Design Realization Phase for a Device to Improve Waking From Sleep

Team 5

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TEAM 5

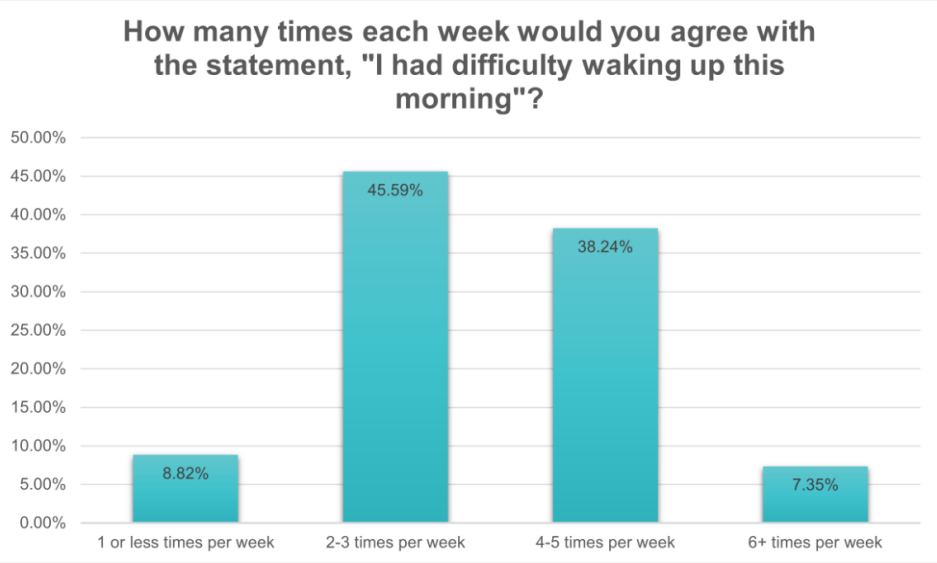
Problem Statement

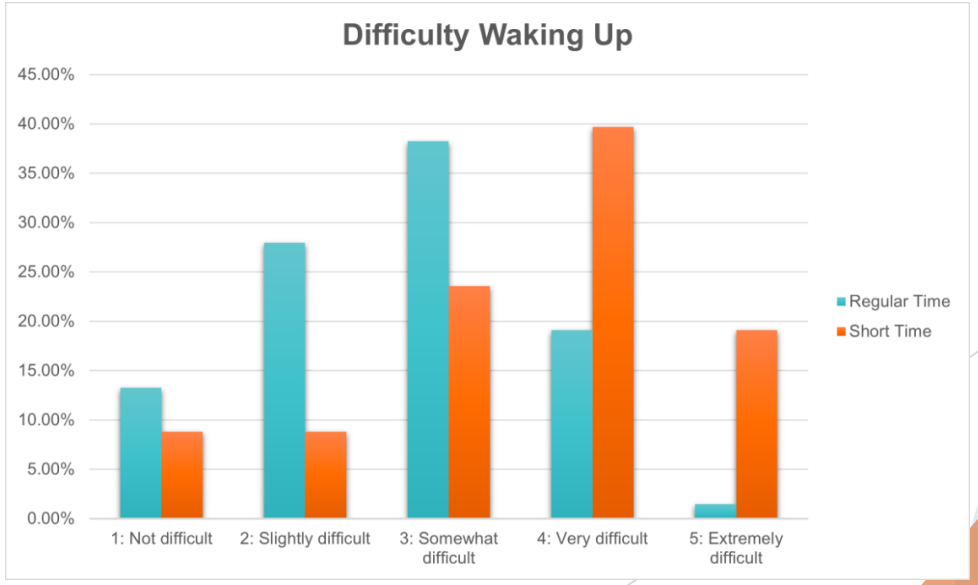
Research shows that most adolescents (90.6%) report having difficulty waking up, which prolongs a phenomenon known as sleep inertia. The team aims to design and implement a device to reduce sleep inertia, making waking up easier.

