

Wart Eliminator Project Report

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Abstract

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The Wart Eliminator is a product based on the theory of resonant frequency and its ability to devitalize pathogens with the use of electronic pulses. Using the resonant frequency of the wart's pathogen, the device is operated by the user with two switches for power and a probe connected by a wire to the device for applying to the affected area of the user while running three minute cycles. The product is in the beginning stages with only a prototype made. The product needed a proper ergonomic design to be easily used by the user and a cost analysis to be ready for a possible future production. The studies showed that with a curved design, it was more ergonomically friendly to the user and that even though it would be more expensive, the user would be willing to pay more money if the device provided customer satisfaction. The cost analysis showed that the product could be sold at a price that is relatively inexpensive to the user. With this knowledge, the social impact on this product could be a huge impact providing home users the ability to cure their ailments without having to receive medical help at a price that is more affordable and a more effective cure.

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I. Introduction

This report will describe the steps taken to make the Wart Eliminator a production ready product. The current Wart Eliminator prototype aims to eliminate the wart virus using resonance frequencies in a small, affordable package that can be used at home. This project seeks to take the prototype in hand and create the product described above using industrial engineering tools such as cost analysis, human factors, Solid Works and design of experiments. The product is currently still at its beginning stages with the prototype in place, and the concept needs to be taken to the next level so that the foundation can be put in place for future business opportunities

II. Background

The wart eliminator prototype was created based on the concept of resonant frequency and its relationship to pathogens in the body. In the early 1900s, a man by the name of Royal Rife discovered that pathogens such as viruses and bacteria could be devitalized by subjecting them to certain frequencies created by an electrical apparatus (Electrical and Frequency Effects on Pathogens). The idea works similar to the idea of a wine glass shattering when it is subjected to the right resonant sound. The wart eliminator focuses on devitalizing the DNA of the wart virus by running a range of frequencies through the body. Applying a probe attached to the machine to the affected area on the body, allows the frequency to run through the body while matching the resonant frequency of the wart pathogen with no side effects by the use of direct current.

The current Wart Eliminator design is shown in the following figures.

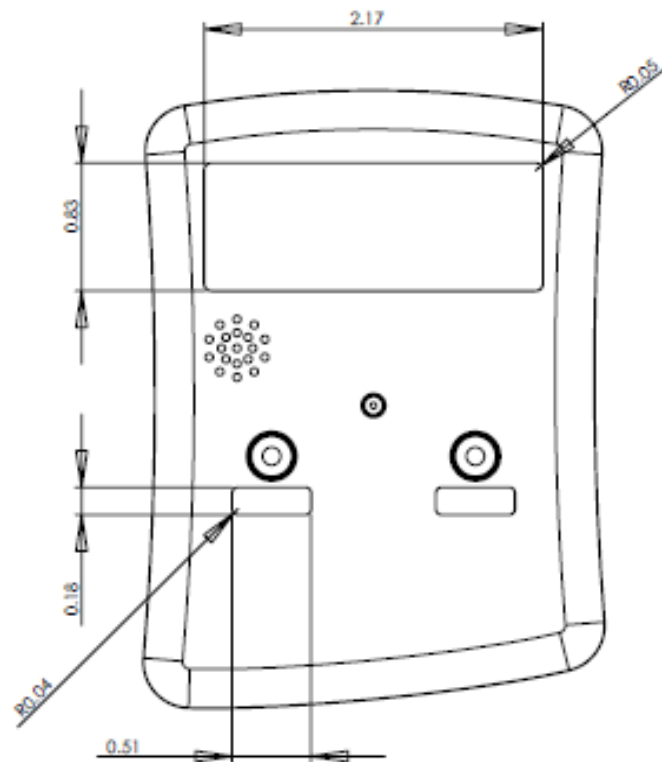


Figure 1: Current Schematic Design of Wart Eliminator Shell

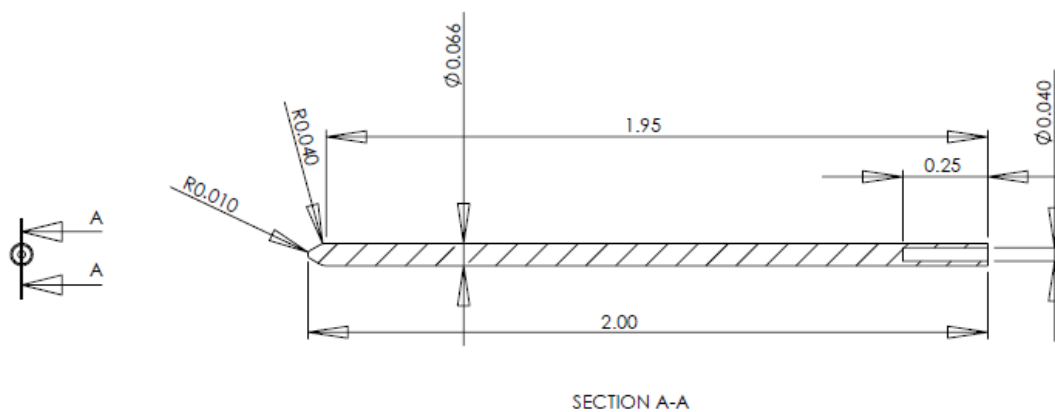


Figure 2: Current Design of Wart Eliminator Probe Metal Tip

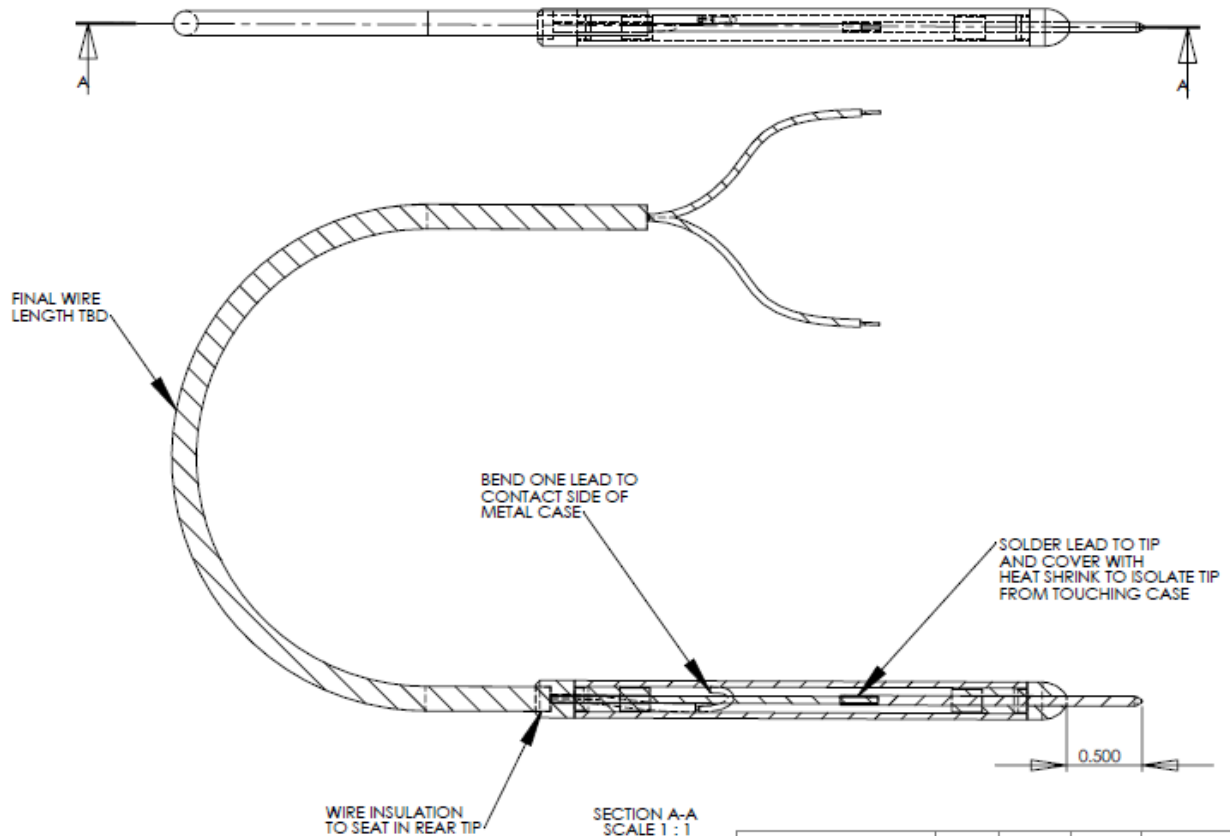


Figure 3: Current Design of Wiring and Probe

Farther research was conducted to farther understand how the Wart Eliminator worked and how it could be improved.

