NEEDS ASSESSMENT

Team 6

Design of a Less Deafening Hair Dryer

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Table of Contents

Table of Figures

Table of Tables

(Future information will be provided)

ABSTRACT

Each group member is properly informed and educated to move forward in the design process. The research performed correlating to the background of hair dryers has provided the group with further incite toward their approach to proceed from one step in the design process to the next one. By adhering to necessary processes developed through the use of the Kano Diagram, Triz Table, and HOQ, the group has a more formal understanding of what it takes to achieve their goals. The comprehension of what the group's limitations toward actual design-creation will increase their chances of success.

Succinctly put, the group has the proper tools and knowledge to move forward into the process of creating a less-deafening hair dryer. There is no excuse for the group to falter, as long as they remain unified and determined to accomplish the task at hand.

ACKNOWLEDGMENTS

(Future acknowledgments will be addressed here)

1.0 Introduction

The objective of this needs assessment report is to clearly lay out the goals and direction that are expected of Team 6 in order to successfully advance forward with this project. The task at hand is to create a hair dryer whose noise output is significantly less than that currently seen in the hair-dryer market. This project also demands us to analyze the entrepreneurship side and to generate a product that is suitable for the current market by creating a device that meets safety regulations, provides equivalent quality, and also is quieter. With this in mind, all design aspects must be made to ensure the product can easily be transferred to the market and be massed produced. Our project sponsor is Dr. Michael Devine; he is very knowledgeable on entrepreneurial endeavors and whose advice will be thoroughly sought after when making decisions about our product. Currently the average hairdryer produces a sound level that is bothersome and can be threatening to one's long term hearing. Some examples include salons where there is excessive noise pollution due to hair dryers, or the case where someone is sleeping but the roommate or significant other needs to use the hair dryer. Being that there is this inherent problem associated with the current hair dryer, it offers a niche in the market for this project to fit a need. A solution that we would deem fit would be one that could offer the same amount of power output, while reducing the noise that it produces compared to current hair dryers in market.

This assessment will begin with some background on the current state of hair dryers to give insight into some design features, while also giving detail of a few leaders in the market of quiet hair dryers. The need statement will be defined to outline the current problem that is intended to be solved. The goals for our project will be clearly described along with the constraints of the project that are set forth by both our sponsor and us. They will consist of aspects of an ideal hairdryer that we believe our final design should fall in and the methodology of some major tasks that are planned to be completed during the project. As a final point, a conclusion will then be given to bring together all the ideas that have been previously stated to reemphasize the direction of our project.

2.0 Project Definition

2.1 Background Research

Hair dryers are the one of the most widely used hair-related instruments, for both men and women who look for a perfectly, shiny and frizz-free hair style. They are meant for one primary purpose, and that is speed-up the time it takes to dry hair. In order to make hair dryers perform efficiently, their heating elements and air flow rate must be extremely effective. However, this causes one big problem: the level of sound created by the hair dryer. It has been observed that people are unhappy with the noise that is associated with using a hair dryer. The typical hair dryer produces anywhere between 80 - 90 decibels[1]. This not only creates an unpleasant environment for the person getting their hair dried, but also can produce undesired noise in both a business and to those sharing the room. Many sources cite that noise-induced hearing-losses begin at the sound level of 85 decibels[2], thus making the average hair dryer detrimental to ones hearing over time.

Fundamentally, a hair dryer is a simple electromechanical device. On the most basic level, it is a heating element that uses resistance in wires to produce heat, then using a fan to continuously force air over them creates a constant stream of hot air. This means of heat transfer is called *forced convection*. The progression of the hair dryer design has been happening since the 1920's when the first of its kind was invented. Over the years, its design has changed to a lighter, safer, and more powerful device. The early models were made of steel and zinc, which only produced 100 Watts, unfortunately resulting in numerous casualties from electrocution. The standard today in heat resistive plastics, generally up to 2000 Watts, a plethora of safety measures have been implemented that have nearly eliminated all hair drying fatalities. Most of the safety measures include mechanisms that trip the circuit if it experiences unusual current, or reaches a certain temperature.

Meanwhile, the problem of noise pollution by hair dryers has been undertook by multiple companies, one of these being Revlon, to produce a "quiet" hair dryer. The "Revlon RVDR5045 Quiet Pro Ionic Dryer" was claimed to be 50% more quiet than the leading brands, however this product is unfortunately no longer on the market[3]. That suggests the product was not quiet enough to satisfy the market-consumers. There are two other companies that have successful products which claim to be the quietest hair dryers. The "Centrix Q-Zone" hair dryer is said to produce roughly 10 less decibels than its competitors. This product is sought out mostly because of its low price and exceptional performance, while also allowing its user to speak on the phone due its low sound production[4]. The second is the "Envy + Onyx" made by Velecta-Paramount, which is said to produce only 64 decibels, but with its higher price tag of $300 (and being built by hand in Paris), it is not as popular as the Centrix[5] model. Both companies suggest that their products utilize advanced noise-cancelling technology; this could be a result from using high-tech motors which both companies place at the center-point of their designs. Unfortunately, both companies do not suggest the finer details of their technology to reduce noise, but the motor could suggest to be the first step, along with insulation to reduce vibrations.