TEAM 5

Market and Consumer Research

- According to a survey of 7,000 adolescents, 90.6% reported difficulty waking up in the morning. Therefore, based on the same percentage, nearly 38 million US adolescents are affected by the problem.
- Based on our survey of 68 college students, 83.8% reported difficulty waking up between 2 and 5 times per week.
- Lastly, medical research has shown that current waking devices (alarm clocks) increase the chances of adverse health outcomes (Kim, 2023)





Based on the estimated size of the market (38 million adolescents), the conducted consumer research (which shows that most people experience at least some difficulty waking up in the morning), and the fact that current solutions (alarm clocks) are disruptive and have negative effects on health, we can conclude that current market solutions are incomplete. This motivates the need for innovation in the sleep-waking-device space.
- Aadit Kumar, 23rd April 2024

Problem Definition

Quantitative Requirements

1. Must wake user from sleep at least 95% of the time
2. Must not cost more than $120 per unit for the consumer
3. Must cost less than $30 per unit to produce
4. Must require, at most, one configuration per week
5. Must survive a drop height greater than four (4) feet
6. Must occupy less than 180 cubic inches of space
7. Must weigh less than four (4) pounds
8. Must consumer less than two (2) watts of power
9. Must have a minimum fillet radius greater than 0.05 inches
10. Must have no choking hazards with a diameter less than two (2) inches
11. Must last more than 2000 use cycles
12. Must contain no substance concentrations above the EPA standard
13. Must take less than 20 minutes to install and set up
14. Must require less than two (2) additional parts
15. Must have no greater than two (2) protruding buttons
16. Must be built using more than 50% recyclable components
17. Must require no more than two (2) tools to assemble

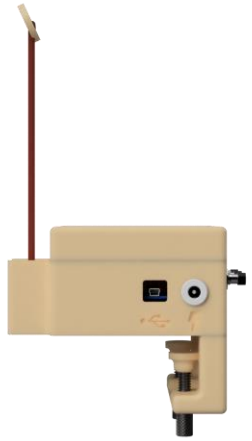
Qualitative Requirements

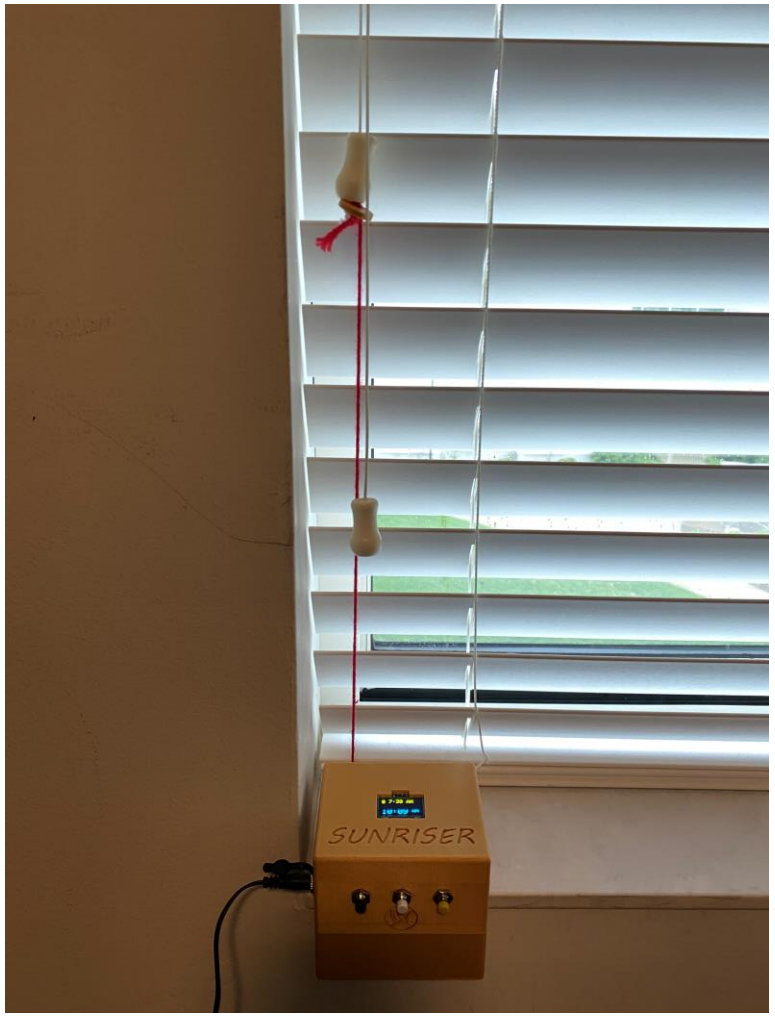
1. Must allow adjustable settings
2. Must not have adverse health effects (non-disruptive)
3. Must encourage user to physically get out of bed
4. Must not degrade upon exposure to disinfectant
5. Must be designed with neutral colors
6. Must be manufactured in the USA
7. Must be wheelchair accessible