Types of Warts

HPV

Human Papilloma Virus (HPV) is the most common sexually transmitted known to man, with various (40) types affecting different parts of the body. This virus mainly infects the genital regions of both males and females, however. HPV has become a worldwide problem due to how easy it is to contract and the health problems that it can cause. Getting the virus can occur

through any type of sex (vaginal, anal, and oral) or genital contact, and because the virus does not always show symptoms, people pass it along without ever knowing. While 90% of HPV cases clear themselves, certain types of the virus are able to change normal human cells into abnormal ones. If symptoms do arise, many health issues could follow. These problems include genital warts, respiratory papillomatosis (RRP or throat warts), and cervical cancer in women. Every year in the US 360,000 people contract genital warts and 12,000 women are diagnosed with cervical cancer with an estimated 79 million Americans holding the virus as of 2012. As of now, there is no way to screen or cure HPV itself, but there are ways to help with health issues created by the virus, such as the genital warts.

Human Papilloma Virus also has many other varieties that do not affect the genitals and are more common, such as the common wart. Common warts appear mostly on hands, fingers, and knees, but in some cases, the wart may imbed in the bottom of the foot, creating what is known as a plantar wart. Contraction usually occurs through touch, broken skin, or hangnails. Though the common wart is considered harmless, many people try and get rid of them by visiting the doctor to get it frozen off and some may even require minor surgery to remove. Over the counter and home remedies are often ineffective and or painful such as using duct tape to rip them off.

There are other, more popular, treatment options for common and plantar warts as well, including cryotherapy, topical salicylic acid, and surgery. In a 13 week randomized study of the effectiveness of cryotherapy and salicylic acid curing common and plantar warts, many interesting statistics were born. Using cryotherapy, 49% of patients were fully cured and with the acid, 15% were cured. This compares to the 8% of patients who received no treatment and the wart went away on its own. In another similar study, at the 12 week mark, 14% of patients using cryotherapy or salicylic acid were cured with a total 32% cured after 6 months.

Square Wave Frequency

The Wart Eliminator is programmed to run at 21.27 Khz which matches the natural resonant frequency of the warts virus including that of Common Warts, Plantar Warts, and HPV, commonly known as genital warts. Since warts are known to be caused by a group of common viruses, the present design uses a frequency close to one established by Dr. John Crane for the treatment of the “wart virus” (21.27kHz) who was the first to extend Dr. Rife’s original testing on electric pulses and their affect on harmful microbes. The various different types of wart viruses tend to have slightly different resonant frequencies, but this product is aimed at implementing the frequency that covers all various types of the wart virus based on the research of Dr. Crane. The Wart Eliminator runs a square waveform through the body with direct current. The reason for square waves instead of some other wave form comes from the fact that square wave’s, “harmonic content exceeds that of other waveforms” (Holman and Dorneau). This means that the frequencies emitted by square waves are, “Formed by the summation of all odd harmonics of a fundamental frequency” (Arnold). They are beyond that of the audible spectrum creating a matching resonance capable of causing a organism such as a virus to shatter and therefore devitalize.

Competition

From research done, there is not very much competition in regards to this type of product. There are products similar to the wart eliminator device, but there are significant areas where the products differ. One such product that is relatively similar to the Wart Eliminator is called the Wartabator. According the Wartabator website, the product pulses at 32 V DC and runs a frequency of 21.27 Khz (The Wartabator Company). What separates this product from the Wart Eliminator is the following:

1. The Wart Eliminator has two settings for high and low voltage which are 15 V and 30 V DC compared to only one setting of 32 V DC.
2. The wart eliminator has a 16.05 MHz internal crystal which causes there to be a frequency tolerance of only plus and minus 7 Hz when the device is performing its cycle.

The importance of the two above specs is the fact that the Wart Eliminator can run at two different levels of power, both 15 V and 30 V. This is important not only as a level of variation, but also as an ergonomic factor. Some users are more sensitive when the probe is touching their skin, so being able to have a power level that is significantly less will avoid discomfort for the user. Also, the most significant difference is the fact that there is a crystal located in the Wart Eliminator that causes the frequency to stay within a very small tolerance. The Wartabator does not have this attribute causing it to fall out of the frequency range at very significant amounts, and therefore not effectively have the correct resonant frequency matching that of the wart virus. These facts are important marketing strategies to address in regards to superiority to the competition if and when the Wart Eliminator is mass produced.

New Product Development

The wart eliminator was a project handed over to us by a business man that came up with the idea for making the current existing product called the Wartabator more effective and a better overall device using his own research and design. The product as it stands is still in the beginning stages, and part of the goal for taking on the project is to develop a business plan for possible future manufacturing of it. Part of the steps to develop a business plan for the Wart Eliminator is to first make the current prototype better both aesthetically and internally if need be. From

research done by both the owner of machine and our senior project group, it has been discovered that the technological aspect of the Wart Eliminator theoretically are correct in terms of what the device is trying to accomplish.

In regards to New Product Development, the following are what have been accomplished so far:

1. Product Specification
2. Product Design
3. Sample Production (a.k.a prototype)

Project Validation and Qualification is the key factor in this project and the stepping block toward full scale production (Kean).

Ergonomics

Ergonomics, or human factors, is a key aspect in designing a new product. It is essentially the way the product fits in with the people and allows them to use whatever it is that they are using effectively. Its goal is to relieve the stress on the user and can also act as a selling point to a customer. In the design of a new product such as the Wart Eliminator, important aspects of ergonomics, or user-centered design, such as dimensions, weight, and strength must all be taken into account. In addition, there must be attention to the user's ability to perceive the product, understand how to use it, and make things such as displays easy to read and operate. Bad ergonomics can lead to drastic mistakes and user errors, resulting in dissatisfaction in the product or service.

User-Centered Design

User Centered Design (UCD) is based around the struggle between form and function. Many engineering problems reside around this conflict and the careful balance of meeting all the customer's needs and requirements, while still having a product that is easy to use and looks appealing. The first step to achieving this is known as creating a conceptual design. Here,

research is done to come up with the need of the products. With this, the creator can decide what the product will actually do and which ways it will interact with the user. It is important at this stage to only include relevant ideas, as including useless items on your product will set you back in the future. The conceptual design phase can also be categorized into four parts: cognitive design, physical design, industrial design, and user experience design. Cognitive design ensures the design is fitting for human interaction and limits. Next the physical design dials in the product dimensions, controls, and displays. Third, the industrial design mixes the last two design forms and creates a product that makes sense and looks good. Lastly, user experience design brings everything together and focuses on how the customer will interact with the product. Sometimes the conceptual design process can become very complex; however, in that case, a sort of hierarchy or priority matrix should be established to focus on the parts of the design that matter the most. In the end, if the user centered design process is completed correctly and efficiently, one should end up with a finished product that needs minimal changes and has high customer satisfaction.

Instruction Manuals

The Food and Drug Administration's Center for Devices and Radiological Health has written a guide to writing instruction manuals for medical devices that are being used at home. The creation of this guide comes from increased user error at home, since manuals were originally designed for use by professionals. The first stage of writing this technical document is the planning stage. Here, one must take into consideration the audience to which the product will reach. Age, language spoken and literacy are three things to look at especially. While planning, it is also critical to have already accounted for all the human factors elements of the product and to

take a team based approach to writing so that no tasks are missed. After this stage is completed, the FDA guides one to at least ten different sections that should be included in the document.

These basic categories are:

- | | |
|--|---------------------------|
| 1. User assistance information | 7. Setup instructions |
| 2. Table of contents | 8. Check-out |
| 3. General warnings and cautions | 9. Operation instructions |
| 4. Purpose of the device | 10. Cleaning |
| 5. Description of the device | 11. Maintenance |
| 6. Environmental conditions affecting
use | 12. Storage |
| 14. Summary | 13. Troubleshooting |
| | 15. Index |
| | 16. Date |

There are also guidelines as to language use and writing the instruction manual as well and writing procedures to be followed. The main point is to use clear and concise language that leaves no room for misinterpretation from the user and so that the manual itself does not become too long. It is also crucial to keep uniformity throughout and use similar word choice and sentence structure for similar ideas. Finally, before finishing and distributing the document, a checklist must be completed of all the necessary items and tests must be performed to ensure that it actually works for the product at hand. Overall, utilizing these steps will allow at home users of medical devices to use a product successfully.

III. Design

A very systematic approach was used in determining what steps to take in order improve the Wart Eliminator. This can be shown by the following flow chart.

