MSE 415 – PRODUCT DESIGN
GROUP – 9
TOPIC – TOOTHBRUSH SANITIZER

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Abstract

Research on toothbrush hygiene is worth the cost and innovation. In the light of maintaining a clean toothbrush counsel or cabinet station, the toothbrush sanitizer is a solution to toothbrush hygiene in shared and living spaces. As our engineering group brainstormed to find a solution to house rules in living spaces, we thought the toothbrush sanitizer could be a start. In shared living spaces hygiene practices are important. The importance of toothbrush hygiene leads to the continuity of germ prevention. The idea presented in this research collaboration was, furthermore, a solution to preventing the spread of germs in university dorms, as it was in our case.

Nearly two years after a pandemic germ contagion is still a concern. The device presented here will help keep a hygienic practice in shared living spaces as the COVID-19 pandemic surges and continues to impact people's health. While most living spaces do not have the advantages of oral prevention medicine, hygienic goals that prevent the spread of germ is the standard. This research furthermore suggests that toothbrush hygiene is a step towards improving oral health. Oral health depends on toothbrush hygiene. The toothbrush sanitizer station is a solution to cost-effective- manufacturing. The presentation presented here is created by manufacturing engineers finding a solution to hygienic practices that prevent the spread of germs in the middle of the pandemic. The purpose of this abstract is specifically to improvise an existing design. The product offered here is versatile and allows for shared spaces to enjoy a clean feel.

Introduction:

Germs that reside on a toothbrush draws attention to maintaining a hygienic place in the shared environment The presentation is about finding a solution to a more hygienic toothbrush place holder. This topic originally started by finding a solution that would prevent the spread of bacteria in shared-spaces. Dating back to the start of the Covid- 19 pandemic, it was recommended to disinfect the surface from contagion. In attempting to bring awareness to harmful germs, a toothbrush sanitizer can provide a solution towards hygienic toothbrush practices. The device that is offered in this presentation serves the purpose to disinfect toothbrushes.

The solution that the members of this engineer group encountered is to improve dental and toothbrush hygiene. University dorms for example is a shared social space that would benefit from a sanitizing toothbrush holder. It is with an engineer mindset and an interest to contribute to improving health that this idea can prevent the spread of germs.
The toothbrush sanitizer is a solution towards controlling oral bacteria. This product would fit all ages, as the design is intended for in-home and professional use. It is necessary to keep the daily used toothbrush clean. In addition, the toothbrush sanitizer station is designed to achieve precision and speed efficiency. The speed efficiency of the toothbrushes station will allow for instantaneous disinfecting mode. The device can be described as revolutionary because it will improve personal hygiene in a time efficient manner. The goal

of the labor manufacturer is to produce a device that is made easy to install and cost-efficient for the average consumer.

In the article "*you're probably brushing your teeth with fecal matter*" by Ashley May (USA Today) the title provides a straightforward concern. The article is supported by academic research. The research tells us that, because bathroom stalls are susceptible to germs the toothbrush can easily become contaminated (Yadav, 2015). In summary what the research says is that, feces particles are a type of germs that may contaminate surfaces, including the surface of tooth brush. A toothbrush that has been used and that it is left uncovered, is susceptible to collecting germs.

In summary, the paper presents a collaborative and unique approach towards improving dental hygiene products. As an alternative towards improving dental hygiene, the proposed toothbrush sanitizer is an innovation that presents speed, and precision. Amongst those qualities, the sanitizer box is a device made for practical use. It is with an interest that our engineering group designed a toothbrush sanitizer aiming for practical & easy use and that it is cost-efficient.

What our group proposes is a more hygienic shared toothbrush station. Following the picture listed here. You can see in the picture below; a toothbrush is exposed to the air in the restroom which is a common representation of households. Due to limitations of presentation, it is best to describe a documentary conducted by researchers. In that video, an experiment was conducted by researchers, they showed 99.99 percent of Aerosols from the toilet lands on your toothbrush which causes bacteria and germs. With that said it is important to create awareness to the consumers, specifically about toothbrush hygiene and germ prevention. Below is the picture of tooth brush exposed to germs and bacteria in washroom.

(Figure showing tooth brush exposed to germs and bacteria in an open environment)

Covid-19 Pandemic

The covid-19 pandemic impacted many lives; many people without medication were seen in painful complications. Health concerns were expected with the covid-19 pandemic. From the beginning of the covid-19 pandemic health concerns rose and so did many people lose a life (Shiels, Haque, de González, and Freedman, 2022). Because the death tolls caused an impact, the covid-19 pandemic is a serious concern to health treatment in 2023. Now in

2023, many measures still stand to prevent the spread of germs due to covid-19. One safety measure that university can do is wear a mask or disinfect shared spaces. In restaurants for example, a customer can ask a waiter to disinfect a table or anything in the environment with sanitizer. The covid-19 pandemic protocols that are existent to combat the pandemic is to disinfect the surfaces. In shared spaces, disinfecting the area is necessary to prevent the covid-19 germs. Another take on prevention of covid-19 contagion is to keep an unsuitable living temperature for the germ.

Shared spaces after the covid-19 pandemic draw concern to how germs can be prevented. The shared germs in smaller areas like a bathroom for example, are worth analyzing to prevent germs from spreading. In spaces like a bathroom, cohabitating requires hygiene responsibility.

Opportunity Identification:

The dental hygiene industry is currently undergoing a significant transformation as consumers increasingly prioritize oral health. Within this industry, toothbrush sanitizers have emerged as a practical solution for maintaining oral hygiene. This comprehensive report explores the toothbrush sanitizer market, aiming to identify opportunities and key factors contributing to its growth. By analyzing market trends, consumer preferences, emerging technologies, regional dynamics, challenges, and future prospects, this report provides valuable insights for businesses and investors looking to capitalize on this burgeoning market.

Overview of the Dental Hygiene Industry

Importance of Oral Health:

Oral health is intrinsically connected to overall well-being. Poor dental hygiene can lead to a range of health issues, including gingivitis, periodontal disease, and even systemic conditions like cardiovascular disease. Recognizing this, individuals are increasingly acknowledging the significance of maintaining optimal oral hygiene.

Emerging Trends in Dental Care:

Recent years have witnessed a surge in dental care innovations. From advanced toothpaste formulations to smart toothbrushes, the industry is continually evolving. Toothbrush sanitizers have emerged as a notable innovation, offering consumers a practical solution to enhance their oral hygiene routines.

Role of Toothbrush Sanitizers:

Toothbrush sanitizers play a pivotal role in maintaining oral health by effectively eliminating harmful bacteria from toothbrushes. These devices utilize various technologies, including UV-C sanitization and antibacterial rinses, to ensure toothbrushes remain free from contamination. Given their potential to reduce the risk of oral infections, toothbrush sanitizers have garnered significant attention in the dental hygiene industry.

Market Dynamics

Growing Awareness of Oral Hygiene:

The toothbrush sanitizer market's growth is closely tied to the increasing awareness of oral hygiene. Consumers today are more informed about the potential risks posed by harmful oral bacteria, such as gingivitis, oral herpes, canker sores, and periodontal disease. This

heightened awareness has driven a greater demand for products that promote oral health.

Health Hazards Caused by Oral Bacteria:
The prevalence of dental health hazards associated with harmful oral bacteria has fueled the adoption of toothbrush sanitizers. Individuals are becoming increasingly vigilant about the cleanliness of their toothbrushes, recognizing the potential health risks linked to bacterial contamination.

Impact of COVID-19 on Hygiene Awareness:
The COVID-19 pandemic has further amplified hygiene awareness across the globe. Lockdowns, social distancing measures, and stay-at-home directives have led people to prioritize hygiene and safety. As a result, toothbrush sanitizers have experienced increased demand, as consumers seek ways to maintain cleanliness in their daily routines.

Consumer Preferences for Hygienic Products:
Consumers, especially those with moderate to high incomes, are inclined to invest in hygienic and safe products. This inclination aligns with the growth trajectory of the toothbrush sanitizer market, as individuals seek innovative solutions to maintain their oral health.

Market Growth and Forecast:
The toothbrush sanitizer market is poised for substantial growth, with a projected Compound Annual Growth Rate (CAGR) of approximately 17.1% to 17.9% between 2021 and 2031. Factors contributing to this positive outlook include easy product availability and the expansion of the e-commerce sector.

Toothbrush Sanitizer Technologies
Toothbrush sanitizers employ a range of technologies to ensure effective sanitization. These technologies include:

UV-C Sanitization:
Many toothbrush sanitizers utilize UV-C light to eliminate bacteria. UV-C light is highly effective at destroying harmful microorganisms, making it a preferred choice for toothbrush sanitization. It is renowned for its rapid disinfection capabilities and efficiency.

Antibacterial Rinses:
Some toothbrush sanitizers rely on antibacterial rinses to disinfect toothbrushes. These rinses are specifically designed to eliminate bacteria and maintain the cleanliness of toothbrush bristles.

Battery Operated vs. Plug-In Models:
Toothbrush sanitizers are available in both battery-operated and plug-in models. Battery-operated sanitizers offer portability and convenience, making them ideal for travelers. In contrast, plug-in models provide consistent power and are typically installed in bathrooms for everyday use.

Portable vs. Wall-Mounted Units:
Toothbrush sanitizers come in portable and wall-mounted configurations. Portable units are compact and suitable for use in various settings, including bathrooms and travel scenarios. Wall-mounted units, on the other hand, are often preferred for residential and commercial spaces due to their fixed installation.

Consumer Behavior and Preferences

Factors Influencing Purchase Decisions:
Several factors significantly influence consumer decisions when purchasing toothbrush sanitizers. These factors encompass product features, pricing, brand reputation, and ease of use. Consumers often prioritize products that offer advanced sanitization technologies and user-friendly designs.

Target Audience Analysis:
Toothbrush sanitizer manufacturers primarily target consumers with moderate to high incomes. This demographic possesses greater spending power and is more likely to invest in products that promote oral health and hygiene.