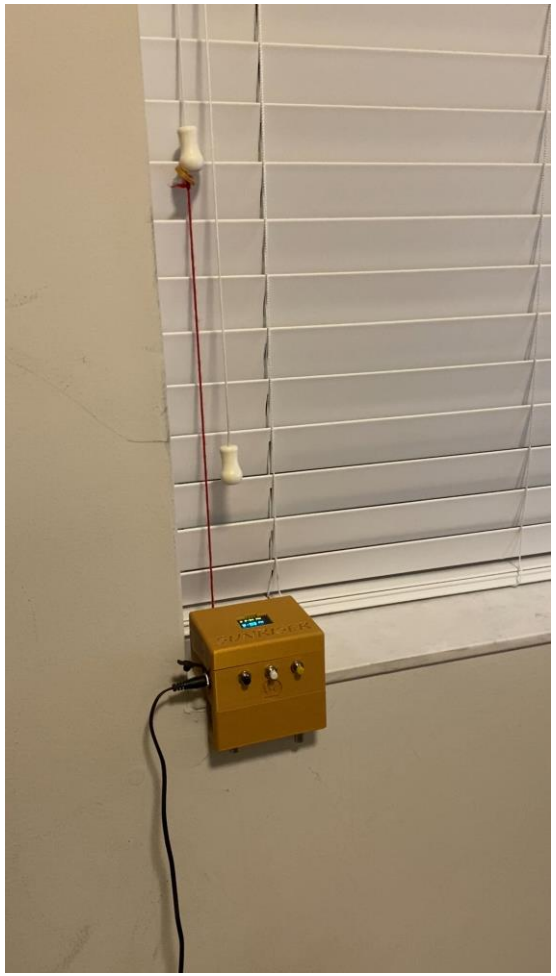
The most important quality of an alarm clock is its reliability in waking the user. Also, to combat the unhealthy nature of products currently on the market, we need to ensure that our product doesn't cause adverse health effects. Durability, affordability and the need to not wake roommates are essential requirements for our target demographic—college students.
- Aadit Kumar, 24th April 2024

Concept Description

The design possesses three buttons to configure and switch between settings. It also possesses an LED display screen as well as an audio system to alert users of systems activation.
Colin Levitt 4/24/2024