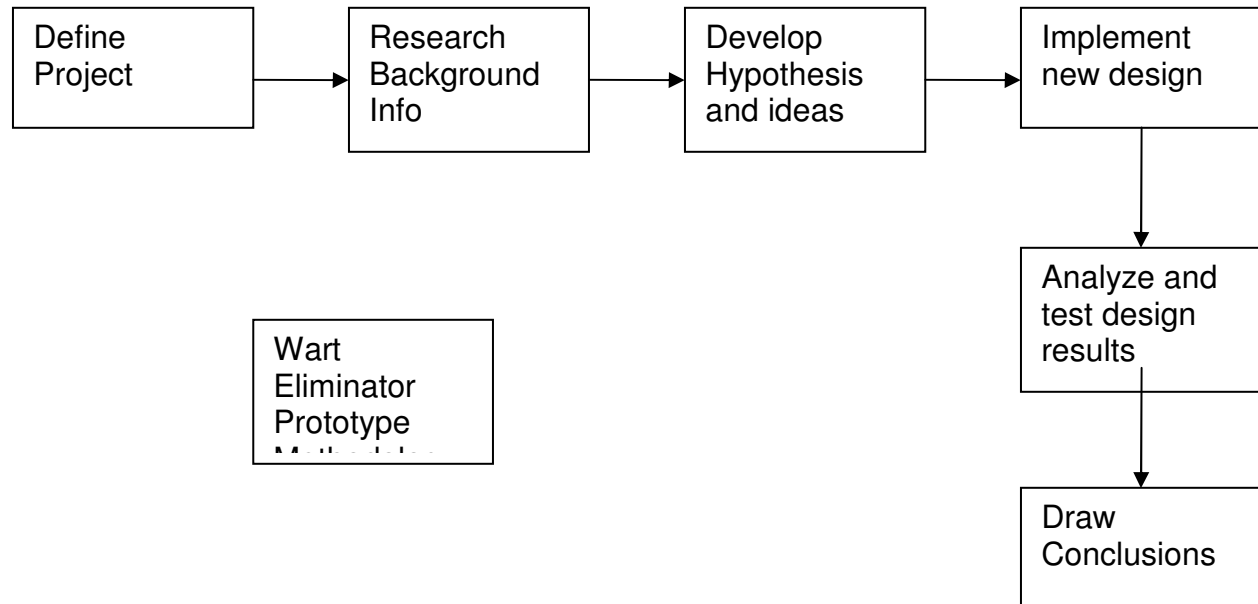


Figure 4: Systematic Approach

In the design phase of the project, it was important to develop hypothesis and ideas that made sense. First, a survey was conducted to get feedback from potential users on what they might like to see in a product like the Wart Eliminator, and then a new product was designed based on the suggestions received. Based on the new design, a cost for production of the product could be calculated.

Wart Eliminator Online Survey

The following is analysis of the online survey sent out to gather information regarding the Wart Eliminator product. The goal of this survey was to figure out areas of focus for the product and to see what purchasers would want. 100 participants filled out the survey and below is a copy of the survey that was used to gain data:

Wart Eliminator New Product Survey

0%

All information gathered in this survey is done so on an anonymous basis

Introduction

Thank you for helping us evaluate our new product/service idea. We hope to bring this product/service to market in a way that meets the needs of individuals like yourself. This short survey will help us identify what aspects of the product/service are most important to you so that we can focus on the most important aspects first. The entire survey should take between 5-10 minutes of your time.

Thanks in advance,

Kyle Shipman and Colton Story

Wart Eliminator Product Description

The Wart Eliminator is an at home medical device that aims to eliminate common warts, or HPV, through the use of resonant frequencies. A user simply holds the device in their hand, touches the tip of the probe to the wart, and activates the correct frequency with the push of the button. After 3 minutes of time, the Wart Eliminator will stop beeping and the process is complete.

Based on our description on the previous page, how well do you understand our product/service idea?

- ☐ Don't Understand
- ☐ Somewhat Understand
- ☐ Understand
- ☐ Understand Very Well

Have you ever used a product/service such as the one proposed?

- ☐ Yes
- ☐ No

What is your overall interest in the product/service described?

- ☐ Not Interested
- ☐ Somewhat Interested
- ☐ Interested
- ☐ Very Interested

Please indicate your gender:

- ☐ Male
- ☐ Female
- ☐ Prefer Not to Answer

How old are you?

- ☐ Under 18
- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65+

How probable is it that you would purchase a product/service like ours in the future?

☐ Definitely
☐ Probably
☐ Not Sure
☐ Probably Not
☐ Definitely Not

Please Explain (Optional)

How probable is it that you would purchase a product/service like ours in the future?

Please indicate your answers in [insert currency of choice here]:

What is the most you would pay?

What is the least you would expect to pay?

What do you believe would be the ideal price?

Which of the following best describes your highest level of education?

☐ Some High School
☐ High School Graduate
☐ Some College
☐ Associate Degree
☐ Bachelor's Degree
☐ Graduate or Professional Degree
☐ Prefer Not to Answer
☐ Other, please specify...

When considering a product/service such as the one proposed, what level of importance do you associate with each of the following factors?

	Not Important	Somewhat Important	Neutral	Important	Very Important
Quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Size and Feel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer Service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Training Material	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Appearance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of Use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 5: Wart Eliminator Online Survey

After the 100 participant goal was reached, charts were created to make sense of all the data. The results of the survey are as follows:

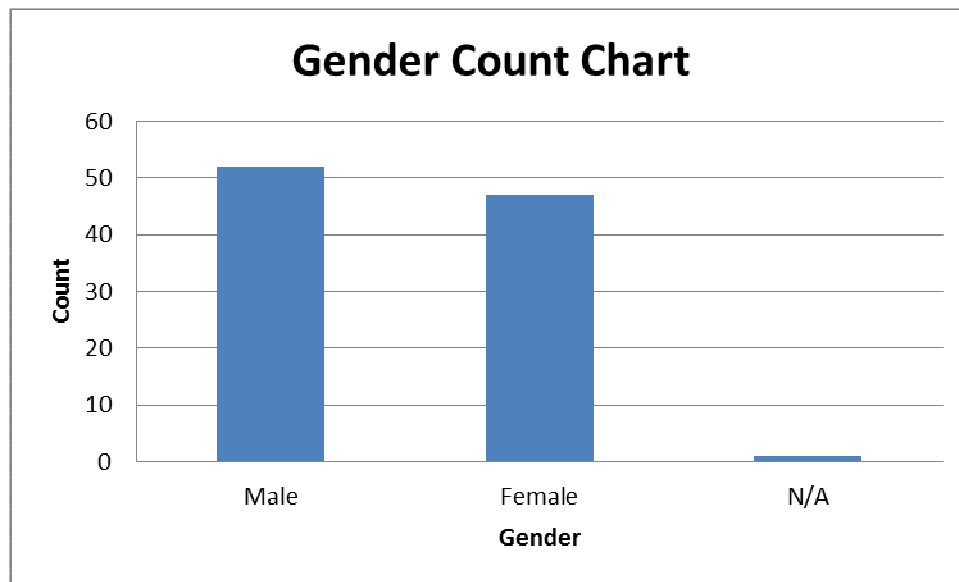


Figure 6: Survey Gender Count Chart

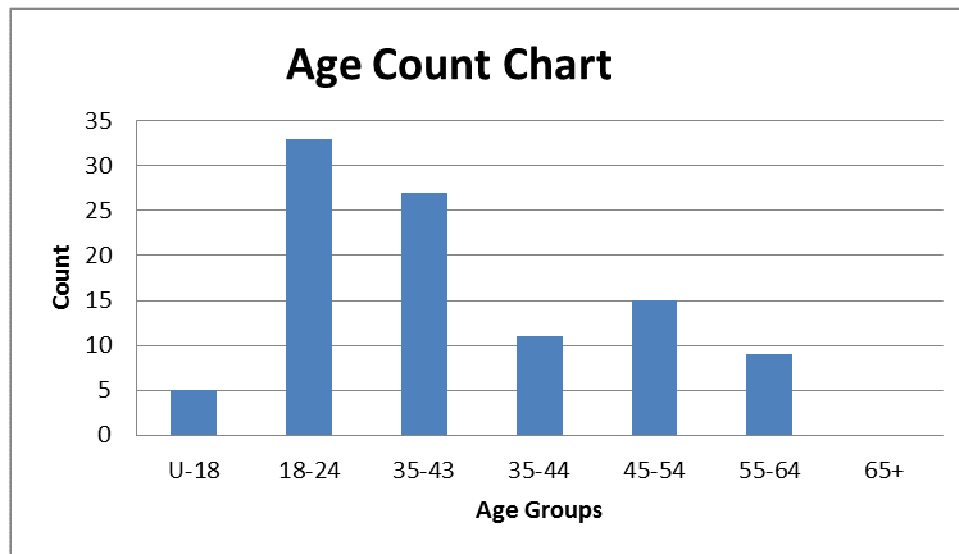


Figure 7: Survey Age Count Chart

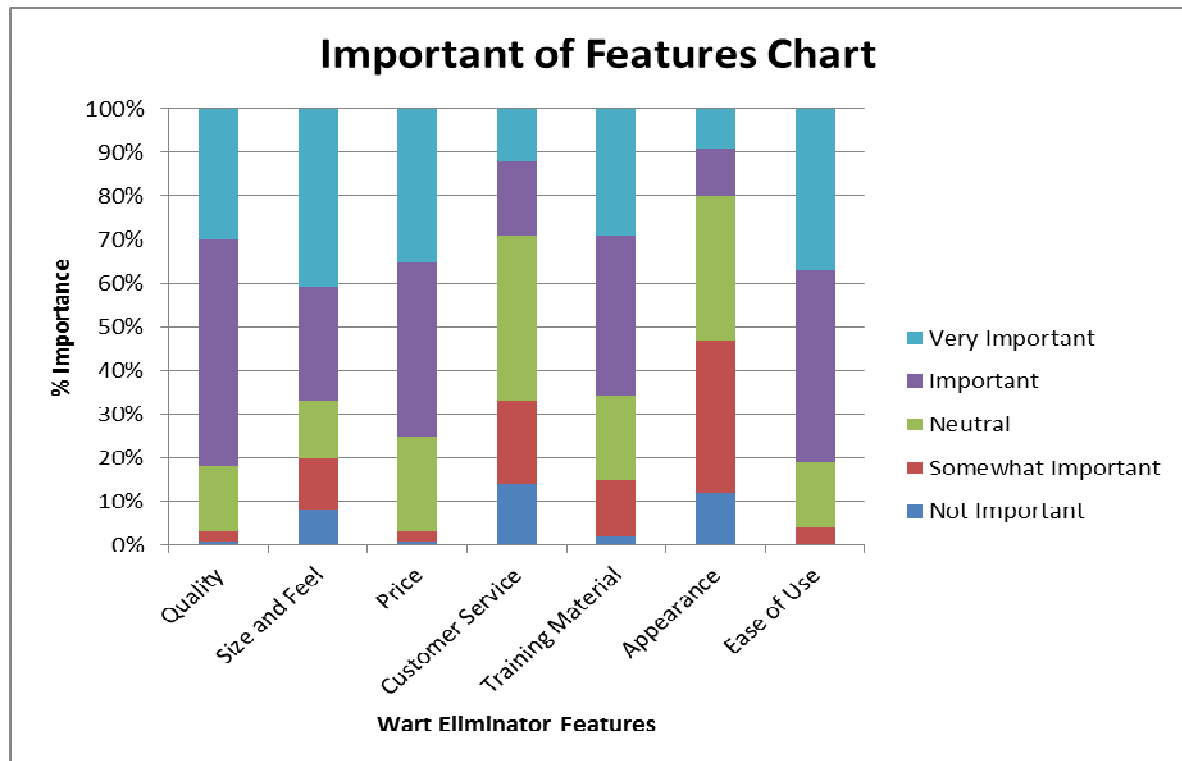


Figure 8: Survey Important Features Chart

From the data above, there is no one feature that is more important than any of the others to include in the Wart Eliminator product production. But what can be seen are that the main issues that need to be focused on together are quality of the product, the price of the product, ease of use, and the size and feel. Some features that are less necessary than the other are customer service opportunity and appearance. From here, the bigger issues were addressed and dealt with in various ways.

New Design Alternative

To first address the issue of size and feel, it was hypothesized that a more simple shape would help users hold the product while using it. Then, to tackle price, that simpler shape would make it easier to manufacture, which would, in return, decrease the potential for defective parts and increase overall quality. Taking these factors into consideration, the following design was proposed.