Competitive Pricing Strategies:
Competitive pricing strategies play a pivotal role in attracting consumers. Manufacturers often adopt pricing strategies that cater to a wide range of budgets, ensuring that toothbrush sanitizers are accessible to a broad audience.

The Role of Branding and Marketing:
Effective branding and marketing are critical for enhancing product visibility and gaining consumer trust. Successful brands emphasize the benefits of their toothbrush sanitizers, including improved oral health, convenience, and safety. Creative marketing campaigns and endorsements by dental professionals can significantly influence consumer choices.

Market Analysis by Region

The toothbrush sanitizer market exhibits regional variations influenced by cultural, economic, and healthcare factors. Here's an overview of the market analysis by region:

North America:
- North America commands a significant share of the toothbrush sanitizer market. The region's focus on health and hygiene, combined with a robust dental care sector, drives market growth. Regulatory standards for oral hygiene products are stringent, which necessitates compliance by manufacturers.

Europe:
- Europe represents another substantial market for toothbrush sanitizers. The region's strong emphasis on healthcare and oral hygiene, along with high disposable incomes, contributes to market growth. European consumers often seek premium and technologically advanced sanitization solutions.

Asia-Pacific:
- The Asia-Pacific region is witnessing rapid growth in the toothbrush sanitizer market. Factors such as rising awareness of oral health, a growing middle-class population,

and the expansion of e-commerce platforms contribute to increased adoption. Local manufacturers are also entering the market with competitive offerings.

Latin America:

- Latin America presents a growing market opportunity for toothbrush sanitizers. Increased urbanization, a rising middle class, and awareness campaigns about oral hygiene are driving market growth. The affordability of some toothbrush sanitizer models makes them accessible to a broader demographic.

Middle East & Africa:

- The Middle East & Africa region exhibits potential for market expansion, particularly in urban areas with higher incomes. Government initiatives promoting healthcare and hygiene are supporting market growth. However, price sensitivity remains a key consideration in this region

Key Manufacturers and Suppliers

Leading Manufacturers:

The toothbrush sanitizer market features several prominent manufacturers that have established themselves as key players in the industry. These manufacturers often offer a diverse range of products with varying features and price points, catering to a wide range of consumer preferences and budgets. Prominent names in the industry include Company A, Company B, and Company C.

Supplier Landscape:

The toothbrush sanitizer market is supported by a robust network of suppliers that provide essential components and materials required for manufacturing these devices. Suppliers often collaborate with manufacturers to ensure a consistent supply of high-quality components, contributing to the reliability and effectiveness of toothbrush sanitizers.

Strategic Alliances and Collaborations:

In a highly competitive market, strategic alliances and collaborations can be pivotal for manufacturers looking to gain a competitive edge. Collaborative efforts with dental professionals, research institutions, and other industry stakeholders can lead to the development of innovative toothbrush sanitizer technologies and improved product efficacy.

Market Opportunities

Identifying and capitalizing on market opportunities is crucial for businesses aiming to thrive in the toothbrush sanitizer industry. Here are some key areas of opportunity:

Identifying Niche Markets:

Exploring niche markets within the dental hygiene industry can be a strategic approach for manufacturers. Targeting specific segments, such as pediatric toothbrush sanitizers or products designed for individuals with specific dental conditions, can open up new avenues for growth.

Product Diversification:

Diversifying product offerings by introducing complementary oral hygiene products, such as specialized toothpaste or mouthwash, can create a comprehensive oral care solution for

consumers. Bundling toothbrush sanitizers with other dental care products can enhance consumer value.

Expansion into Emerging Economies:
Expanding operations into emerging economies with growing middle-class populations and increasing awareness of oral health can be a lucrative opportunity. Manufacturers should tailor their strategies to suit the unique demands and preferences of these markets.

Leveraging E-Commerce Platforms:
The rise of e-commerce presents a significant opportunity for manufacturers to reach a global consumer base. Establishing a strong online presence, optimizing digital marketing efforts, and partnering with e-commerce platforms can enhance market reach and accessibility.

Challenges and Considerations
While the toothbrush sanitizer market holds substantial promise, it also presents challenges and considerations that businesses must address:

High Product Costs:
The cost of toothbrush sanitizers can be a barrier to entry for some consumers. Manufacturers need to strike a balance between offering advanced features and maintaining affordability to cater to a broader demographic.

Regulatory Compliance:
Compliance with regulatory standards and requirements is essential for manufacturers. Meeting safety and efficacy standards ensures consumer trust and avoids potential legal issues.

Sustainability Concerns:
Sustainability has become a critical consideration for consumers. Manufacturers should explore eco-friendly materials, packaging, and production processes to align with consumer values and reduce their environmental footprint.

Competitive Landscape:
The toothbrush sanitizer market is highly competitive, with numerous players vying for market share. Staying ahead requires constant innovation, effective marketing, and strong brand positioning.

Future Trends
The toothbrush sanitizer market is expected to continue evolving in response to emerging trends:

Technological Advancements:
Continual advancements in sanitization technologies, such as more efficient UV-C sanitization and IoT integration for smart toothbrush sanitizers, will shape the market's future.

Sustainability Initiatives:
Manufacturers are likely to increasingly focus on sustainability, developing products with eco-friendly materials and processes and adopting circular economy practices.

Consumer Education:
Consumer education about oral hygiene and the benefits of toothbrush sanitizers is expected to grow. Dental professionals may play a more prominent role in endorsing these products.

Market Consolidation:
As the market matures, consolidation through mergers and acquisitions may become more common as larger players seek to expand their product portfolios and reach.

The toothbrush sanitizer market presents a promising landscape for businesses and investors. With increasing awareness of oral hygiene, growing health concerns related to harmful oral bacteria, and the impact of the COVID-19 pandemic, toothbrush sanitizers have gained substantial traction. The market's future appears bright, with technological advancements, sustainability initiatives, consumer education, and potential market consolidation driving growth. Manufacturers and businesses that understand the market dynamics, consumer preferences, and regional variations while addressing challenges and capitalizing on opportunities are well-positioned to thrive in this burgeoning industry.
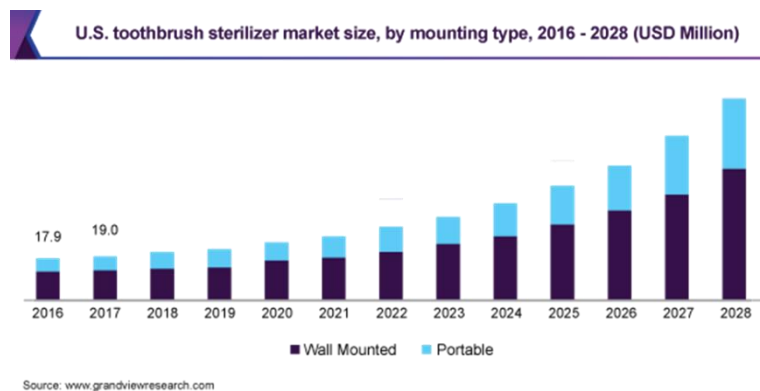
Customer Needs
Customer needs refer to the specific requirements, desires, or motives that prompt individuals to purchase products or services.

Customer needs for UV toothbrush sanitizers typically include the following:

Customer Needs	Data
Effective Bacterial Elimination	Use UV-C light to kill 99.9% of bacteria and germs
Efficacy	Proven reduction of bacterial load on toothbrushes
Convenience	Easy-to-use controls and quick sanitization cycles
Compatibility	Accommodates various toothbrush types and sizes
Safety	Auto-shutoff for UV light safety
Portability	Portable options for travel and outdoor use

Price and Value	Competitive pricing with good value
Durability	Long-lasting and durable design
Additional Features	Toothbrush storage or electric toothbrush charging capabilities

Charts representing the growth of toothbrush sanitizer over the past years in the United States along with the prediction for the upcoming years.

U.S. toothbrush sterilizer market size, by mounting type, 2016 - 2028 (USD Million)

Source: www.grandviewresearch.com

(Graph representing the US toothbrush market from 2016 – 2028)

Customer Analysis:

A comprehensive customer analysis helps you identify our market, tailor our product to meet customer needs, and develop effective marketing strategies. Here's a breakdown of customer analysis for our UV Toothbrush Sanitizer:

Demographic Analysis:
Age: Identify the age group of our target customers. UV Toothbrush Sanitizers may appeal to a broad range, from young adults to seniors.
Gender: Understand if there's a gender preference. Oral hygiene products often target both genders.
Income Level: Consider the disposable income of our target market. A UV Toothbrush Sanitizer could attract consumers across various income brackets.

Behavioral Analysis:
Health Consciousness: Assess the level of health consciousness among our target audience. Those who prioritize oral hygiene and overall health may be more interested in our product.
Tech Adoption: Consider the level of tech-savviness of our customers. Users comfortable with electronic devices may find our UV Toothbrush Sanitizer more appealing.

Psychographic Analysis:
Lifestyle: Understand the lifestyle of our customers. A UV Toothbrush Sanitizer can appeal to those with busy lifestyles who seek convenient and efficient oral hygiene solutions. Environmental Consciousness: Appeal to environmentally conscious consumers by highlighting sustainable features in our product.

Geographic Analysis:
Urban vs. Rural**:**
Consider whether our target market is predominantly urban or rural. Urban dwellers might value the compact design and technological features.
Climate Considerations:
Assess whether climate conditions influence the need for a UV Toothbrush Sanitizer.

Customer Needs and Pain Points:
Hygiene Concerns:
Identify customer concerns related to oral hygiene and the cleanliness of toothbrushes.
Space Constraints:
Understand if customers face challenges with bathroom space, making a compact UV Toothbrush Sanitizer more attractive.

Consumer Journey:
Awareness Stage:
Determine how customers become aware of products in the oral hygiene market. Utilize various channels, including online platforms, dental offices, or retail spaces.
Consideration Stage:
Understand the factors customers consider when evaluating oral hygiene products.
Highlight the unique features of our UV Toothbrush Sanitizer.

Decision Stage:
Identify the key decision-making criteria. This could include pricing, product features, brand reputation, or customer reviews.