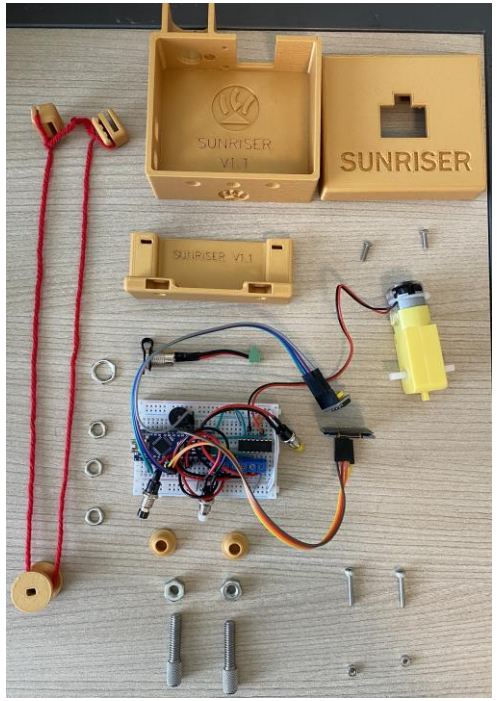


Product Demonstration

- Prototype for live demo
- Example with blinds shown in video

Fabrication and Assembly

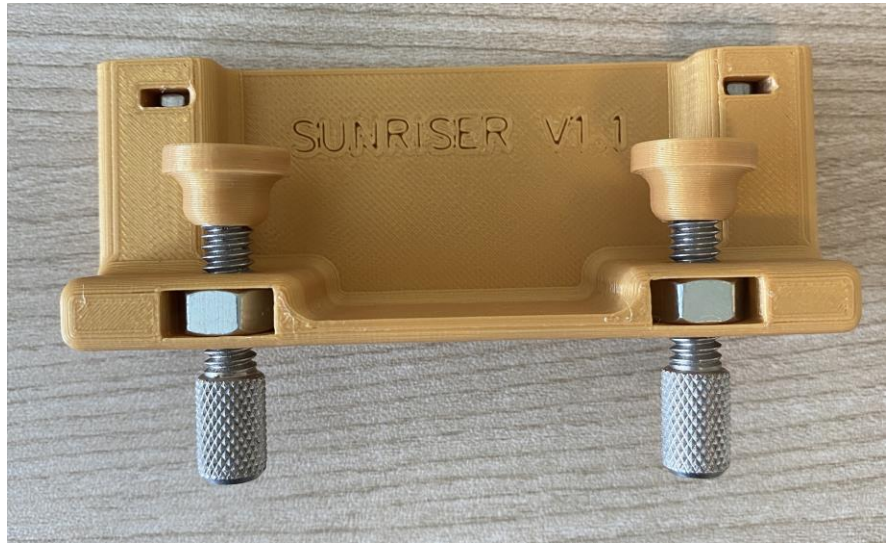
Lay out all hardware



Insert imbedded nuts