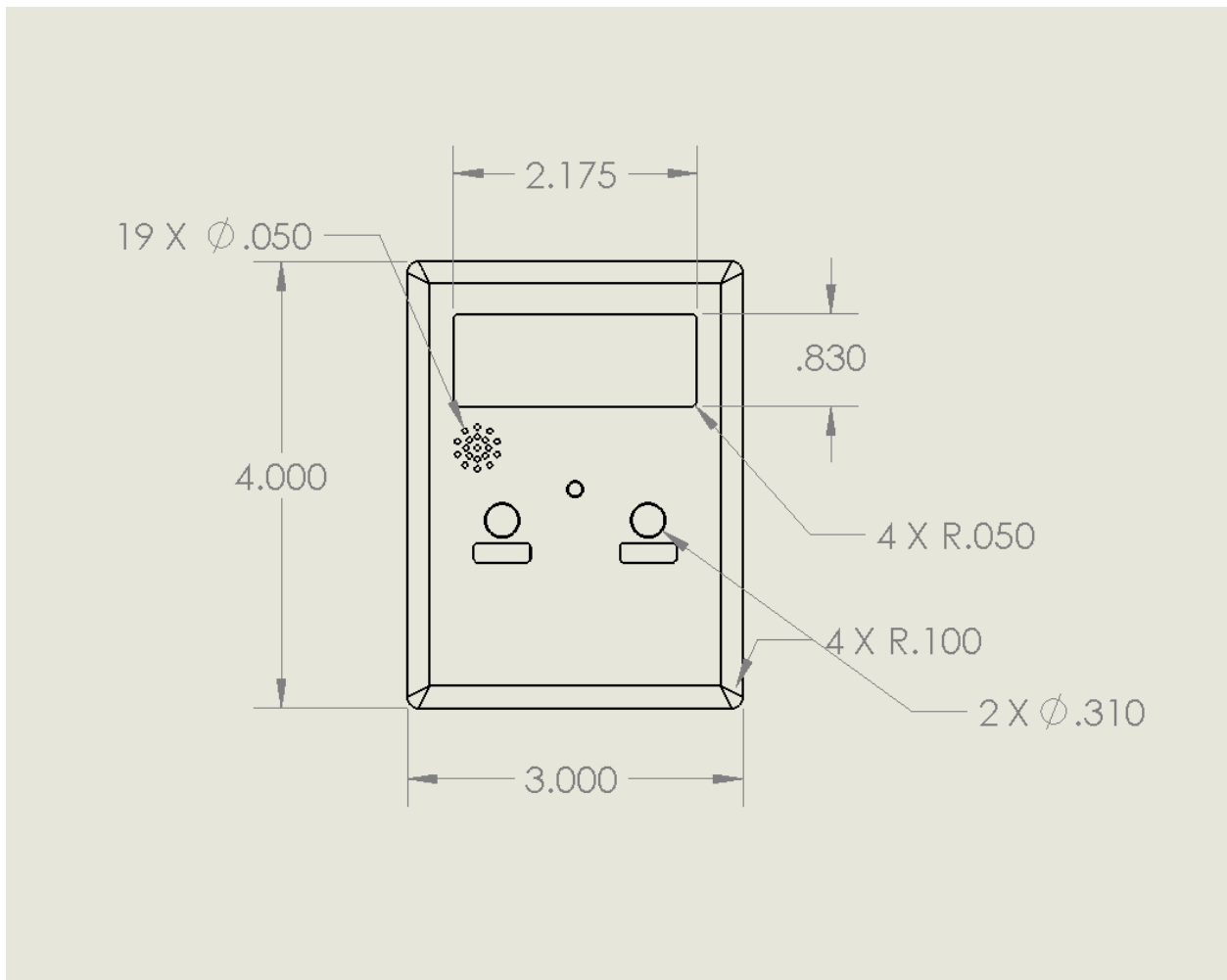


Figure 9: Schematic of Wart Eliminator Alternative 1

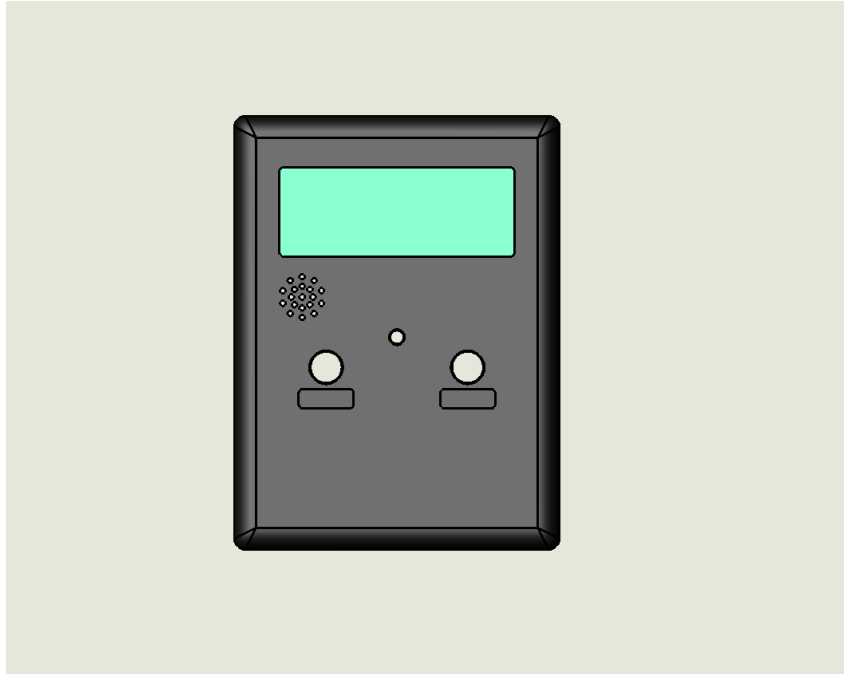


Figure 10: 3D Front View of Design Alternative 1

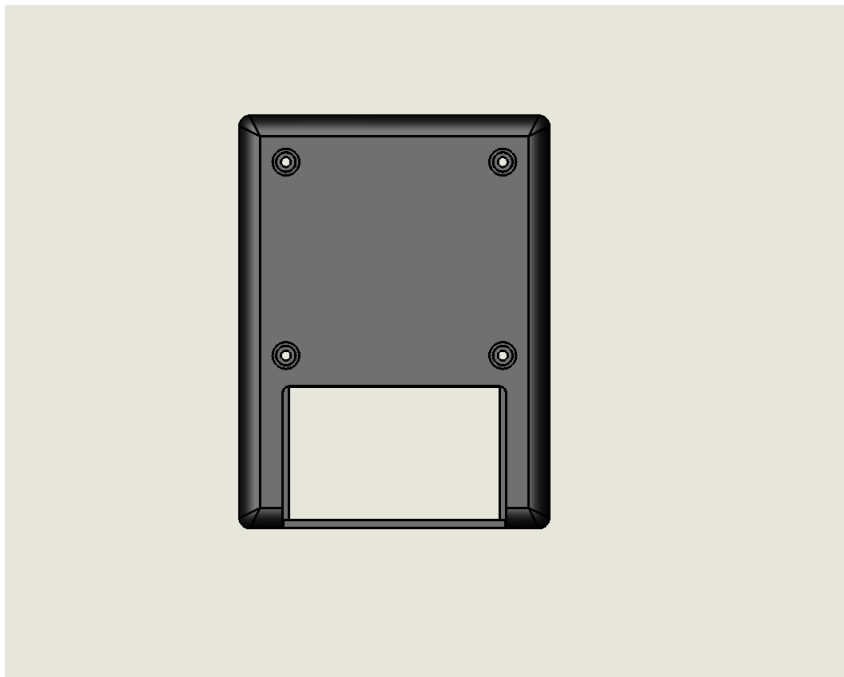


Figure 11: Rear View of Design Alternative 1

Design alternative 1 was considered as a solid alternative to the original design, but farther testing was needed to ensure the thoughts. Costs also needed to be calculated to make sure that this product would be able to be made at an affordable price, thus making it possible for the purchasers to obtain the Wart Eliminator at a fair price. To do this, first, the following parts list had to be created for both the PCB board inside and the outer shell.

WART ELIMINATOR PCB PARTS LIST (SOURCE: INFINETIX CORP.)				
Item	Quantity	Value	PCB Footprint	Vendor
1	1	9V		Mouser
2	4	0.1uF	C_0603A_IPC	Mouser
3	2	20pF	C_0603A_IPC	Mouser
6	2	4.7uF Cer	CAP/EIA7343+/KEMET	Mouser
7	2	10uF Cer	CAP/EIA7343+/KEMET	Mouser
8	1	100pF	C_0805A_IPC	Digi-Key
9	1	GLEED	T-1\LS .100	Digi-Key
10	2	BAT54C	SOT-23_IPC_312	Future
11	1	BAT54A	SOT-23_IPC_312	Future
12	1	MBRO540	SOD-123	Future
13	1	BAV99	SOT-23	Future
14	1	MTA2M	MTA2M	Digi-Key
15	1	PIEZO		Mouser
16	1	10uH	INDUCTOR_SMD_CR54	Mouser
18	1	BSS123	SOT-23	Future
19	3	1.0K	603	Digi-Key

20	1	9.1K 1%	603	Digi-Key
22	4	100 1%	603	Digi-Key
23	1	10K	603	Digi-Key
24	1	0	603	Mouser
25	4	100K	603	Digi-Key
26	1	205K 1%	603	Digi-Key
27	1	13.3K 1%	603	Digi-Key
28	1	25.5K 1%	603	Digi-Key
29	2	PB		Mouser
		with ground pin		
30	1	PIC16F1823	SOIC-14	Future
31	1	S-812C50AMC-C3ET2G	SOT-23-5	Mouser
32	1	LMR64010	SOT-23-5	Mouser
33	1	16.XXMHz	XTAL_ECS_SM_CSM-7	T.B.D.
34	1			T.B.D.

Table 1: Parts List For Wart Eliminator PCB

Vendor p/n	Manuf p/n
534-237	237
Battery Holders, Snaps & Contacts Eco 9V battery strap T-style 8.0 vinyl	
810-C1608Y5V1H104Z	C1608Y5V1H104Z
Multilayer Ceramic Capacitors (MLCC) – SMD/SMT 0603 0.1uF 50volts Y5V +80-20%	
81-GRM39C200J50	GRM1885C1H200JA01D
Multilayer Ceramic Capacitors (MLCC) – SMD/SMT 0603 20pF 50volts C0G 5%	
81-GRM21BR61E475MA2L	GRM21BR61E475MA12L
Multilayer Ceramic Capacitors (MLCC) – SMD/SMT 4.7uF 25Volts 20%	
667-EEE-FK1H100UR	EEE-FK1H100UR

Aluminum Electrolytic Capacitors – SMD 10uF 50V	
311-1111-1-ND	CC0805JRNPO9 BN101
CAP CER 100PF 50V 5% NPO 0805	
754-1217-ND	WP3A8GD
LED SS 3MM 568NM GRN DIFF	
BAT54C	BAT54C
BAT54 Series 0.8 V 200 mA 30 V Max Reverse Voltage Schottky Diode – SOT-23-3	
BAT54A	BAT54A
BAT54A Series 0.8 V 200 mA 30 V Max Reverse Voltage Schottky Rectifier –SOT-23-3	
MBR0540T1G	MBR0540T1G
MBR Series 0.5 A 40 V Surface Mount Schottky Power Rectifier – SOD-123	
BAV99-7-F	BAV99-7-F
BAV99 2A 75V 350mW Dual Switching Diode – SOT-23	
A1921-ND	640456-2
CONN HEADER VERT 2POS .100 TIN	
254-PB140-ROX	254-PB140-ROX
Audio Indicators & Alerts 13.8 x 6.8mm 4.0KHz	
963-CBC2518T100M	CBC2518T100M
Power Inductors INDCTR HI CUR WND 1007 10uH 20%	
BSS123LT1G	BSS123LT1G
N-Chan 100 V 6 Ohm 225 mW MOSFET – SOT-23	
RMCF0603JT1K00CT-ND	RMCF0603JT1K 00
RES 1K OHM 1/10W 5% 0603 SMD	
P9.10KHCT-ND	ERJ-3EKF9101V
RES 9.10K OHM 1/10W 1% 0603 SMD	
P100HCT-ND	ERJ-3EKF1000V
RES 100 OHM 1/10W 1% 0603 SMD	
P10.0KHCT-ND	ERJ-3EKF1002V
RES 10.0K OHM 1/10W 1% 0603 SMD	
660-RK73Z1JTTD	RK73Z1JTTD
Thick Film Resistors ZEROohms JUMPER	
RMCF0603JT100KCT-ND	RMCF0603JT10 0K
RES 100K OHM 1/10W 5% 0603 SMD	
P205KHCT-ND	ERJ-3EKF2053V
RES 205K OHM 1/10W 1% 0603 SMD	
P13.3KHCT-ND	ERJ-3EKF1332V
RES 13.3K OHM 1/10W 1% 0603 SMD	
P25.5KHCT-ND	ERJ-3EKF2552V
RES 25.5K OHM 1/10W 1% 0603 SMD	
688-SKHHPJ	SKHHPJA010
Tactile & Jog Switches 6.0x6.0x4.3mm 100gf	
PIC16F1823-I/SL	PIC16F1823- I/SL
128 B RAM 3.5 kB Flash 12 I/O 8-Bit Microcontroller – SOIC-14	

628-812C50AM-G	S-812C50AMC-C3ET2G
Low Dropout (LDO) Regulators 5.0V 1.2uA 2.0%	
926-LMR64010XMFENOPB	LMR64010XMF E/NOPB
DC/DC Switching Regulators 20VOUT,1A SIMPLE SW NANO STEP-UP REG	
T.B.D.	T.B.D.
Crystals 16.05MHz & 16.20MHz 20pF	
T.B.D.	T.B.D.
Printed Circuit Board etch	

Table 2: Parts List For Wart Eliminator PCB Continued

WART ELIMINATOR SHELL PARTS LIST			
Item	Quantity	Vendor	Vendor p/n
1	1	PPR	PPR
			Black Acrylonitrile Butadiene Styrene (ABS) thermoplastic resin
2	1	Alibaba	Alibaba
			Small custom LED displays
3	4	McMaster-Carr	6-32 5/8" flathead screw

Table 3: Parts List for Wart Eliminator Shell

Using this parts list, a fully allocated cost for the Wart Eliminator could be calculated. The following tables show these calculations.