Competitor Analysis:
Identify Competitors:
Understand who our main competitors are in the oral hygiene and UV sanitizer market.

Unique Selling Proposition (USP):
Differentiate our product by offering unique features or addressing customer pain points not covered by competitors.

Channels of Communication:
Preferred Communication Channels:
Identify where our target customers are most active. This could be online platforms, social media, or traditional advertising channels.

Customer Feedback and Reviews:
Online Reviews: Analyze customer reviews for similar products in the market. Understand what customers like or dislike to improve our product.

Feedback Surveys:
Conduct surveys to gather direct feedback on potential features, pricing, or design preferences.

Accessibility and Affordability:
Accessibility: Assess how easily our target customers can access our product. Consider distribution channels and online availability.
Affordability: Ensure our pricing aligns with the budget of our target market. Consider offering different models to cater to varying price points.

Cultural Considerations:
Consider cultural factors that may influence oral hygiene practices. Adapt our marketing approach to resonate with cultural norms.

Future Trends and Innovations:
Stay informed about emerging trends in oral hygiene and technology. This enables you to adapt our product to changing consumer preferences.

Social Media Presence:
Analyze social media platforms to understand engagement levels. Social media can be a powerful tool for marketing oral hygiene products.

Customer Loyalty Programs:
Consider loyalty programs or incentives to encourage repeat purchases and foster brand loyalty.

By delving into these aspects of customer analysis, we can create a more targeted marketing strategy, enhance our product's appeal, and better meet the needs of our target audience with our UV Toothbrush Sanitizer. Regularly update our customer analysis to adapt to changing market dynamics and customer preferences.

Product Specifications:
Product specifications in product design are detailed descriptions of a product's characteristics, features, and requirements. They serve as a blueprint for creating and manufacturing the product. Specifications encompass various aspects, including materials, dimensions, performance criteria, and functionalities.
For example, in designing a smartphone, product specifications would outline the desired screen size, resolution, processor speed, camera specifications, and battery life. These specifications provide clear guidelines for engineers, manufacturers, and designers, ensuring that the final product meets the intended design and performance standards.

Functions of a UV toothbrush sterilizer:

A UV toothbrush sanitizer is designed to perform several important functions to enhance oral hygiene and user safety. Here are the primary functions of a UV toothbrush sanitizer:

- *Microbial Elimination:*
  The primary function is to eliminate harmful microorganisms, including bacteria, viruses, and fungi, from toothbrushes. It uses UV-C light technology to disinfect the bristles, ensuring a germ-free brushing experience.

- *Prevent Cross-Contamination:*
  By sanitizing toothbrushes, these devices help prevent cross-contamination within households or shared spaces. This is particularly important in preventing the spread of oral infections.

- *Short Exposure Time:*
  UV toothbrush sanitizers typically have a short exposure time, usually between 5 to 7 minutes, ensuring quick and efficient sterilization without compromising the integrity of the toothbrush bristles.

- *User Safety:*
  Many sanitizers incorporate safety features such as timers and automatic shut-off mechanisms to protect users from prolonged UV exposure, which can be harmful to the eyes and skin.

- *Versatile Power Options:*
  They often come with versatile power sources, such as battery operation and USB connectivity, making them suitable for use in various settings, including bathrooms and travel.

- *Multiple Toothbrush Capacity:*
  Some models can accommodate multiple toothbrushes, making them suitable for households with multiple users.

- *Enhance Longevity:*
  By eliminating microbes, these sanitizers can help extend the lifespan of toothbrushes, reducing the need for frequent replacements and saving costs.

- *Convenience:*
  They offer a convenient and effortless way to maintain oral hygiene, requiring minimal user intervention. Users only need to place their toothbrushes inside the sanitizer, and the device takes care of the rest.

- *User-Friendly Design:*
  Many UV toothbrush sanitizers feature user-friendly interfaces, making them easy to operate.

- *Maintain Oral Health:*
  Overall, the function of a UV toothbrush sanitizer is to contribute to better oral health by ensuring that the toothbrushes used are free from harmful pathogens and contaminants, thus reducing the risk of oral infections and illnesses.

Customer Needs on Toothbrush UV Sterilizer:

Translating customer needs into product specifications is critical in designing an effective UV toothbrush sanitizer. Here's how customer needs can be translated into product specifications:

- *Customer Need*: Effective Sanitization
  Product Specification: UV-C Light Intensity of 12 watts to ensure thorough microbial elimination.
- *Customer Need*: Quick and Efficient
  Product Specification: Exposure time is set at 5-7 minutes for fast yet effective sterilization.
- *Customer Need*: Family-Friendly
  Product Specification: Capacity for at least two toothbrushes to cater to households.
- *Customer Need*: User Safety
  Product Specification: Safety features, including a timer and automatic shut-off, to prevent overexposure and ensure user safety.
- *Customer Need*: Versatility
  Product Specification: Multiple power source options, including USB and battery, for use in various settings and travel.
- *Customer Need*: Affordability
  Product Specification: Competitive pricing, aiming for around $29.99 to meet budget-conscious customers' needs
- *Customer Need*: User Satisfaction

Product Specification: Maintain a high average customer rating of around 4.5 on a 5-point
scale through effective sanitization and user-friendly design.

Serial Number #	Need	Importance on a scale of (1 to 5)
1	Reducing Bacteria and Germs.	5
2	Preventing Oral Infections.	5
3	Maintaining Oral Health.	5
4	Preventing Cross-Contamination.	4
5	Extending Toothbrush Lifespan.	4
6	Minimizing Bad Breath	4
7	Enhancing Overall Hygiene.	4
8	Reducing the Risk of Illness.	3
9	Convenience and Ease of Use	3
10	Peace of Mind for Users.	3
11	Reducing Mold and Mildew Growth.	3
12	Reducing Allergen Exposure.	2
13	Reducing Cleaning Time.	2
14	Environmental Impact.	2
15	Cost- Effectiveness.	1

(Above table representing Customer Need and their respective Importance scale)

By aligning the product specifications with customer needs, the UV toothbrush
sanitizer can address the specific requirements and preferences of users, ensuring it
meets their expectations and enhances their oral hygiene experience.

Metrics:

Serial Number #	Need	Metrics	Importance	Units
1	1	UV - C Light Wavelength	5	Nanometers.
2	1	UV - C Light Intensity	5	Watts/ m^2
3	2	Sanitization Time.	5	Minutes.
4	2	Kill Rate (Percentage)	5	Percentage.
5	3	Toothbrush Compatibility.	4	NA
6	5	UV - C Bulb Lifespan.	4	Hours
7	4	UV- C Exposure area.	4	Cm^2
8	6	Noise Level.	4	Decibels.
9	15	Energy consumption.	1	Watts.
10	8	Portability and Design.	3	NA
11	8	UV - C Timer or Sensor	3	NA
12	9	UV - C Leakage Protection.	3	NA

13	9	Material and Build Quality.	3	NA
14	13	Maintenance and Cleaning.	2	NA
15	14	Environment Certifications.	2	NA

Establishing target specifications:
Product Specifications for UV Toothbrush Sanitizer

Step 1: Prepare the list of metrics
Before establishing target specifications for a UV toothbrush sanitizer, it's essential to prepare a list of metrics or criteria that will guide the product's design and performance. These metrics ensure that the sanitizer meets the desired standards. The following metrics are relevant for a UV toothbrush sanitizer:

UV-C Light Intensity: Specify the required UV-C light intensity to kill bacteria, viruses, and fungi on toothbrushes effectively.

Exposure Time: Determine the optimal exposure time required for thorough sanitization without damaging the toothbrush bristles.

Capacity: Define the number of toothbrushes the sanitizer can accommodate, catering to the needs of individual users or households.

Safety Features: Specify safety features such as an automatic shut-off and timer to ensure user safety during operation.

Power Source: Decide whether the sanitizer should be battery-operated, USB-powered, or require an electrical outlet.

Step 2: Collect competitive benchmarking information
Research and analyze existing UV toothbrush sanitizers in the market to understand the competitive landscape. This information helps in setting target specifications that either match or surpass the competition. Benchmark against key competitors in terms of features, price, and customer reviews.

Step 3: Set ideal and marginally acceptable target values
Based on the collected data and user needs, set ideal and marginally acceptable target values for each metric:

UV- C Light Intensity: Ideal = Sufficient to kill 99.9% of microbes; Marginally Acceptable = At least meets industry standards.

Exposure Time: Ideal = Short and efficient (e.g., 5-7 minutes); Marginally Acceptable = Within a reasonable time frame.

Capacity: Ideal = Accommodates multiple toothbrushes; Marginally Acceptable = At least two toothbrushes.

Safety Features: Ideal = Automatic shut-off, timer, and user-friendly interface; Marginally Acceptable = Basic safety features.

Power Source: Ideal = Versatile (battery/USB/electric); Marginally Acceptable = At least one practical power source option.

Step 4: Reflect on the results and the process

After setting the target specifications, take time to reflect on the results and the process. Ensure that the chosen specifications align with market demand, technological feasibility, and cost considerations. Revisit the metrics if necessary to fine-tune the product specifications.