Fabrication and Assembly

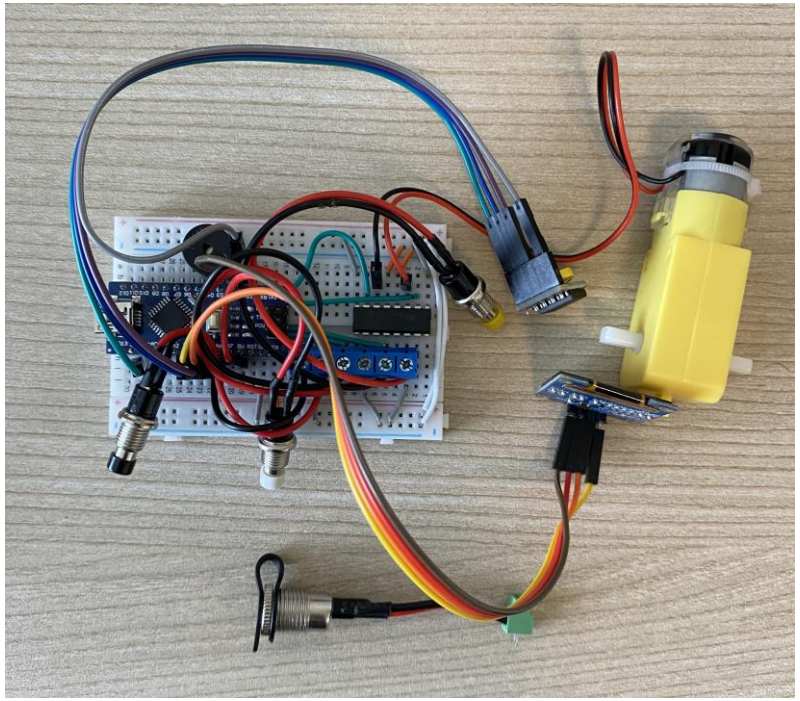
Fasten clamp thumbscrews



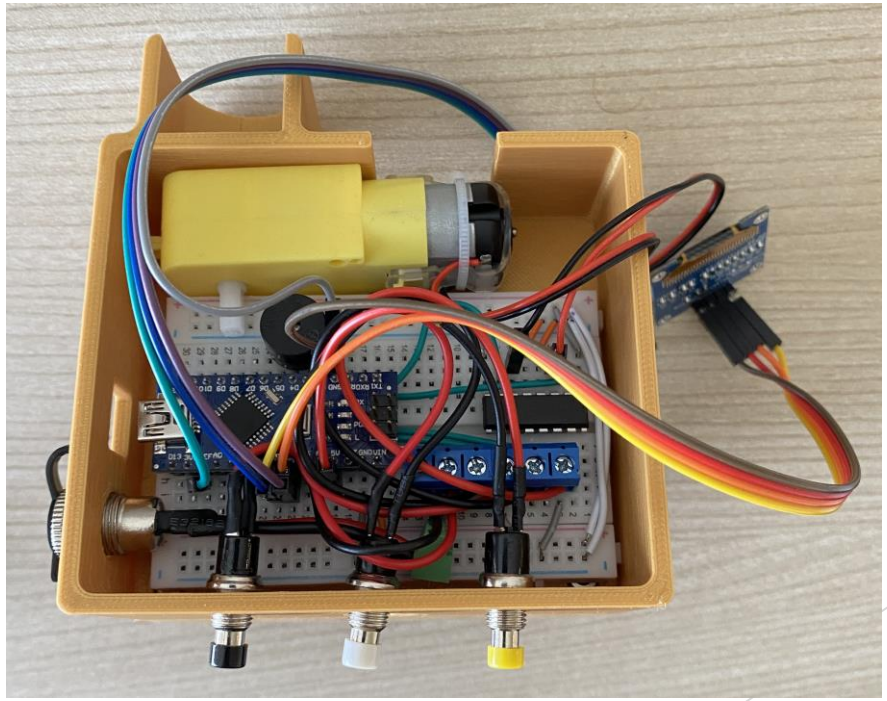
Attach body and clamp assembly

Fabrication and Assembly

Assemble electronics

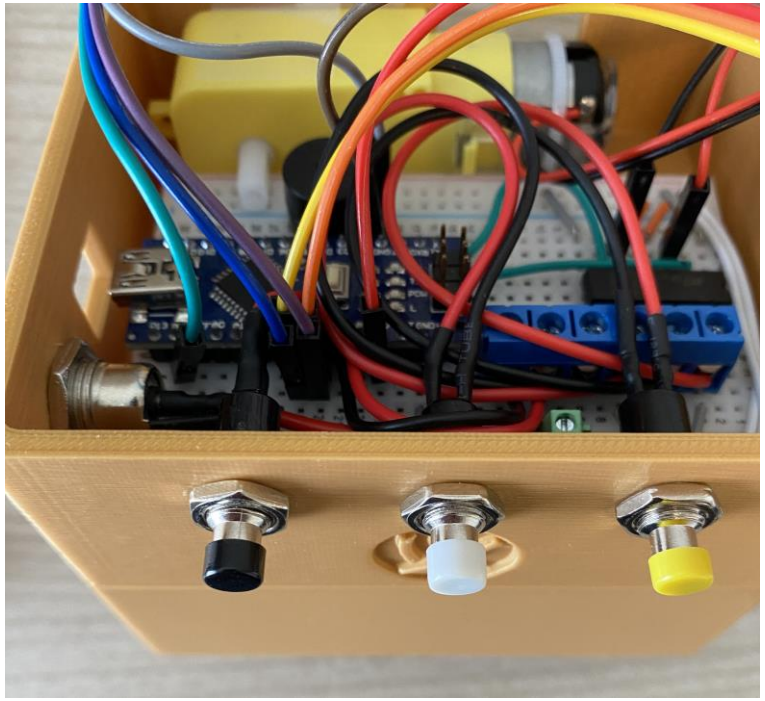