PARTS LIST continued			Units to Build:	
			1	
			Line Total	Line item cost
Manufacturer	Qty/\$\$\$	Qty/\$\$\$	Cost/Part	
Keystone Electronics	1	100	1	
	0.38	0.28	\$ 0.380	\$ 0.38
TDK	1	50	4	
	0.07	0.013	\$ 0.070	\$ 0.28
Murata	1	50	2	
	0.1	0.025	\$ 0.100	\$ 0.20
Murata	1	50	2	
	0.39	0.203	\$ 0.390	\$ 0.78
Panasonic Electronic Components	1	25	2	
	0.28	0.205	\$ 0.280	\$ 0.56
Yageo	10	100	1	
	0.07	0.032	\$ 0.070	\$ 0.07
Kingbright Corp	1	10	1	
	0.13	0.094	\$ 0.130	\$ 0.13
FAIRCHILD	1	10	2	
	0.0219	0.0213	\$ 0.022	\$ 0.04
FAIRCHILD	1	10	1	
	0.0219	0.0213	\$ 0.022	\$ 0.02
ON SEMICONDUCTOR	1	5	1	
	0.0651	0.0647	\$ 0.065	\$ 0.07
DIODES INC.	1	10	1	
	0.0178	0.0162	\$ 0.018	\$ 0.02
TE Connectivity	1	10	1	
	0.14	0.13	\$ 0.140	\$ 0.14
Kobitone	1	25	1	
	0.86	0.66	\$ 0.860	\$ 0.86

Taiyo Yuden	1	10	1	
	0.17	0.16	\$ 0.170	\$ 0.17
ON SEMICONDUCTOR	1	10	1	
	0.0396	0.0394	\$ 0.040	\$ 0.04
Stackpole Electronics Inc	1	10	3	
	0.02	0.017	\$ 0.020	\$ 0.06
Panasonic Electronic Components	1	50	1	
	0.1	0.0138	\$ 0.100	\$ 0.10
Panasonic Electronic Components	1	50	4	
	0.1	0.0138	\$ 0.100	\$ 0.40
Panasonic Electronic Components	1	50	1	
	0.1	0.0138	\$ 0.100	\$ 0.10
KOA Speer	1	100	1	
	0.06	0.02	\$ 0.060	\$ 0.06
Stackpole Electronics Inc	1	10	4	
	0.02	0.017	\$ 0.020	\$ 0.08
Panasonic Electronic Components	1	50	1	
	0.1	0.0138	\$ 0.100	\$ 0.10
Panasonic Electronic Components	1	50	1	
	0.1	0.0138	\$ 0.100	\$ 0.10
Panasonic Electronic Components	1	50	1	
	0.1	0.0138	\$ 0.100	\$ 0.10
ALPS	1	50	2	
	0.26	0.2	\$ 0.260	\$ 0.52
MICROCHIP	1	10	1	
	1.08	1.03	\$ 1.080	\$ 1.08
Seiko Instruments	1	100	1	
	0.51	0.46	\$ 0.510	\$ 0.51
National Semiconductor (TI)	1	25	1	
	1.61	1.3	\$ 1.610	\$ 1.61
T.B.D.	1	10	1	

	0.41	0.3	\$ 0.410	\$ 0.41
T.B.D.	1		1	
	1.5		\$ 1.500	\$ 1.50
			TOTAL =	\$ 10.49
			TOTAL/UNIT =	\$ 10.49

Table 4: Cost of PCB

			Units to Build:	
			1	
			Line Total	Line item cost
Manuf p/n	Manufacturer	Qty/\$\$\$	Cost/Part	
PPR-ABS01-G	Premier Plastic Resins	4 oz.	1	
		\$0.33	\$ 0.330	\$ 0.33
lcd display	Bolong Electronics	1	1	
		0.2	\$ 0.200	\$ 0.20
92485A617	McMaster-Carr	4	4	
		0.06	\$ 0.060	\$ 0.24
			TOTAL =	\$ 0.77
			TOTAL/UNIT =	\$ 0.77

Table 5: Cost of Shell

The cost of labor was calculated as following from information received from Listo Corporation:

1. A shop rate of \$75 for the setup of 1000 units to be produced in the injection molder which was calculated to take around 2 to 4 hours. This equates to \$.15/unit.
2. During a machine run it was calculated to be \$30 an hour to operate the machine at an average of a 36 second cycle time. This comes out to about 100 units per hour. Along with this machine operator cost is about \$15/hour. The total cost per unit based on one thousand units in a production run equates to \$.45/unit.

3. The cost to make the mold to produce the outer shell was calculated to be \$60 an hour at one hundred hours in order to make the proper mold design. Total cost is around \$6000. The price per unit was difficult to calculate because the cost per unit will decrease with the more units produced, but based on a production run of 1,000 units; it would be \$6/unit.
4. The labor cost associated with the assembling of the product on the manufacturing floor after all parts are in inventory was also a difficult calculation because the product does not have proper time studies and manufacturing procedures. Despite this, on an estimated cycle time of thirty minutes with four operators at \$15/hour, the total cost per unit arrives at \$3/unit.

The total material based on parts for the PCB and Shell of the Wart Eliminator were calculated from the above part lists. Total cost/unit for the PCB board \$10.49/unit and the total cost/unit for the outer shell was \$.77/unit. Cost of the probe and wired is separate from these parts lists and are estimated at a cost of \$2.50/unit. Along with these calculations, total cost for epoxies, tools, oscilloscopes PCB testing and other miscellaneous items for manufacturing are unknown at this time because the product has not yet been put into production, but the rough estimate is around \$3000. For a production run of \$1,000 units, this is \$3/unit.

Overhead was by far the toughest calculation to tackle. As of now, the product has no specified facility for manufacturing so rent could not be determined. The proper insurance to insure this type of company was also uncertain along with the cost machinery, utilities, and a possible

supervisor. Putting a number on this calculation was a very rough estimate, but for a production run of 1,000 units overhead was approximated to a per unit cost of about \$10.

In summary, the total combined cost to produce an FAC was estimated to be the following:

1. Labor cost derived from above at \$10.60
2. Material cost derived from above at \$16.76
3. Approximate overhead cost derived from above at \$10.00

Total FAC for one unit was then calculated at \$37.36.

Now that a new design alternative had been created and a cost had been calculated, it was important to verify our results with testing. Testing would allow the project to move farther and for conclusions and recommendations to be drawn.

IV. Methodology

To test our design alternative, a design of experiments was conducted so that statistical data could be used to back up the new product. The experiment below is written as if it were a stand-alone project.

Design of Experiments

Executive Summary

A study was conducted to find which shape the Wart Eliminator product should be by considering comfort ratings of participants holding the product in their left or right hands. Using statistical analysis of 50 men and 50 women, it was concluded that there was a statistical difference in holding the original curved product with a right or left hand and that there was a difference in overall comfort between the original and curved Wart Eliminator designs.

Introduction

This report will examine the comfort rating of participants when holding the Wart Eliminator. Mainly, the effects of a user holding the product with their left hand or their right hand is being looked at between two different shell designs. It is important that users of this product are comfortable holding it when in use so that the maximum benefit can be gained. The goal of this experiment was to gain insight into the best design and use recommendations from participants to make improvements to the Wart Eliminator. The two different designs are the original curved shell with the long left side and the squared side design.



Figure 12: DOE Curved Design

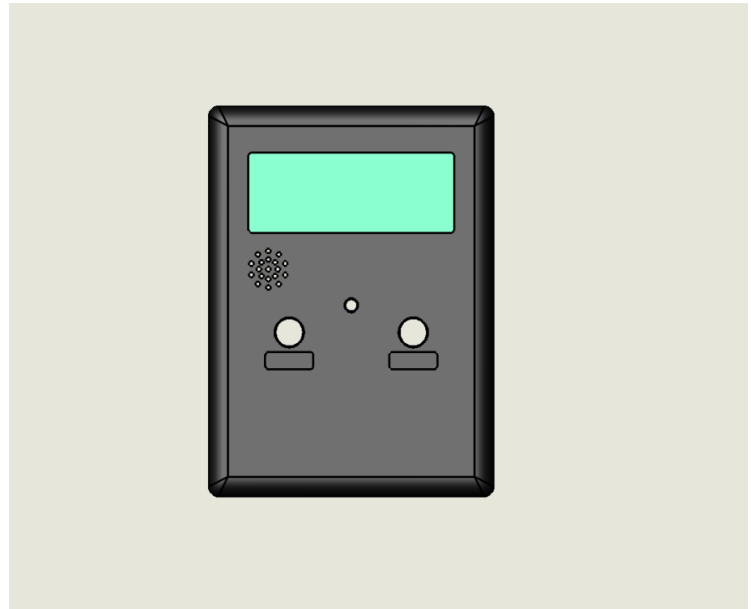


Figure 13: DOE Square Design

Methods

In order to ensure consistent and accurate data, each team member had a specific list of tasks to perform in order with the same equipment. First, a random number generator on excel was used to determine what product design the participant would hold and in what hand. It was programmed so that each case occurred equally. The test subject was then asked to step forward and a script was read to them. Four scripts existed for the various options a participant could encounter. The script used is as follows:

“Hello, thank you for participating in my experiment. When instructed, please proceed to pick up the product (specified then) with your hand (specified then). Once you feel that you have a firm grip on the product, please rate your comfort level, or how well it fits in your hand, based on the scale on the page in front of you; 1 being very uncomfortable in my hand and 10 being very comfortable. Are there any questions before we start?”