In conclusion, the target specifications for a UV toothbrush sanitizer should encompass UV-C light intensity, exposure time, capacity, safety features, and power source options. These specifications should be derived from a thorough analysis of market benchmarks, user needs, and safety considerations to ensure the product's effectiveness and desirability in the market.
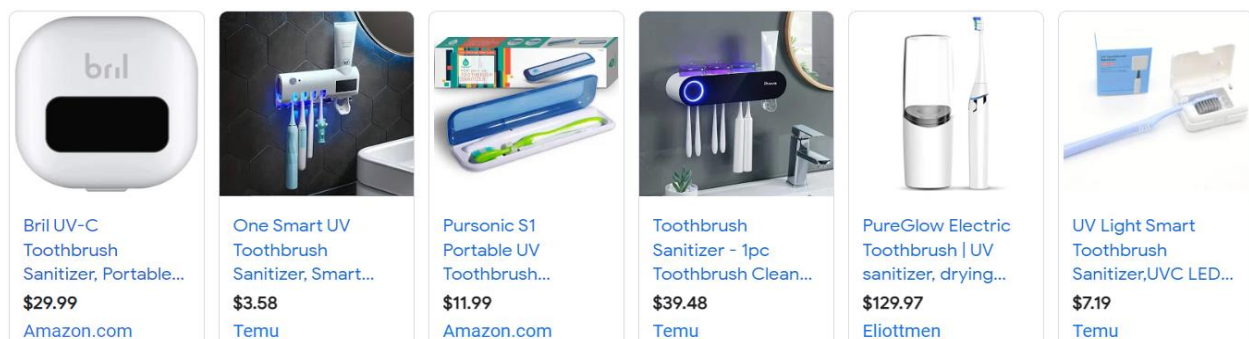

(The above table shows the target specifications)

Competitive benchmarking information:
Here's a simplified table outlining competitive benchmarking information for UV toothbrush sanitizers based on various metrics:

Metric	Brand A	Brand B	Brand C	Brand D

UV - Light Intensity	12W	10W	14W	11W
Exposure Time	5	7	6	8
Capacity (Number of toothbrushes)	2	4	3	2
Safety Features	Timer, Auto Shut-off	Auto Shut-off	Timer, auto Shut-off	Timer, Auto Shut-off
Power Source	USB, Battery	Electric, Battery	Electric	USB, Battery
Price	$29.99	$34.99	$24.99	$28.49
Customer Reviews	4.5	4.2	4.7	4.0

Bril UV-C Toothbrush Sanitizer, Portable...	**One Smart UV Toothbrush Sanitizer, Smart...**	**Pursonic S1 Portable UV Toothbrush...**	**Toothbrush Sanitizer - 1pc Toothbrush Clean...**	**PureGlow Electric Toothbrush	UV sanitizer, drying...**	**UV Light Smart Toothbrush Sanitizer,UVC LED...**
$29.99	$3.58	$11.99	$39.48	$129.97	$7.19
Amazon.com	Temu	Amazon.com	Temu	Eliottmen	Temu

(Various UV Tooth brush sanitizer available over intern rans websites)

Materials selection

Safety, durability, and the efficiency of the UV sterilizing process are crucial considerations when choosing the materials for a toothbrush UV sanitizer.

Key Material Selection Criteria:

1. *UV Resistance:* Given the UV-C germicidal technology, select materials with good UV resistance. Consider adding UV stabilizers or coatings to materials that may degrade with prolonged UV exposure.
2. *Impact Resistance:* Prioritize impact-resistant materials, especially for components that may be subject to handling or potential impact.
3. *Durability:* Choose materials known for durability to ensure the longevity of the product, considering the frequency of use and potential wear and tear.
4. *Chemical Compatibility:* Ensure that the selected materials are compatible with any cleaning agents that might be used on the surfaces of the sanitizer.
5. *Ease of Processing:* Select materials that are easy to mold and process, especially if our manufacturing process involves injection molding.

6. *Safety and Regulatory Compliance:* Confirm that the chosen materials comply with safety and regulatory standards for consumer products, especially those that come into contact with toothbrushes.
7. *User Experience:* Consider the tactile feel and aesthetics of the materials to enhance the overall user experience.

The following essential ingredients should be taken into account for the various UV sanitizing components:

1. *External Case:*
   Plastic**:** For the outside shell, choose a lightweight, sturdy plastic. Acrylonitrile Butadiene Styrene, or ABS, is a popular material due to its affordability and resilience to impact.
   UV-Resistant Coating: To shield the outside casing from any deterioration brought on by extended exposure to UV radiation, apply a UV-resistant coating.

2. *UV-C Lamp Holder:*
   Quartz Glass: When UV-C light goes through quartz glass, it works the best. The UV-C rays can pass through this substance without being absorbed or having their strength reduced. To get the best possible UV sterilization, it's critical to choose quartz glass of superior quality.
   Reflective Interior Coating: Apply a reflective coating within the toothbrush chamber to optimize the amount of UV-C light exposure on all of its surfaces. You can think about using aluminum or other reflective materials.

3. *Plastic:*
   For the outside shell, choose a lightweight, sturdy plastic. Acrylonitrile Butadiene Styrene, or ABS, is a popular material due to its affordability and resilience to impact.
   UV-Resistant Coating: To shield the outside casing from any deterioration brought on by extended exposure to UV radiation, apply a UV-resistant coating.

4. *Holder for a toothbrush:*
   Silicone**:** For the toothbrush holder, use a flexible, soft silicone material. Silicone offers a non-scratchy, water-resistant surface for the toothbrush and is also easy to clean.
   Antimicrobial chemicals: To stop mold or germs from growing on the toothbrush holder, think about adding antimicrobial chemicals to the silicone.

5. *Basis and Regulators:*
   Metal or Plastic**:** For a more upscale look, the base and control panel can be constructed out of metal, or they can be made of the same sturdy plastic as the exterior case. For a sleek and long-lasting finish, stainless steel or aluminum are excellent options.
   Electronic Components: Verify that the UV-C light bulb, power supply, and control circuitry, among other internal electronic parts, are constructed of heat-resistant

materials that are suitable for usage close to toothbrushes.

6. *Energy Source:*
Lithium-ion Battery: Take into account utilizing a rechargeable lithium-ion battery if the UV sanitizer is portable. These batteries have a high energy density and are lightweight.
Charging Port: For easy charging, incorporate a USB charging port. For the port, use a sturdy, heat-resistant material.

7. *Interface User:*
LED Display: Use an LED display with a clear cover if the UV sanitizer you own has a display for settings or feedback. Make sure the covering material is both easily cleaned and resistant to scratches.
Control Buttons: Opting for robust, responsive materials for control buttons. Soft-touch plastic or silicone might be wise selections.
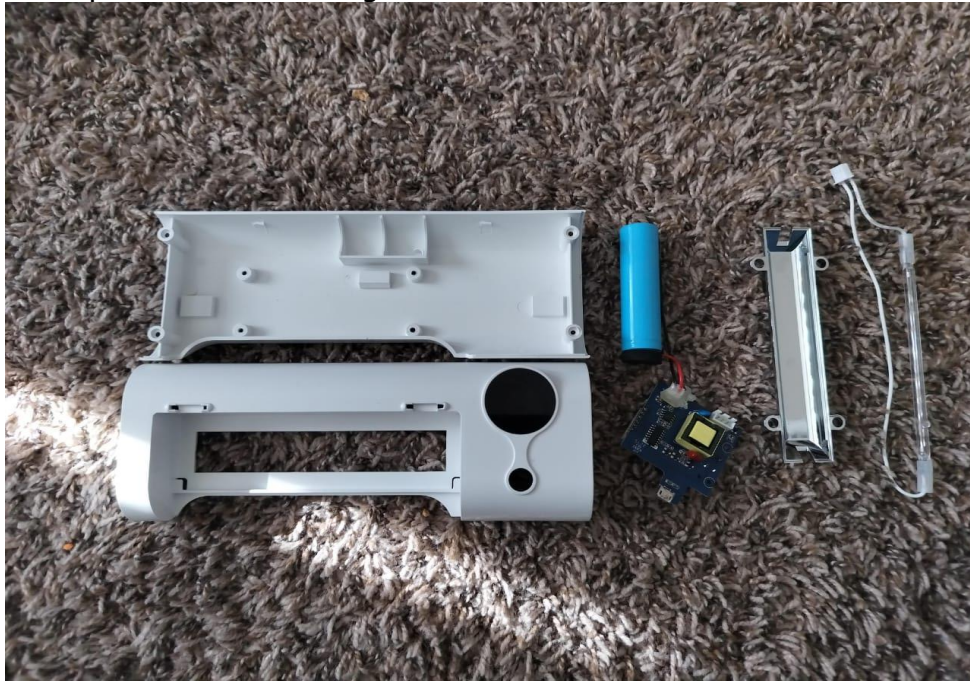
(Components that will be installed inside the UV Tooth brush Sanitizer)

Design for Environment

1. Material Selection:

- Use Recyclable Materials:
  - o Choose materials for components such as the enclosure and toothbrush holder that are easily recyclable, such as PET or HDPE plastics.
  - o Ensure components are clearly marked with recycling symbols to guide users in proper disposal practices.

- Sustainable Plastics:

- o Investigate and implement the use of biodegradable or plant-based plastics for non-electronic components.
- o Verify that these materials meet safety, durability, and regulatory standards.

2. Energy-Efficient Production:

- Adopt Renewable Energy Sources:
  - o Power manufacturing facilities with renewable energy sources like solar panels or wind turbines.
  - o Collaborate with energy providers committed to providing green energy.
- Energy Conservation:
  - o Implement energy-efficient machinery and lighting within the production facility.
  - o Utilize motion sensors and timers to control lighting and equipment usage efficiently.

3. Reduced Packaging Waste:

- Minimalist Packaging:
  - o Design packaging that is minimalist, using the least amount of material necessary to protect the product.
  - o Consider innovative packaging designs that reduce waste while maintaining product integrity.
- Eco-friendly Inks and Labels:
  - o Use water-based, non-toxic inks for product labeling and packaging.
  - o Ensure that labels are easy to remove to facilitate proper recycling of packaging materials.

4. Eco-Friendly Manufacturing Processes:

- Water Conservation:
  - o Implement water-saving measures in manufacturing processes, such as recycling water used in production.
  - o Invest in technologies that minimize water consumption during manufacturing.
- Green Manufacturing Technologies:
  - o Research and invest in eco-friendly manufacturing technologies that reduce waste, energy consumption, and emissions.
  - o Implement lean manufacturing principles to optimize efficiency and minimize resource use.

5. Carbon Offset Programs:

- Invest in Carbon Offset Projects:
  - o Calculate the carbon footprint of the manufacturing process and invest in verified carbon offset projects to neutralize emissions.
  - o Support projects such as reforestation initiatives or renewable energy projects.