Insert electronics into body

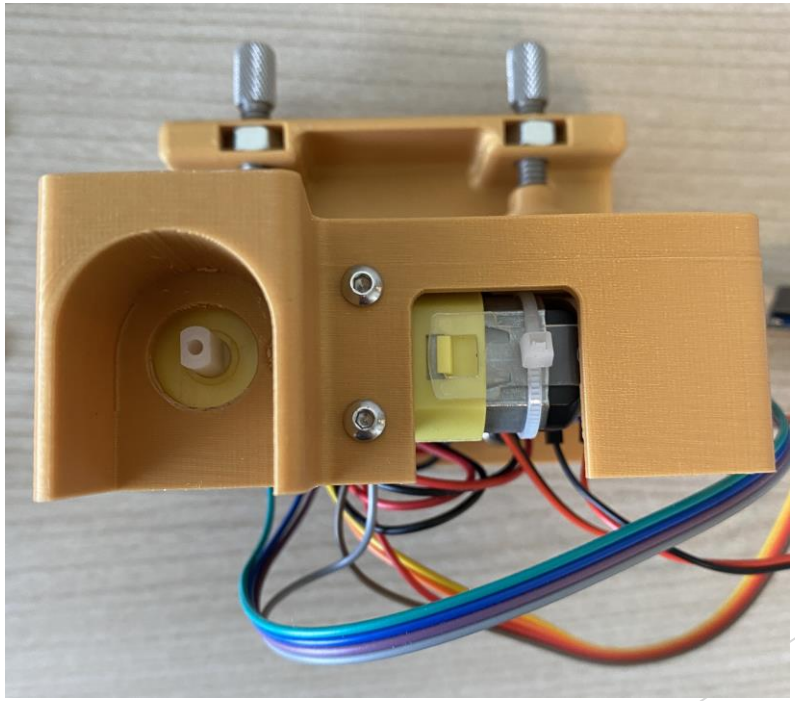


Fabrication and Assembly

Secure buttons and power plug to body with nuts



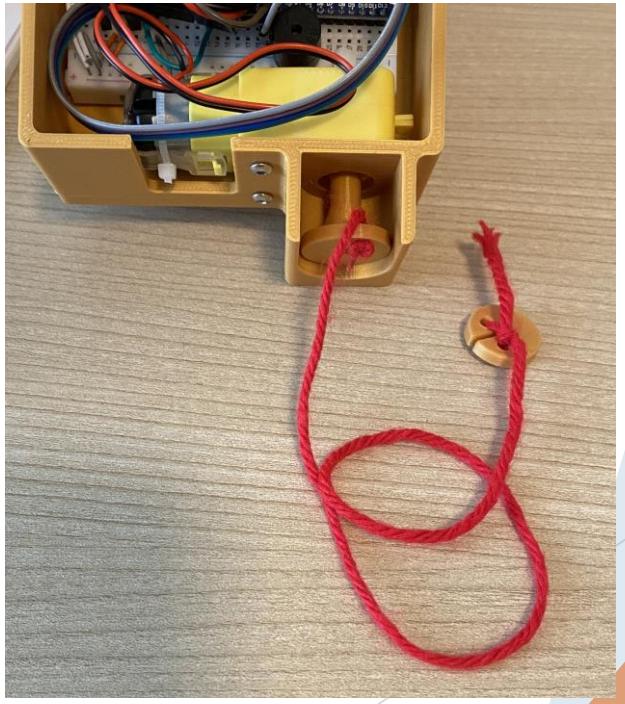
Secure motor to body with screws



Fabrication and Assembly