The noise-cancelling technology via high-tech motor was achieved by Dyson, a company that solely produces high-tech vacuums and fans. The idea behind the noise-cancelling technology was to eliminate the use of blades that propel the air out of a nozzle. The high-tech, neodymium magnet-engine that is employed in every Dyson product helps reduce turbulence by pulling air in from the atmosphere at a relatively high velocity[6]. Ultimately, the idea of reducing the turbulence

from the air flow is the major key in reducing the sound produced by air-multipliers such as fans, or even extended toward hair dryers.

2.2 Needs Assessment

Through our concept design progress, the development of creating a hand-held device with characterization of a rod, rather than a pointer, is needed in order to provide easier handle for the needs of customers. Though this method will indeed be challenging, such as shifting components and minimizing/maximizing/optimizing their limitations, the main goal will still be to be able to reduce sound that is emitting from the device as it processes, and if possible, provide better performance. Proceeding with a full agreement on the concept selection, the next step within the following weeks and up to several months will be to research the entire detail regarding hair dryers. Detail can be specified in sub categories, such as obtaining and storing more information from the customers by organizing them into Kano Diagram/QFD/HOQ. The following sub category would be generating details of selections with TRIZ or decision matrices. Lastly, we can break down all the data by iterating, refining, and reviewing/testing with strategic methods, such as setting up a CPM. Afterwards, can we actually dispatch the detailed design to the sponsor (Dr. Devine), and if acceptable, it can be further processed, produced, used and disposed by customers. Though reducing sound is a critical focal point, the updated technology around us, and seeing that the product has been never updated or altered around 10-20 years, we believe with our engineering intuition and teamwork, there can be lesser storage and a more powerful resource that can suit within our parameters in order to solve this problem.

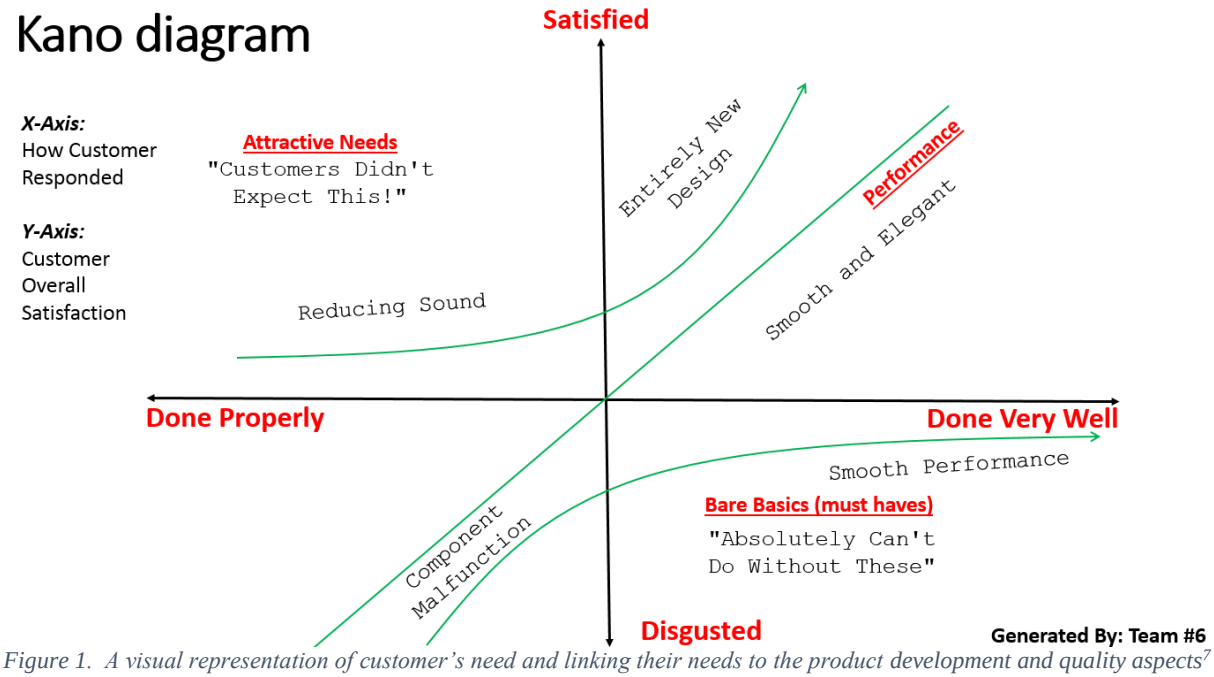


Figure 1. A visual representation of customer's need and linking their needs to the product development and quality aspects[7]