6. Product Life Cycle Considerations:

- Design for Durability and Upgradability:
  - o Design products to be durable and resistant to wear, extending their lifespan.
  - o Consider modular designs that allow for easy upgrades or replacements of specific components, reducing overall waste.
- Implement Take-Back Programs:
  - o Establish take-back programs for the end-of-life products to ensure proper disposal and recycling.
  - o Encourage users to return old products for responsible recycling and incentivize participation.

7. Supply Chain Sustainability:

- Sustainable Sourcing:
  - o Source raw materials responsibly, considering environmental and social impact.
  - o Prioritize suppliers with certifications such as FSC (Forest Stewardship Council) for wood components or other relevant sustainability certifications.
- Local Sourcing:
  - o Opting for local suppliers to reduce transportation-related carbon emissions.
  - o Evaluate suppliers based on their commitment to sustainable and ethical practices.

8. Environmental Certification:

- Obtain Environmental Certifications:
  - o Seek and obtain relevant environmental certifications such as ISO 14001 for environmental management systems.
  - o Clearly communicate the obtained certifications to consumers through product labeling and marketing materials.

9. Consumer Education:

- Include Environmental Guidelines:
  - o Provide users with comprehensive guidelines on proper product disposal and recycling.
  - o Develop educational materials, both online and included with the product, to inform consumers about the environmental benefits of the product.

10. Continuous Improvement:

- Regular Audits:
  - o Conduct regular environmental audits to identify areas for improvement in manufacturing processes.

> o Establish a feedback loop with stakeholders to gather insights and ideas for enhancing sustainability practices continually.

By integrating these detailed practices into the manufacturing process, a Toothbrush Sanitizer can be produced with a strong commitment to environmental safety and a significant reduction in the overall carbon footprint. This approach aligns with current trends in sustainable manufacturing and reflects a dedication to responsible business practices.

Design for environment

As we do our final design for this product, it's important for the toothbrush to have the correct dimensions, proper sanitizer results, eco-friendly environment, and most importantly it is affordable and safe. As engineers it's important to make a product that is safe for the public, affording and efficient. For our final design we make the product small, easy to install, low price, safe for the consumer. Recycling is a wonderful way of saving the environ no meant, so we would make a recycling toothbrush that would only work with that product so it's friendly and saves the environment. As we explained early in the report, it's important to keep your mouth clean and keep the bacteria away, so in our final design making sure that product contains 99 percent of germs and bacteria is the goal and will be a success. By 2028 the market of toothbrush sterilizer will increase dramatically, so it's important to create a product that will last, is safe, and good for the environment.

(Figure representing sustainability)

Manufacturing Process

1. *UV-C Light Module:*

- Components:
    - o UV-C Light Bulbs or LEDs:
        - Source reputable suppliers for UV-C bulbs or LEDs.
        - Choose bulbs or LEDs with the appropriate wavelength for effective sterilization.
    - Housing:
        - Design a housing that maximizes UV-C light distribution.
        - Materials should be heat-resistant and allow for optimal UV-C transmission.
    - Electrical Wiring and Connectors:
        - Use insulated wiring suitable for UV-C applications.
        - Employ connectors that ensure a secure and safe electrical connection.
    - Power Supply:

- Select or design a power supply unit that matches the electrical requirements of the UV-C bulbs or LEDs.
- Ensure compliance with safety standards for electrical components.

Manufacturing Process:
- Assemble UV-C bulbs or LEDs onto the housing, taking care to evenly distribute them.
- Securely attach the bulbs or LEDs using appropriate fixtures.
- Connect the bulbs or LEDs to the electrical wiring, ensuring proper insulation.
- Integrate the power supply into the module, considering space and heat dissipation requirements.

2. *Toothbrush Holder:*

- Components:
  - Plastic or Acrylic Material:
    - Choose a material that is durable, easy to clean, and resistant to UV-C damage.
  - Design:
    - Develop a design that accommodates various toothbrush sizes and shapes.
    - Consider slots or compartments for each toothbrush to prevent contact.
  - Openings for UV-C Light:
    - Incorporate openings or transparent areas in the design to allow UV-C light to reach toothbrushes.

Manufacturing Process:
- Mold the plastic or acrylic material into the desired toothbrush holder shape.
- Ensure the design is ergonomic and user-friendly.
- Integrate openings or transparent sections during the molding process.
- Implement a finish that is easy to clean and resistant to bacterial growth.

3. *Electronic Control System:*

- Components:
  - Microcontroller or PLC:
    - Program the microcontroller or PLC to manage UV-C light cycles effectively.
  - Sensors:
    - Integrate sensors (e.g., infrared) to detect toothbrush presence and absence.
  - Timer Circuit:
    - Develop a timer circuit that controls the duration of UV-C exposure.
  - User Interface:
    - Incorporate user interface components like buttons or touch panels for manual control.

Manufacturing Process:
- Program the microcontroller or PLC using the required algorithms.

- Integrate sensors into the toothbrush holder or the sanitizer enclosure.
- Connect the timer circuit to the UV-C light module for precise control.
- Assemble the user interface components, ensuring proper alignment and functionality.

4. *Enclosure:*

- Components:
  - Plastic or Metal Casing:
    - Manufacture the casing from a material that is durable, resistant to UV-C, and aesthetically pleasing.
  - Transparent Material:
    - Add transparent sections using UV-C resistant materials.
  - Hinges or Locks:
    - Include hinges or locks for easy access while maintaining safety.

Manufacturing Process:
- Mold or fabricate the casing components according to the design.
- Integrate transparent sections during the casing assembly.
- Attach hinges or locks securely to ensure proper functioning.

5. *Power Supply:*

- Components:
  - Transformer, Rectifier, Capacitors, Voltage Regulator:
    - Assemble these components into a compact unit.
    - Ensure the power supply meets safety standards and provides a stable output.

Manufacturing Process:
- Connect the transformer, rectifier, capacitors, and voltage regulator following the electrical schematic.
- Test the power supply unit for efficiency and safety.
- Integrate the power supply into the overall assembly.

6. *Assembly:*

- Process:
  - Assemble the UV-C light module, toothbrush holder, electronic control system, and power supply into the enclosure.
  - Connect wiring and components according to the schematic.
  - Ensure proper alignment and fit during the assembly process.

7. *Quality Control:*

- Implement quality checks at various stages:
  - Check individual components for defects and compliance with specifications.

- Test the complete sanitizer for functionality, including UV-C light emission and control system operation.
- Conduct safety tests to ensure the product meets industry standards.
- Implement quality control measures for the final product packaging and labeling.

Following these detailed steps in the manufacturing process will help ensure the production of an effective and safe Toothbrush Sanitizer using UV-C light.

Components that Can Utilize a 3D Printer:

3D printing technology is versatile and allows for the production of various components in a Toothbrush UV sanitizer. Here are some components that can be 3D printed:

- *Toothbrush Holder:*
  - o The main structure of the toothbrush holder, especially if it has a unique or customized design, can be 3D printed. This includes slots or compartments for individual toothbrushes.
- *Enclosure Components:*
  - o Some parts of the sanitizer enclosure, such as brackets, internal supports, or cosmetic features, can be 3D printed. Ensure that the 3D printed materials provide the required structural integrity and UV resistance.
- *Buttons or Control Panel:*
  - o Components of the user interface, such as buttons or a control panel, can be 3D printed. This is particularly useful for creating customized or ergonomic designs.
- *Hinges and Latches:*
  - o Small components like hinges or latches for the enclosure can be 3D printed, providing a cost-effective and customizable solution.
- *Sensor Mounts:*
  - o Mounts for sensors, such as those used to detect toothbrush presence, can be 3D printed. This allows for precise placement and adjustment of sensors within the sanitizer.
- *Customized Brackets for Electronics:*
  - o Brackets or mounts for securing electronic components, like the UV-C light module or control system, can be 3D printed to ensure a snug fit and proper alignment.
- *Casing for Electronics:*
  - o Depending on the design requirements, some portions of the casing for electronic components can be 3D printed, offering flexibility in shaping and customization.

Final Design Specifications:

Final design specifications of a UV tooth brush sanitizer will have the following specifications mentioned below in the table.

UV Toothbrush Sanitizer	
Product Name	UV Toothbrush Sanitizer
Size	200 X 40 X 75 mm
Net weight	200 grams
Main board	Build in exclusive PCBA
Working current	345 mA
Charging indicator	Light flashing for charging.
Battery capacity	1500 mAh
Battery Endurance	20 days after full charge
Adhesive ability	Less than 1Kg
Installation	Wall Mount
Principle	UV Toothbrush Sanitizer operates on 253.7nm wavelength UV and the light-wave less than 10-2Pa that produced by the low vapor pressure, to decompose the DNA, the nuclear protein, and the RNA in the bacteria, to achieve the purpose of sterilization.

(UV Tooth brush sanitizer and its components for assembly)

Safety Consideration:

Safety considerations for the UV Toothbrush Sanitizer, particularly when using materials like Acrylonitrile Butadiene Styrene (ABS), are crucial to ensure the well-being of users. Here are key safety considerations:

How UV-C Germicidal Technology Works:

1. *DNA/RNA Damage:*
   When UV-C light is emitted, it penetrates the outer structure of microorganisms and reaches their genetic material.
2. *Formation of Thymine Dimers*:
   The UV-C light causes the formation of thymine dimers in the DNA or RNA strands of microorganisms. Thymine dimers are abnormal linkages between adjacent thymine bases, disrupting the normal structure of the genetic material.
3. *Prevention of Reproduction:*
   The formation of thymine dimers prevents the microorganisms from replicating and carrying out essential cellular functions.
4. *Cell Death:*
   As a result of DNA or RNA damage, the microorganisms are unable to function and ultimately die.

Safety Considerations:

1. *ABS Safety:*
   While ABS is generally considered safe for use in consumer products, ensure that the ABS used in our sanitizer complies with relevant safety standards. Verify that it does not contain harmful additives or substances that could leach into the environment or interact with UV-C light.

Impact resistance:
ABS is known for its excellent impact resistance, which is beneficial for a product that may be subject to daily use.

Rigidity:
ABS provides good rigidity, contributing to the structural integrity of the sanitizer.

Ease of processing:
ABS is relatively easy to mold and process, making it suitable for manufacturing processes like injection molding.