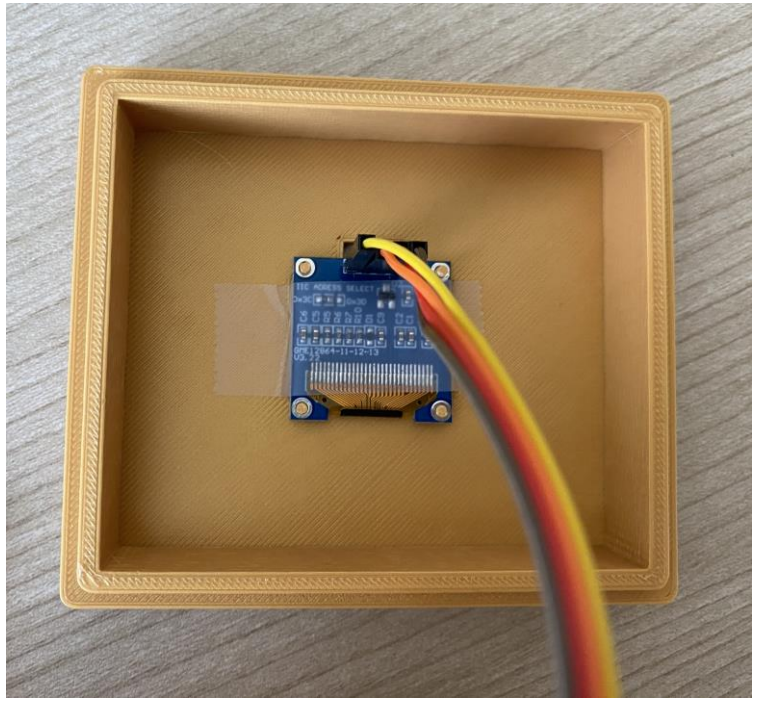
Wrap belt around pulley

Attach belt pulley to motor shaft



Fabrication and Assembly

Fix OLED screen to lid

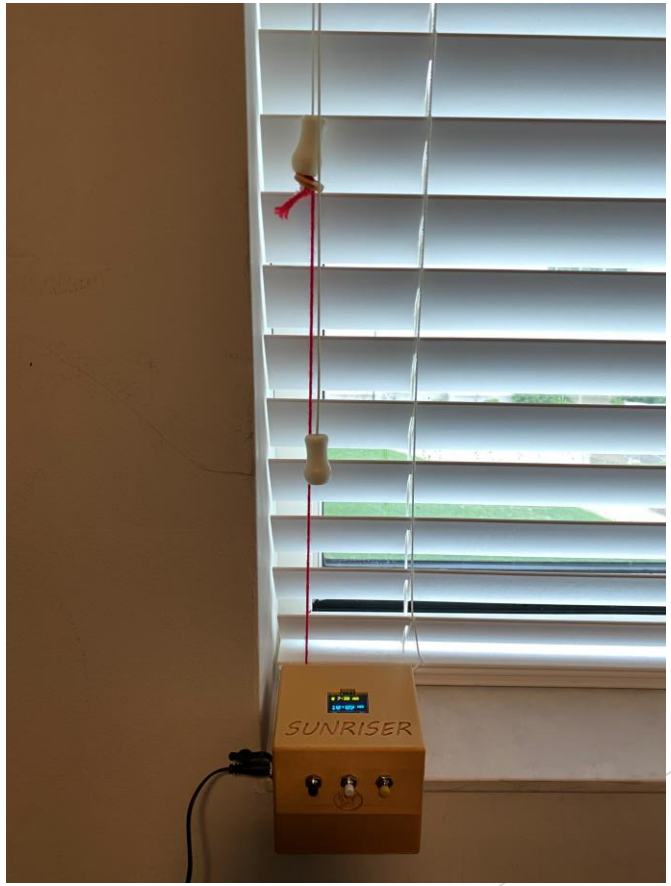


Attach lid onto body

Assembly (End Customer)