The subject would then complete the experiment and a score would be recorded. During the experiment, the location and methodology used to conduct the experiment were controlled in order to guarantee a sound project. Our independent variable was which product and which hand the subject used. The dependent variable was the comfort score the subject gave.

With the data, a Minitab analysis was conducted to test for normality and to test the difference among the four means to determine if there was a significant difference between the comfort of holding either product in your right or left hand. Furthermore, basic statistics were computer for the data.

Lastly the following materials were used to make this experiment take place:

- Two foam products
- Comfort Scale Sheet
- Table
- Chair
- Data Sheet

Results

After conducting the experiment and gathering the data, various histograms were generated in order to assess the normality of the data.

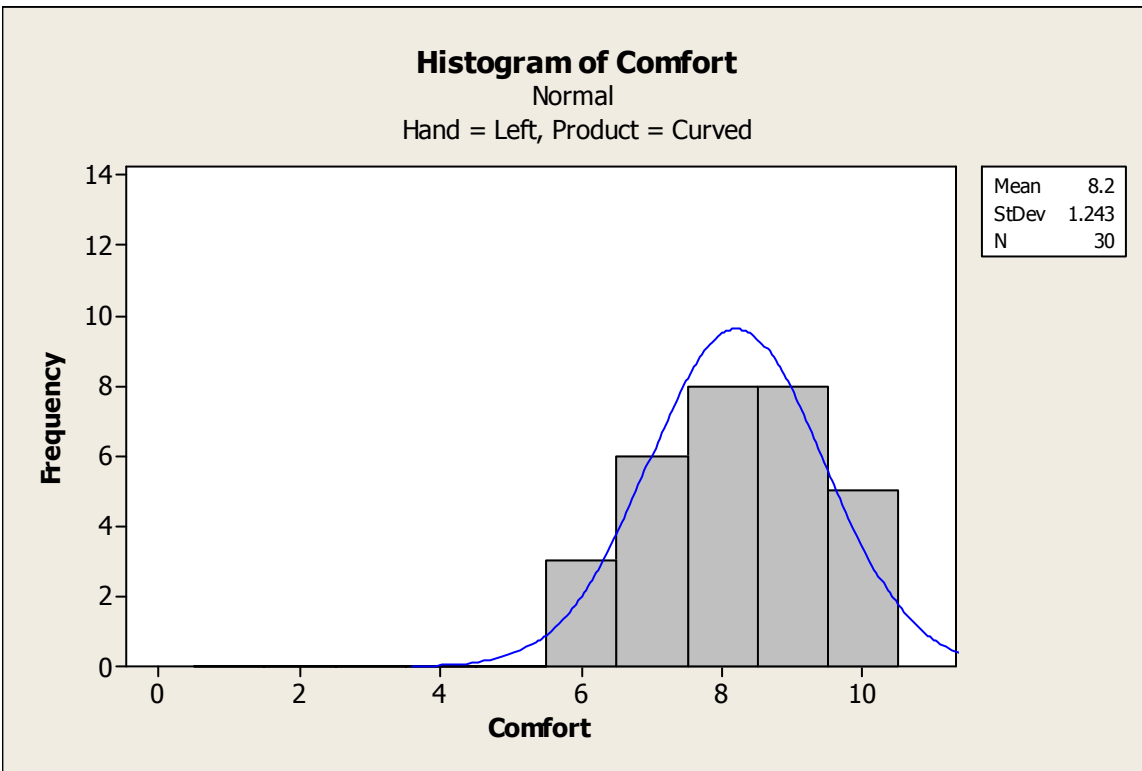


Figure 14: Histogram of Comfort for Left Hand and Curved Product

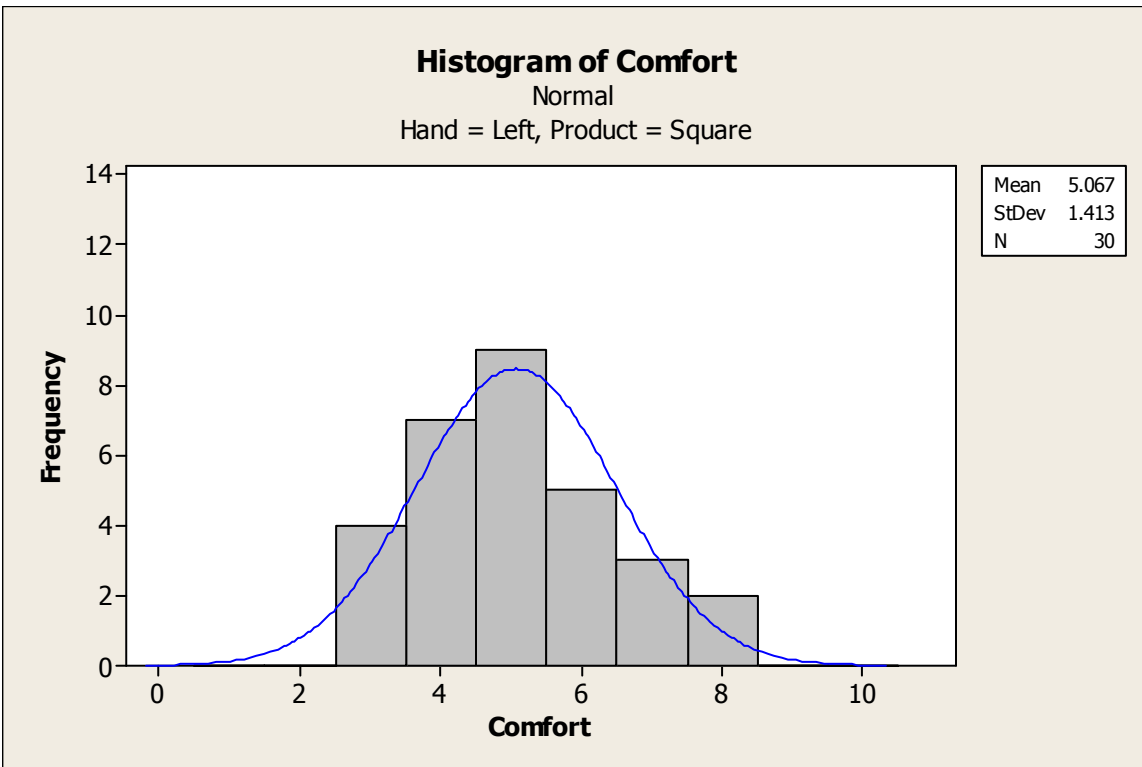


Figure 15: Histogram of Comfort for Left Hand and Square Product

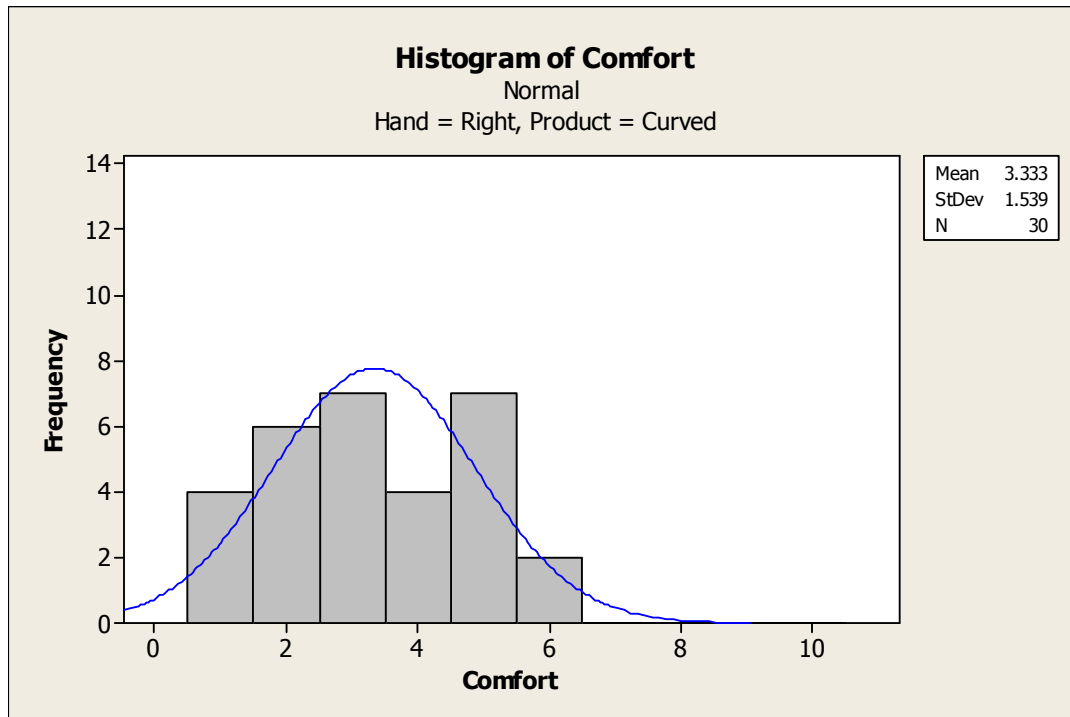


Figure 16: Histogram of Comfort for Right Hand and Curved Product

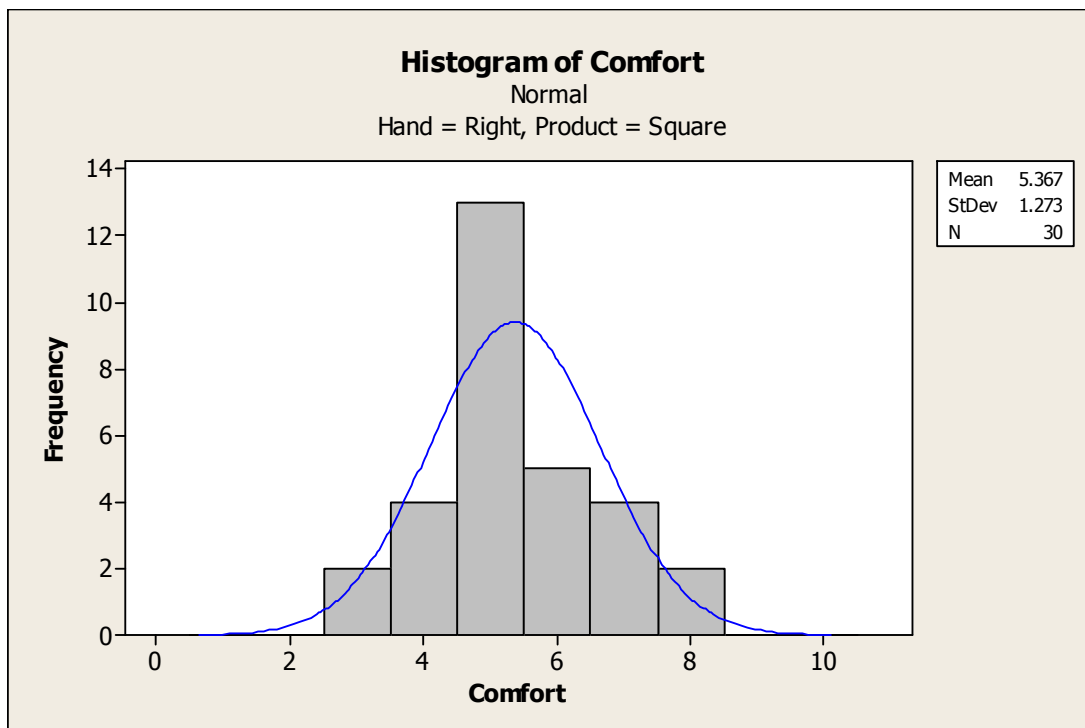


Figure 17: Histogram of Comfort for Right Hand and Square Product

The Minitab output containing descriptive statistics regarding these histograms are as follows:

Hand,Product	Minimum (Rating)	Maximum (Rating)	Mean (Rating)	Std. Dev. (Rating)
Left, Curved	6	10	8.2	1.243
Left, Square	3	8	5.067	1.413
Right, Curved	1	6	3.333	1.539
Right, Square	3	8	5.367	1.273

Table 6: DOE Descriptive Statistics

Following these results, normality tests were conducted on the data in order to meet requirements for performing an ANOVA test. For the normality test, the null hypothesis states that the data is normally distributed. Furthermore, the alternative states that the data is **not** normally distributed.

These can also be seen below:

H_0 : The data is normally distributed
 H_A : The data is **not** normally distributed

The following table shows the summary results of the normality tests. The appendix shows the graphs of this data.

Hand,Product	P-Value
Left, Curved	.018
Left, Square	.035
Right, Curved	.025
Right, Square	.005

Table 7: Normality Test Summary

Based on the p-values calculated, normality cannot be assumed for any combination of hand and product. This is believed to be due to the fact that no decimals were allowed as scores in the experiment. In order to proceed with the analysis, it was important that keep this fact in mind when looking at results. Furthermore, a test for equal variances was conducted as part of the qualifications for a Two-Way ANOVA Test. In conducting the Levene Test of Equal Variances, the null hypothesis states that the variances of each sample are equal. Further, the alternative hypothesis states that these variances are not equal. This can be depicted below:

$$H_0: \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$$

$$H_A: \sigma_1^2 \neq \sigma_2^2 \neq \sigma_3^2 \neq \sigma_4^2$$