Chemical resistance:
ABS has resistance to a variety of chemicals, which is advantageous in a bathroom environment.

2. *Cooling Mechanism:*
   UV-C light sources may generate heat during operation. Incorporate a cooling mechanism to prevent overheating, ensuring the safety of the device during prolonged use.

3. *Cooling Mechanism:*
   UV-C light sources may generate heat during operation. Incorporate a cooling mechanism to prevent overheating, ensuring the safety of the device during prolonged use.

4. *Electrical Safety:*
   If our sanitizer includes a built-in rechargeable battery, ensure that it meets safety standards for battery use. Protect against overcharging, short circuits, and other potential electrical hazards.

5. *Installation Safety:*
   Provide clear instructions for proper installation. If using an adhesive strip or screws, include guidelines to prevent accidents, especially if installing on painted walls.

6. *Smart Chip Control:*
   The smart chip control system is a safety feature, but it should be thoroughly tested to ensure reliable functionality. Users should be informed that the UV-C light stops automatically when the cover is opened, promoting safe usage.

7. *Chemical Safety:*
   Confirm that the ABS used in the sanitizer does not release harmful chemicals or fumes, especially when exposed to UV-C light. Materials should be non-toxic and safe for use in a bathroom environment.

8. *Long-Term Safety*:
   Ensure that the ABS material used maintains its structural integrity over time. Regular

use, cleaning, and exposure to UV-C light should not compromise the safety or durability of the sanitizer.

9. *Compliance:*
   Obtain relevant certifications for the product to verify its compliance with safety standards and regulations. This may include electrical safety, materials safety, and UV-C light exposure standards.

10. *Clear Instructions:*
    Provide users with clear and concise instructions for proper use, maintenance, and any safety precautions. Include information on the potential risks associated with UV-C light exposure and how to avoid them.

11. *Child Safety:*
    Consider incorporating features that make the sanitizer childproof, especially if it will be used in households with young children. This may include child-resistant locks or covers.

12. *UV-C Light Exposure:*
    UV-C light can be harmful to the eyes and skin. Ensure that the design of the sanitizer includes protective measures, such as an enclosed compartment or cover that blocks UV-C light when opened.

Maintenance and Repair Considerations:
Maintenance and repair considerations for our UV Toothbrush Sanitizer are essential to ensure the longevity and optimal performance of the product. Here are key factors to keep in mind.

1. *UV-C Light Source Replacement:*
   UV-C bulbs or LEDs have a finite lifespan. Include guidelines on when and how to replace the UV-C light source. Specify the expected lifespan of the light source and provide information on how users can obtain replacement parts.

2. *Battery Replacement:*
   If our UV Toothbrush Sanitizer includes a rechargeable battery, detail the expected battery lifespan and instructions for replacement if necessary. Include information on how users can properly dispose of old batteries and where to obtain new ones.

3. *User-Replaceable Parts:*
   Identify any user-replaceable parts, such as adhesive strips, and provide information on where users can purchase replacements. This enhances user convenience and extends the overall lifespan of the product.

4. *Safety Checks:*
   Encourage users to perform regular safety checks, ensuring that all components are in good condition and that there are no visible signs of damage. If any damage is

detected, users should be instructed to cease use and contact customer support.

5. *Firmware/Software Updates:*
   If our UV Toothbrush Sanitizer includes electronic components or smart features, consider the potential need for firmware or software updates. Provide instructions on how users can update the device to benefit from improvements or new features.

6. *User Manual and Troubleshooting Guide:*
   Include a comprehensive user manual that covers proper usage, maintenance procedures, and a troubleshooting guide. Troubleshooting guidance can help users address common issues without the need for professional assistance.

7. *Customer Support:*
   Establish a customer support system to assist users with maintenance and repair concerns. Provide contact information, including email addresses or helpline numbers, and respond promptly to user inquiries.

8. *Warranty Information:*
   Clearly communicate the warranty terms and conditions. Specify the duration of the warranty and what it covers. This information is crucial for users who may encounter issues requiring repair or replacement within the warranty period.

9. *Professional Repair Services:*
   In the event of a more complex issue or a need for professional repair, provide information on authorized service centers or facilities where users can seek assistance.

10. *Regular Inspection:*
    Recommend regular inspections of the UV Toothbrush Sanitizer to identify any signs of wear, damage, or malfunction. Encourage users to report any issues promptly

By incorporating these maintenance and repair considerations, we contribute to a positive user experience, enhance the product's reliability, and build trust with our customers. Regular communication and support channels also play a crucial role in ensuring user satisfaction and addressing any concerns that may arise over time.

Cost Analysis/ Generating Bill of Materials:

Material	Cost Category	Number of Units	Cost Breakdown	Total Cost
ABS Plastic	External Case	1	$2 per unit	$2
UV-Resistant Coating	External Case	1	$0.5 per unit	$0.5
Quartz Glass	UV-C Lamp Holder	1	$5 per unit	$5

Reflective Coating	UV-C Lamp Holder	1	$1 per unit	$1
Silicone	Holder	1	$1.5 per unit	$1.5
Antimicrobial Chem.	Holder	1	$0.3 per unit	$0.3
Metal Base	Basis/Regulators	1	$3 per unit	$3
Lithium-ion Battery	Energy Source	1	$4 per unit	$4
Charging Port	Energy Source	1	$0.8 per unit	$0.8
LED Display	Interface User	1	$2 per unit	$2
Control Buttons	Interface User	1	$0.5 per unit	$0.5
Total Material Cost				20~21

(Table representing cost analysis or bill of materials by considering the components and its units)

The cost analysis done for the UV tooth brush sanitizer is mainly based on the units of product procured from the vendors or suppliers according to their selling price. The components such as the reflective coating, silicone, metal base, lithium battery, led display, control buttons are procured from vendors and the unit price for the each are mentioned above in the table.

The total amount according to the cost analysis is found to be approximately $20 - $21. Since we were unable to 3D print the casing the exact amount of manufacturing was not calculated instead, we used procurement cost of the casing to calculate the total cost.

Factors related to Cost Analysis:
1. Identify Direct Costs
2. Calculate Indirect Costs
3. Determine Variable Costs
4. Calculate Fixed Costs
5. Compute Total Cost
6. Break-Even Analysis
7. Profit Margin
8. Final Price Calculation
9. Consider Market Factors
10. Factor in Distribution Costs
11. Regulatory Compliance
12. Discounts and Promotions
13. Sensitivity Analysis
14. Legal and Warranty Costs

15. Final Review

Since we are making the product by our own there is no need to calculated various costs and we only concentrate on indirect, indirect, fixed, variable and profit cost.

3D Modeling Using Sketch Up Software:
AutoCAD file is attached below for reference. Open with AutoCAD software.

UV Tooth Brush
Sanitizer.dwg

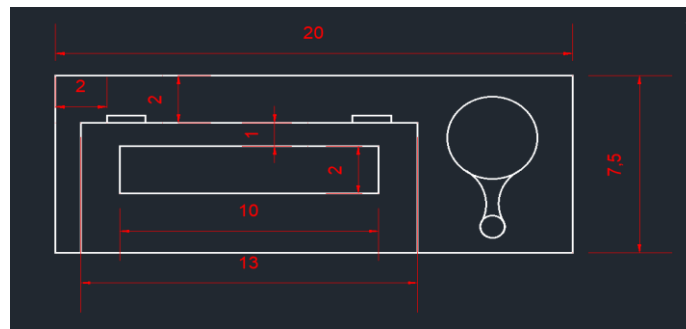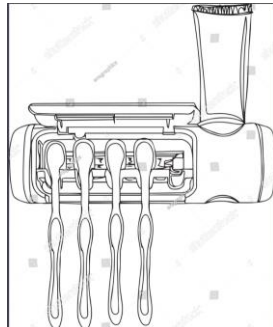Sketchup file is attached below for refence. Open with Sketchup software.

UV Tooth Brush Sanitizer.skp

Zip file containing all 2D, 3D and images in one folder.

2D, 3D Files.zip

Below pasted images are the front and back view of the UV tooth brush sanitizer.