Clamp to windowsill

Adjust tassel clip length and plug in



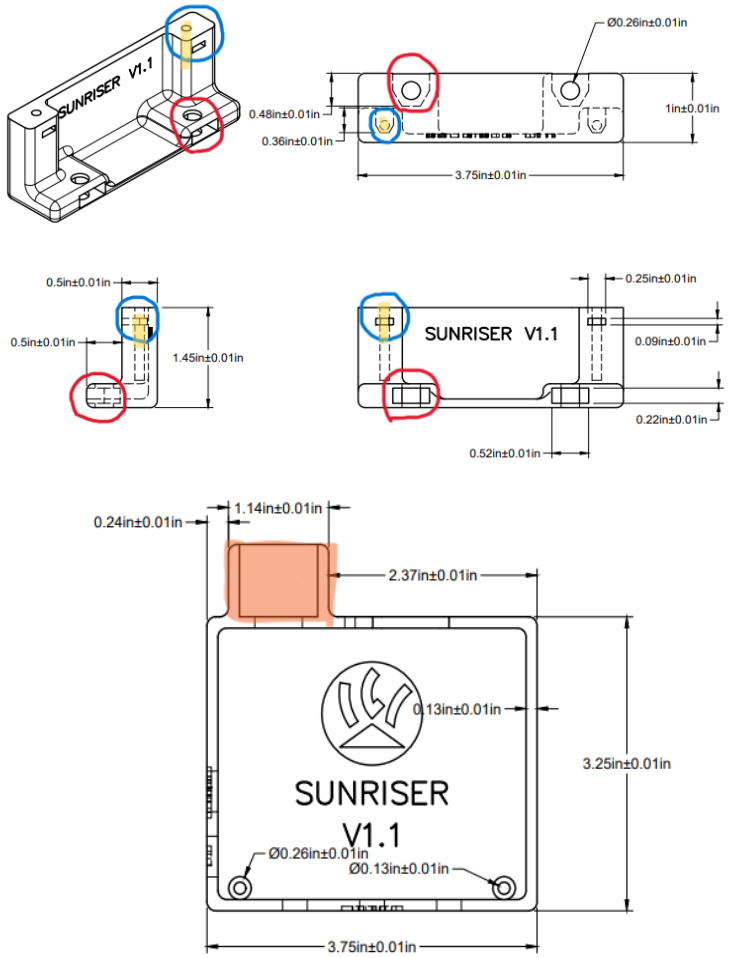
Comparison to Benchmarks

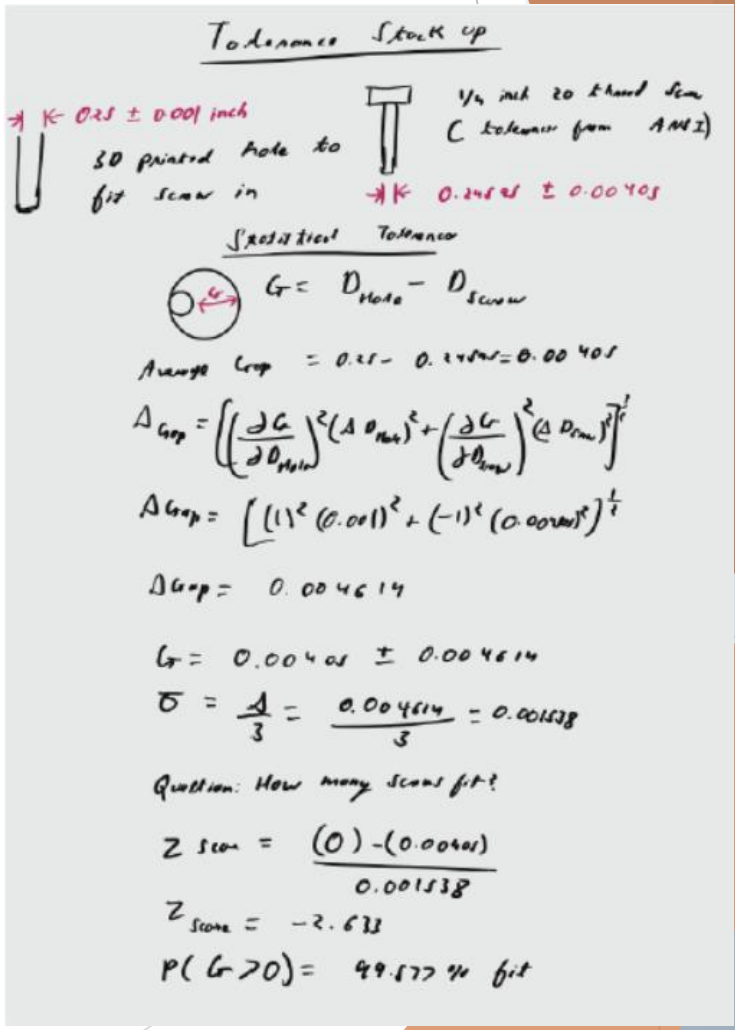
A decision matrix was used to compare the Sunriser to current sleep waking products on the market. The Sunriser outperformed two competitors; the Philips SmartSleep and the Clocky. The Sunriser outscored the Phillips SmartSleep when comparing affordability, dependability, and portability. The Sunriser outscored the Clocky when comparing non-disruptiveness and accessible. After weighted totals were calculated, it's clear to see that the Sunriser solves problems that current products cannot.
Cecilia Kutheis 4/24/2024

		Primary Concept	Benchmark	Benchmark
				
Design Requirements	**Weights**	**Sunriser**	**Philips SmartSleep**	**Clocky**
Affordable	4	0	-2	1
Low maintenance	3	0	0	0
Configurable	2	0	0	0
Durable	3	0	-1	0
Dependably wakes customer	5	0	-1	0
Portable	3	0	-1	0
Non-disruptive	3	0	0	-2
Low Power	2	0	1	0
Stand-alone	2	0	0	0
Impervious to household cleaners	1	0	0	0
Safe for children	2	0	1	0
Sustainably Sourced	1	0	0	0
Good Aesthetics	3	0	1	0
Recyclable	1	0	0	0
Ethical	3	0	0	0
Long-lasting	4	0	0	0
Non-Toxic Materials Used	1	0	0	0
Easy to install	3	0	1	0
Accessible	4	0	0	-2
	Total +	0	4	1
	Total -	0	-5	-4
	Overall Total	0	-1	-3
	Weighted Total	**0**	**-9**	**-10**

Tolerance Stack-ups

Each member of the team performed a tolerance stack up on a different component fit of the final design. This included the clamp pulley holder, the clamp screw, the thumb screw and the pulley nut. The pulley nut was found to have the greatest error at 99.6%, meaning only 0.4% of components are wasted. The team considered switching to cheaper material as a larger error was still acceptable, however the present material was kept to minimize waste and maintain the teams environmental and ethical obligations.
Colin Levitt 4/24/2024





Conclusion & Recommendations

Suggested improvements to the Sunriser:

- To incorporate more type of blinds into our product (adapters for different blinds)
- More ways to affix to walls (like adhesives), and larger clamps
- Label Buttons and to provide a Manual

Team 5 has successfully created a design concept and has enjoyed the design process. We thank Aayush and the teaching team for the support throughout the semester.

Any Questions?

Appendix 1: Model