TRIZ

Improving Feature \ Worsening Feature	Weight of Moving Object	Length of Moving Object	Speed	Shape	Duration of Moving Object	Reliability	Convenience of Use (Versatility)
Weight of Moving Object	X	15, 8, 29, 34	2, 8, 15, 38	10, 14, 35, 40	5, 34, 31, 35	1, 3, 11, 27	29, 5, 15, 8
Length of Moving Object	8, 15, 29, 34	X	13, 4, 8	1, 8, 10, 29	19	10,14, 29, 40	14, 15, 1, 16
Speed	2, 28, 13, 38	13, 14, 8	X	35, 15, 18, 34	3, 19, 35, 5	11, 35, 27, 28	15, 10, 26
Shape	8, 10, 29, 40	29, 34, 5, 4	35, 15, 34, 18	X	14, 26, 9, 25	10, 40, 16	1, 15, 29
Duration of Moving Object	19, 5, 34, 31	2, 19, 9	3, 35, 5	14, 26, 28, 25	X	11, 2, 13	1, 35, 13
Reliability	3, 8, 10, 40	15, 9, 14, 4	21, 35, 11, 28	35, 1, 16, 11	2, 35, 3, 25	X	13, 35, 8, 24
Convenience of Use (Versatility)	1, 6, 15, 8	35, 1, 29, 16	35, 10, 14	15, 37, 1, 8	13, 1, 35	35, 13, 8, 24	X

Figure 2. Created for purpose of solving categorized problems with logic and data rather than intuition or brainstorming

Inventive Principles
1. Segmentation
2. Extraction, Separation, Removal, Segregation
3. Local Quality
4. Asymmetry
5. Combining, Integration, Merging
6. Universality, Multi-functionality
7. Nesting
8. Counterweight, Levitation
9. Preliminary anti-action, Prior counteraction
10. Prior action
11. Cushion in advance, compensate before
12. Equipotentiality, remove stress
13. Inversion, The other way around
14. Spheroidality, Curvilinearity
15. Dynamicity, Optimization
16. Partial or excessive action
17. Moving to a new dimension
18. Mechanical vibration/oscillation
19. Periodic action
20. Continuity of a useful action
21. Rushing through
22. Convert harm into benefit, "Blessing in disguise"
23. Feedback
24. Mediator, intermediary
25. Self-service, self-organization
26. Copying
27. Cheap, disposable objects
28. Replacement of a mechanical system with 'fields'
29. Pneumatics or hydraulics:
30. Flexible membranes or thin film
31. Use of porous materials
32. Changing color or optical properties
33. Homogeneity
34. Rejection and regeneration, Discarding and recovering
35. Transformation of the physical and chemical states of an object, parameter change, changing properties
36. Phase transformation
37. Thermal expansion
38. Use strong oxidizers, enriched atmospheres, accelerated oxidation
39. Inert environment or atmosphere
40. Composite materials

Figure 3. Inventive principles that correlates with the TRIZ's Improving and Worsening Features

2.3 Goal Statement

As engineering students, the goal is to solve a problem with a method devised to reduce the cost, time and effort. The goal, on the other hand, is to create a hand-held device which generates hot air at a satisfactory level in a safe environment with the included capability of emitting low sound decibels. Additionally, we'd like to allow users not to feel weary after using this product, therefore creating a new parameter is needed.

2.3.1 Purpose of Objectives

- Reduce sound → Ease hearing (PRO, no CON)
- Change parameter → Discovered while trying to reduce sound; other products were outdated (PRO -> Lighter weight, CON -> Slightly heavier weight)

2.4 Constraints

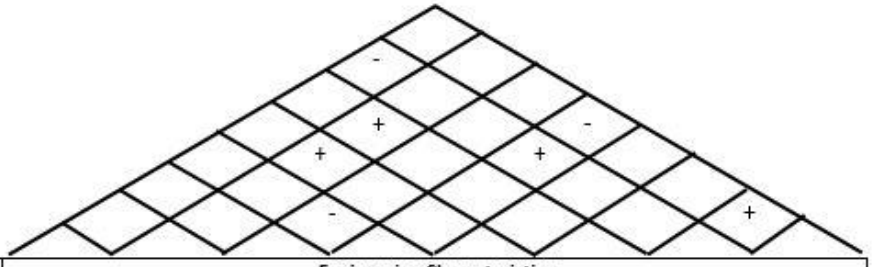
The initial constraint imposed upon our group is the financial aspect prototype production. Our budget ranges from 1,500 – 2,000 US dollars. It is believed that with this amount of money, a quieter (yet still effective) hair dryer can be assembled into a fully-functioning device. Other probable constraints could be listed as:

- Weight – it is imperative to develop a hand-held device which can be held above the head for long periods of time, therefore a lightweight design is a critical aspect of this project
- Size/Boundary Conditions – the size and shape of the design should resemble current products on the market due to an ease-of-use factor, however this should not limit creativity levels inputted toward the overall look
- Temperature Output – during use of the product, the temperature output should not make the user feel as if their hair/face/body is "freezing or melting"; the settings of the device should provide comfort to the user during an point of product usage
- Noise Output – possibly the most desirable aspect of this project; the device WILL output a decibel reading which qualifies as a "less deafening" hair dryer; must reduce turbulence
- Velocity and Pressure Input/Output – this may be the most challenging engineering feat to overcome; ensuring a properly calculated amount of air velocity and pressure to enter and exit the device will be crucial for a function hair dryer
- Vibrational Effects – another constraint to overcome would be to reduce, or eliminate, any vibrational output from the dynamic parts moving within the interior of the hair dryer's housing unit
- Insulation – in order to provide user safety, proper temperature control of the heating and/or cooling elements of the product's operation would be critical to maintain; the device should not overheat during any period of usage

3.0 Methodology

The group's general and initial strategy in order to complete both senior design courses is to follow the master deliverable's schedule and to complete each assigned task. Additionally, the group will also continue to communicate with senior staff members and fellow colleagues. If there are any sudden changes within the schedule, the group will readjust in order to stay on a proper schedule.

More specifically, the group intends to initially purchase standard and inexpensive hair dryers, then disassemble each one in order to study the typical inner-workings of a hair dryer. Concurrently, the group will also provide conceptual sketches of the prototype design in order to visualize a potential outcome. Afterward a selection is made, certain group members will attempt to model the design utilizing CAD programs; the measurements used for the CAD design process will be based off of part-specifications purchased throughout several stores. More importantly, no parts will be purchased or actual designs be constructed UNTIL some form of mathematical-work has been calculated. By utilizing the HOQ listed ahead in Fig. 4 will provide a better guideline as to properly access and approach the creation of a physical product.



		Engineering Characteristics							
Customer Requirements	CI	Number of Colors	Type of Motor	Ceramic and Ionic Capable	Parts Design for Non-Turbulent Flow	Power Usage	Heat/ Speed Settings	Strong Corrosive Resistant Materials	Removable Parts
Blows Really Hot Air	9					10	10		
Cold Shot	8						10		
Reliable	9		6			3		6	10
Ergonomic	7							10	
Easy to Fix/Clean	8				10				10
Light Weight	5				6			10	
Attractive	3	10						6	
Affordable	4		6	6	6			6	
Quieter	10		10		10	3		3	
Small Profile	7				6				
Powerful	9		10			10			
Features	7	3		10			10		3
Score		51	268	94	276	237	240	246	191
Relative Weight		3.2%	16.7%	5.8%	17.2%	14.8%	15%	15.3%	12%
Rank		8	2	7	1	5	4	3	6

Scale: Of Importance

CI = 1-10

EC = 3 (Min), 6(Median), 10(Max) (Ctrl)

Figure 4. House of Quality chart used to determine priority levels throughout design process

4.0 Expected Results

At this stage of the design process, group optimism is still very high. The group does expect to produce a fully-functional prototype. This device is expected to not only produce minimal sound (in comparison to other popular noise-cancelling models), but also effectively dry the user's hair within a reasonable amount of time. The future device should be lightweight in order to reduce the amount of stress imposed upon the user's arm, shoulders, and muscles. Other expectations involve the reduction of the amount of vibration created by the installed motor, however the quantity of vibrational motion is still undetermined. Also, with regards to the relatively high temperatures produced from the dryer's heating elements, is the inevitable usage of proper insulation in order to provide user safety. Sufficed to say, obvious expectations developed from brainstorming and sketch designs have provided the group with a clearer path towards production, however time has yet to provide the group with additional concerns.

5.0 Conclusion

In conclusion to this assessment, the group has a strong understanding of what to expect in the near future, and is able to confidently implement the correct steps to achieving their goals. By creating an optimum plan, the group will be able to successfully create a functional hair dryer with minimum setbacks. Maintaining constant communication, high expectations, and elevated motivation will escalate the design process toward a positive, future outcome.

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Appendix A

(Future information will be placed here)

Biography

(Future information will be placed here)