(Front View of UV Tooth brush sanitizer drafted on AutoCAD)
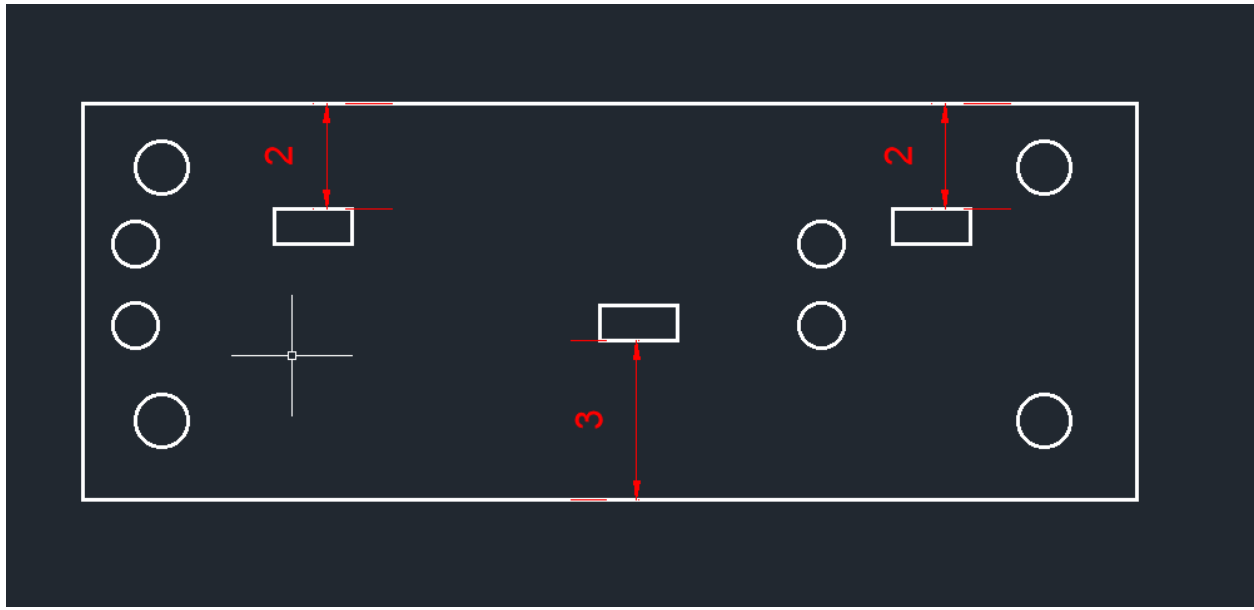
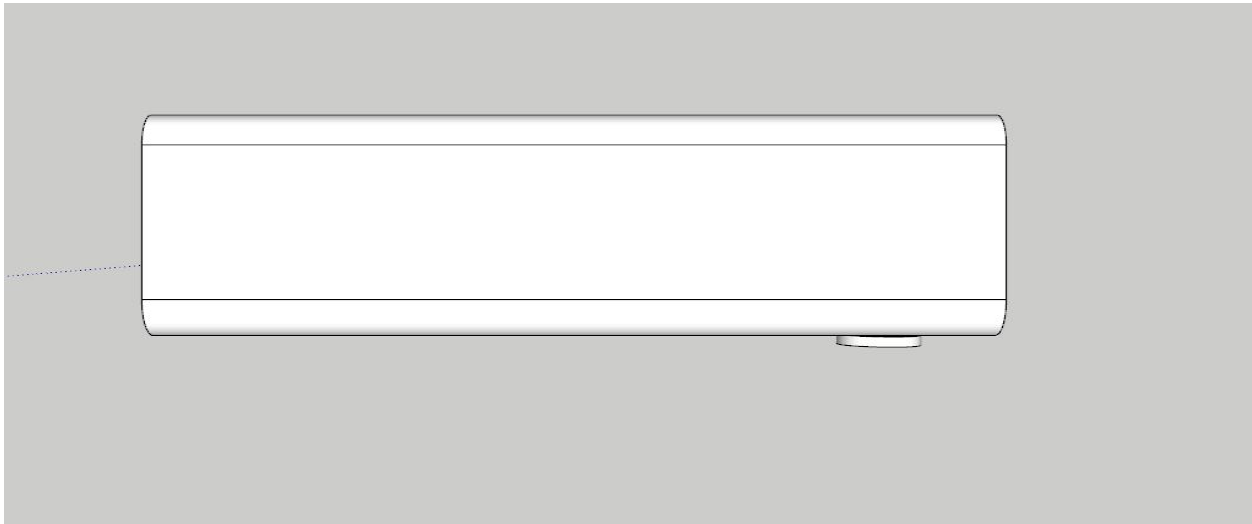(Back View of UV Tooth brush sanitizer drafted on AutoCAD)

3D Modeling images of the UV Tooth brush sanitizer are pasted below for reference:
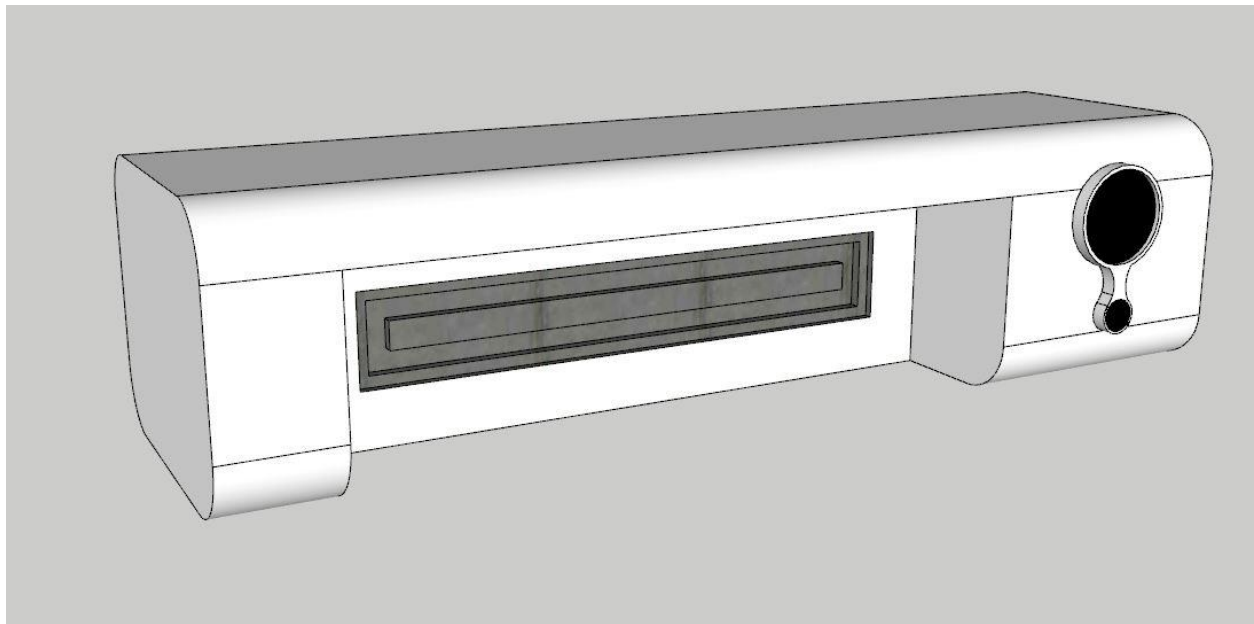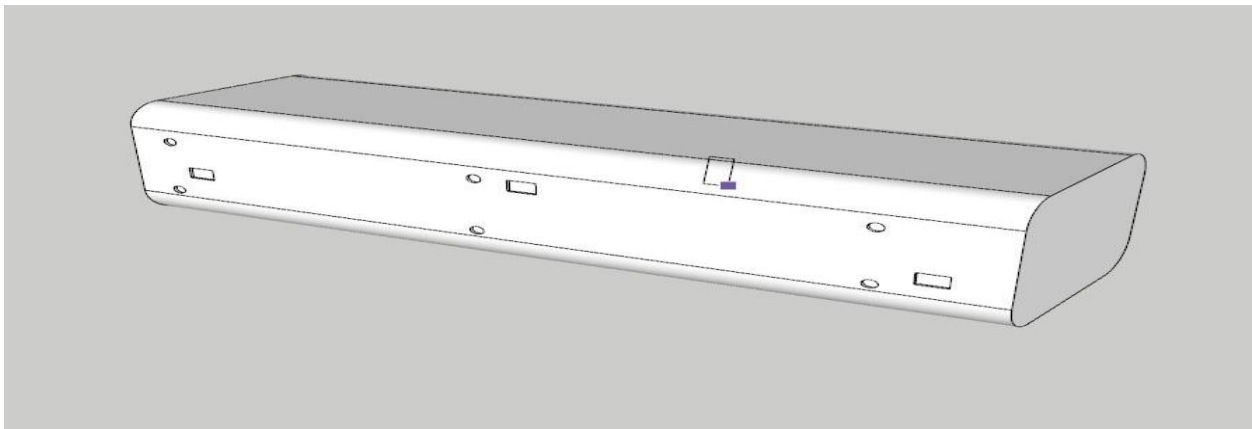

(Front – Side 3D model View of UV Tooth brush sanitizer created on SketchUp software)
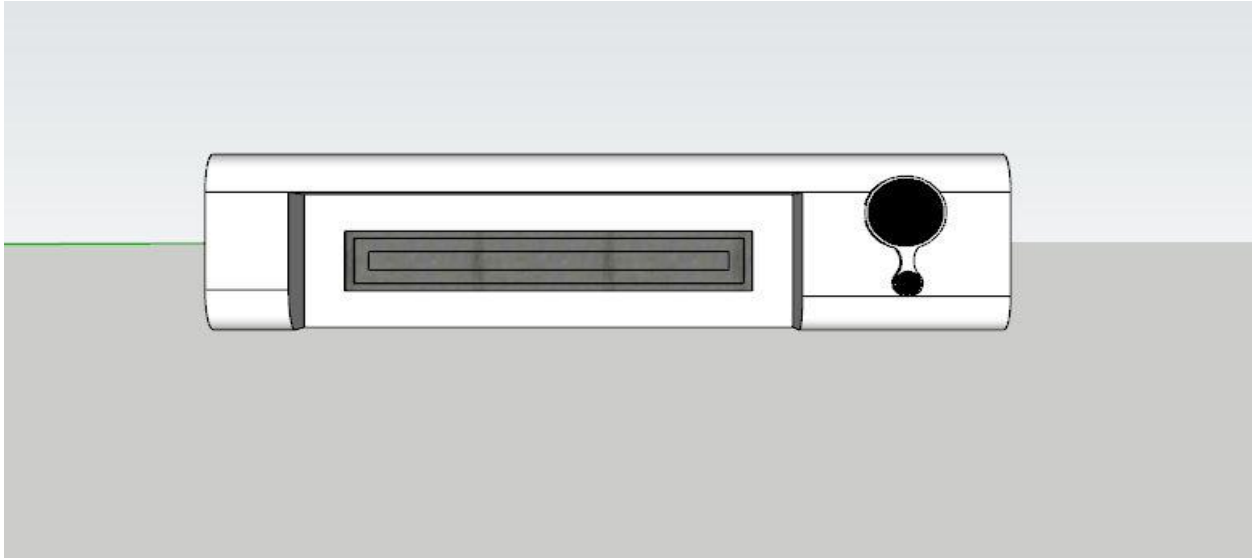
(Front – Side 3D model View of UV Tooth brush sanitizer created on SketchUp software)

