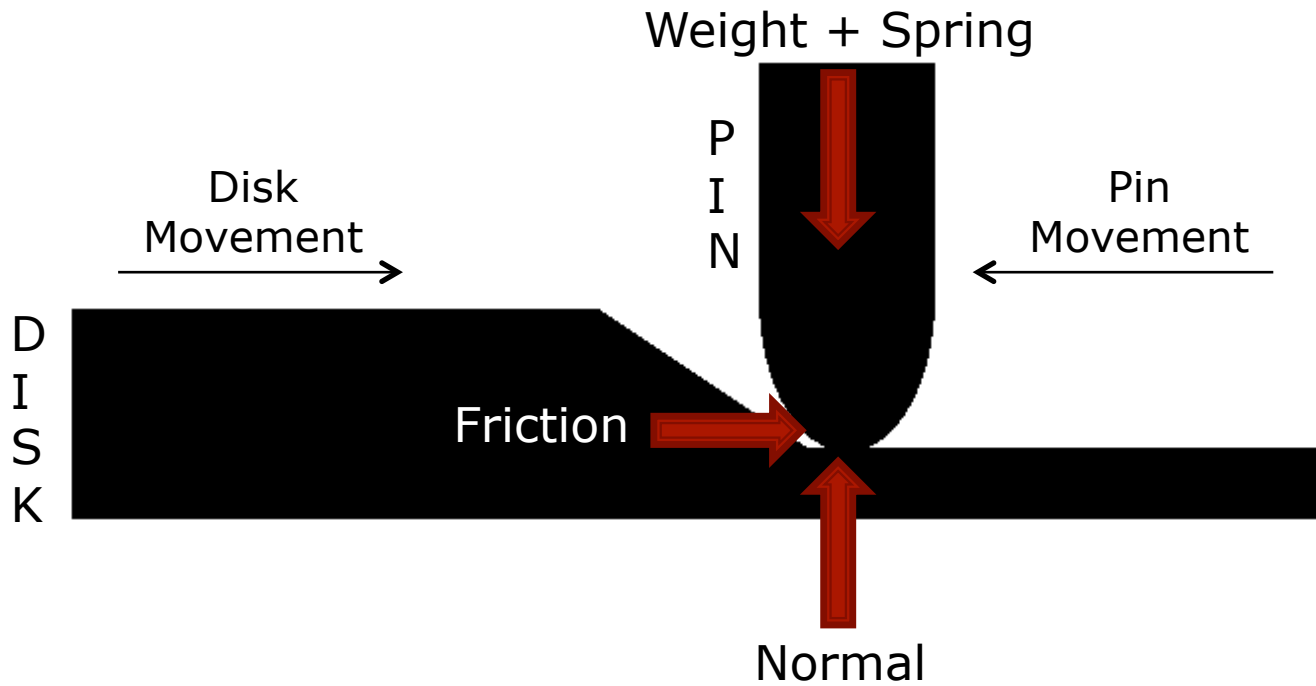
<http://www.orientalwatchsite.com/choosing-the-right-watches-movements-affects-quality-and-lifespan/>

Force Calculations

- ▶ Modeling worst case scenario reveals torque requirement for motor
- ▶ Forces to consider
 - Frictional force between bottom of gears and casing
 - Frictional force between gears and axels
 - Frictional force between interacting gears
 - Frictional force between pins and disks
 - Spring force pushing pins into disks
 - Pin Weight
 - Gear and Disk Weight

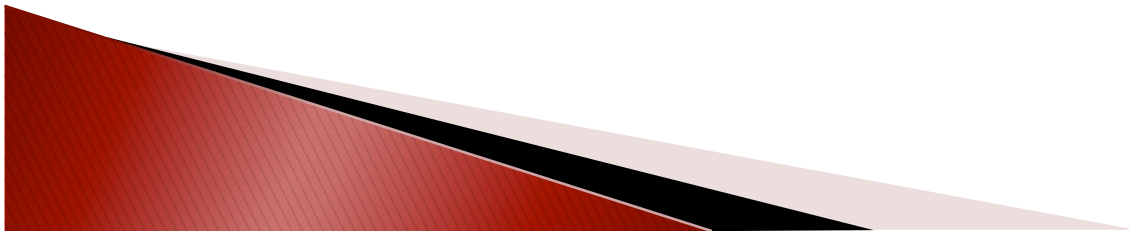


Force Calculations



Semester Goals

- ▶ Finish force analysis
- ▶ Fabricate parts
- ▶ Implement motor
- ▶ Produce functional product
- ▶ Test prototype
- ▶ Gain company interest



Acknowledgments

- ▶ Holly and Colton Albrecht
- ▶ John Puccinelli, Ph.D.
- ▶ Callie Bell, J.D.
- ▶ Wisconsin Alumni Research Foundation
- ▶ Wisconsin Institutes for Discovery
- ▶ UW Physical Sciences Lab
- ▶ UW Biomedical Engineering Department
- ▶ Survivor

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- ▶ http://ecx.images-amazon.com/images/I/41hK4nPA-zL._SL500_AA280_.jpg
- ▶ <http://www.labvolt.com/uploads/products/full/5600-cnc-millnew.jpg>
- ▶ http://www.nanoterra.com/soft_lithography.asp
- ▶ <http://www.a-m.de/englisch/lexikon/giesstemperatur.htm>
- ▶ http://www2.dupont.com/DuPont_Home/en_US/index.html
- ▶ <http://www.orientalwatchsite.com/choosing-the-right-watches-movements-affects-quality-and-lifespan/>