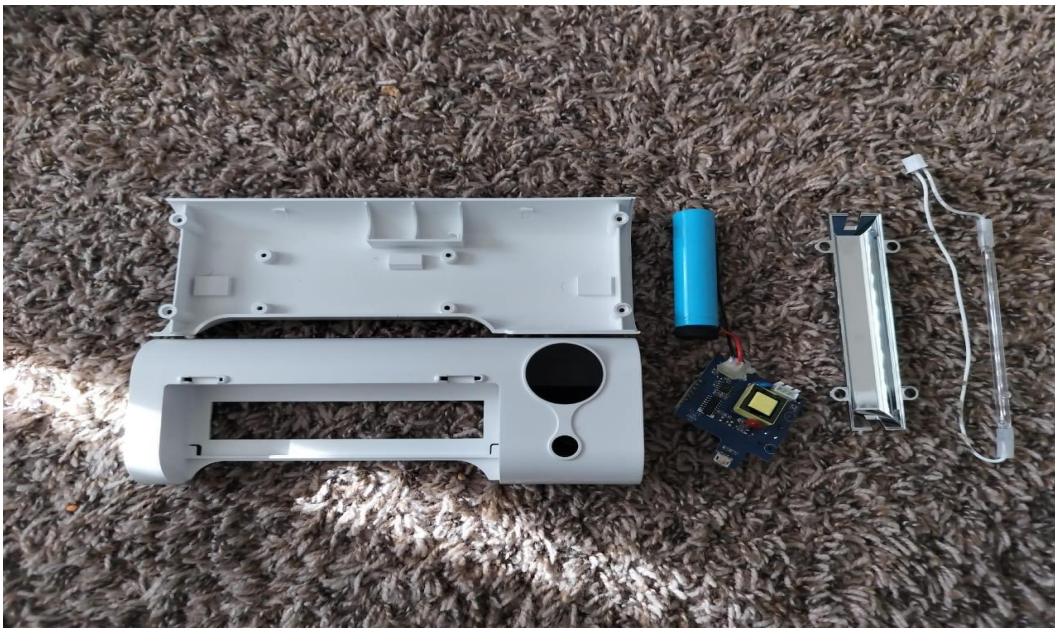(Back – Side 3D model View of UV Tooth brush sanitizer created on SketchUp software)
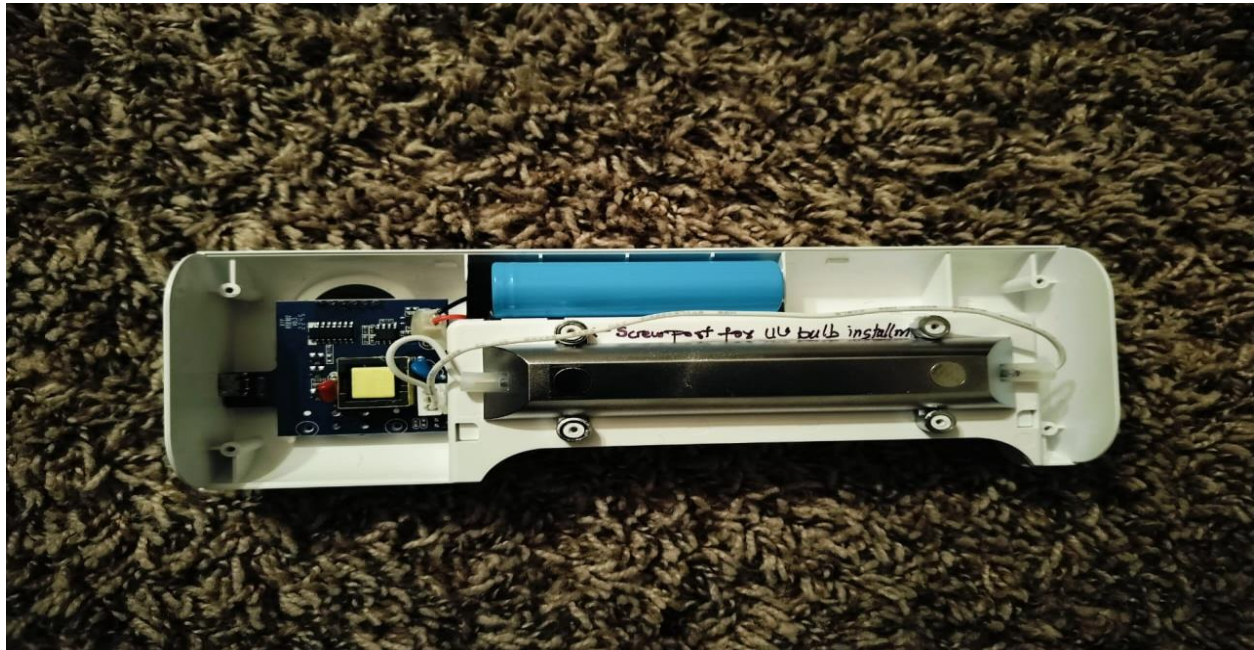

(Back – Side 3D model View of UV Tooth brush sanitizer created on SketchUp software)
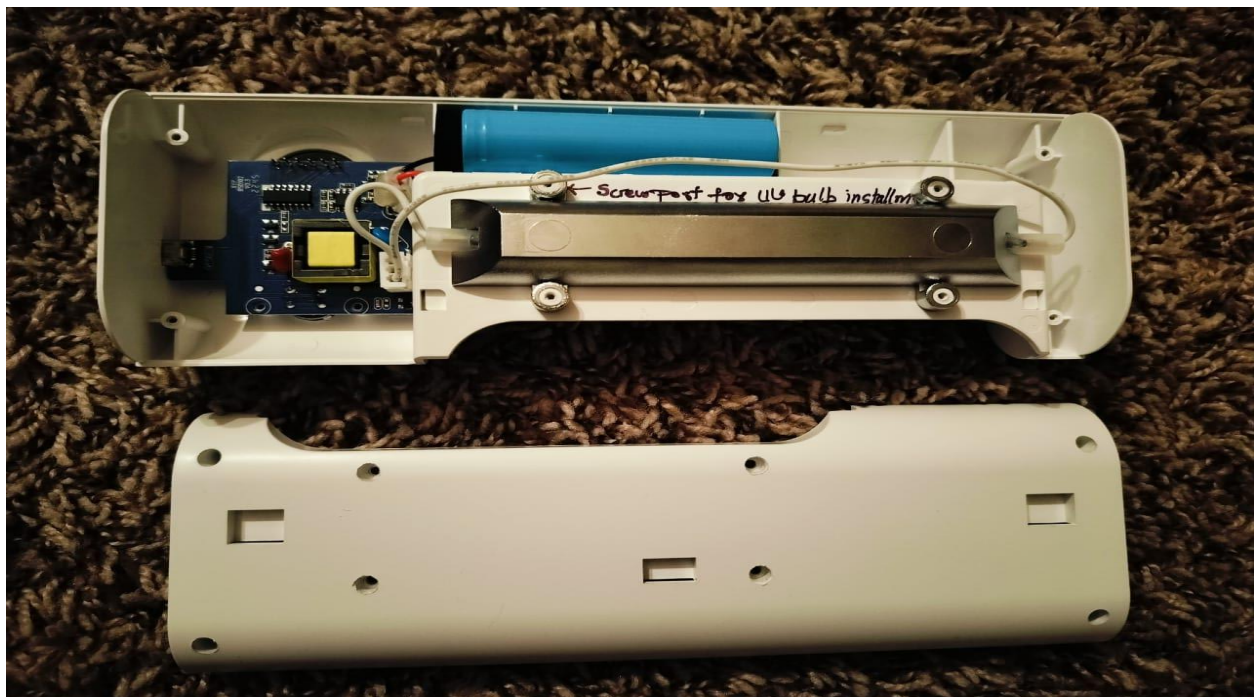
Expected End Product:

Prototype of UV Tooth brush sanitizer:

(Prototype i.e, components ready for assembly)

(UV Tooth brush sanitizer prototype installed with its components without back cover)

(UV Tooth brush sanitizer prototype installed with its components with back cover)

Work Cited:

(For the pages 4 – 34 the references are mentioned below in order as per the page number order).

Contreras, A., Arce, R., Botero, J. E., Jaramillo, A., & Betancourt, M. (2010). Toothbrush contamination in family members. *Revest clinical de periodontia, implantology y rehabilitation oral*, *3*(1), 24-26.

Shiels, M. S., Haque, A. T., de González, A. B., & Freedman, N. D. (2022). Leading causes of death in the US during the COVID-19 pandemic, March 2020 to October 2021. *JAMA Internal Medicine*, *182*(8), 883-886.
``
https://www.usatoday.com/story/news/nation-now/2017/04/06/youre-probably-brushing-your-teeth-fecal-matter/99785026/

Toothbrush sanitizer market. Future Market Insights. (n.d.).
https://www.futuremarketinsights.com/reports/toothbrush-sanitizer-market \

Toothbrush Sanitizer: https://toothbrushsanitizerholder.com/how-to-choose-the-right-uv-toothbrush-sanitizer-for-your-needs/

Toothbrush sanitizer efficacy: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4268624/

Toothbrush Sanitizer chart:
https://www.google.com/search?q=toothbrush+sanitizer+uv+charts&tbm=isch&chips=q:toothbrush+sanitizer+uv+charts,online_chips:electric+toothbrush+market:F9zTQMyj_DY%3D&rlz=1C1GCEA_enUS1076US1076&hl=en&sa=X&ved=2ahUKEwiRi_y08-mBAxWLOUQIHTJ5C0EQ4lYoAXoECAEQNw&biw=1519&bih=715#imgrc=NvyjzEDT3BcI9M

https://www.usatoday.com/story/news/nation-now/2017/04/06/youre-probably-brushing-your-teeth-fecal-matter/99785026/

Toothbrush sanitizer market. Future Market Insights. (n.d.).
https://www.futuremarketinsights.com/reports/toothbrush-sanitizer-market

Toothbrush Sanitizer: https://toothbrushsanitizerholder.com/how-to-choose-the-right-uv-toothbrush-sanitizer-for-your-needs/

Toothbrush sanitizer efficacy: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4268624/

Toothbrush Sanitizer chart:
https://www.google.com/search?q=toothbrush+sanitizer+uv+charts&tbm=isch&chips=q:toothbrush+sanitizer+uv+charts,online_chips:electric+toothbrush+market:F9zTQMyj_DY%3D&rlz=1C1GCEA_enUS1076US1076&hl=en&sa=X&ved=2ahUKEwi

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