As can be seen in the table below, the p-value is higher than $\alpha=0.05$ and as a result, we failed to reject null hypothesis and it was determined that all of the variances are equal.

Test Statistic	P-Value
.92	.432

Table 8: Equal Variance Test Results

Overall, the Two-Way ANOVA Test is justified for the following reasons:

- Normal samples (Caution needed)
- Equal variances
- Samples are independent of each other
- Each groups has the same sample size

In conducting the Two-Way ANOVA Test, the null hypothesis states that the population means for the first factor are equal, the population means for the second factor are equal, and there is no interaction between the two factors. In contrast, the alternative hypothesis states that the population means for the first factor are not equal, the population means for the second factor are not equal, and there is interaction between the two factors. This can be seen visually on the following page:

$$H_0: \begin{array}{l} \mu_{\text{Sitting}} = \mu_{\text{Standing}} \text{ (Factor 1)} \\ \mu_{\text{Fatigue}} = \mu_{\text{No Fatigue}} \text{ (Factor 2)} \\ \text{Interaction} = 0 \end{array}$$

$$H_a: \begin{array}{l} \mu_{\text{Sitting}} \neq \mu_{\text{Standing}} \text{ (Factor 1)} \\ \mu_{\text{Fatigue}} \neq \mu_{\text{No Fatigue}} \text{ (Factor 2)} \\ \text{Interaction} > 1 \end{array}$$

The results for the Two-Way ANOVA can be seen in the table below on the following page.

Based on the results it is clear that the null hypothesis is rejected for factor 1 as well as factor 2

with $\alpha = 0.05$. Furthermore, with the low p-value for interaction, the null hypothesis is rejected and it was concluded that there was interaction between the two factors.

	P-Value for Test
Factor 1- Left and Right And	.000
Factor 2- Curved or Square	.030
Interaction	.000

Table 9: ANOVA Test Results

V. Results and Discussion

In conducting the experimental survey, the main issue that occurred was the amount of time participants held the product in their hand before they came to a conclusion about the comfort level. This may have caused a misinterpretation of the comfort scale in front of them.

However, using the data and observations above, it was shown that there is statistical difference in the comfort levels of users using their right vs left hands, with an interaction of this effect between both the square and curved products. In addition, there was a significant difference in comfort ratings between the square and curved products. With these results, we can conclude that having a product that can be used in both hands will be beneficial to user comfort. Also, looking at the high mean comfort of users holding the curved product in their left hand combined with comments from subjects suggesting that the two sides of the product be of equal length, we can conclude that a new symmetrical design with curved edges may be the best option for the Wart Eliminator. The new symmetrical design can be seen on the next page.

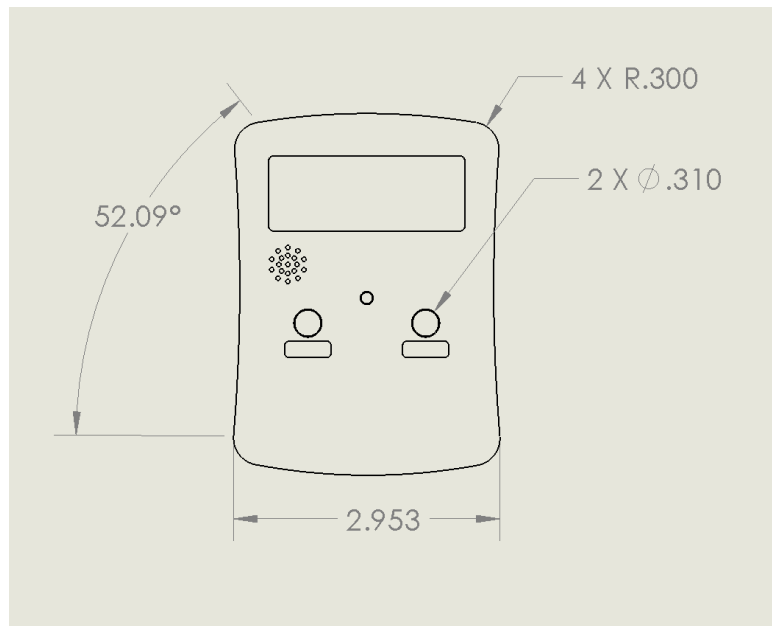


Figure 18: Schematic of Wart Eliminator Alternative 2

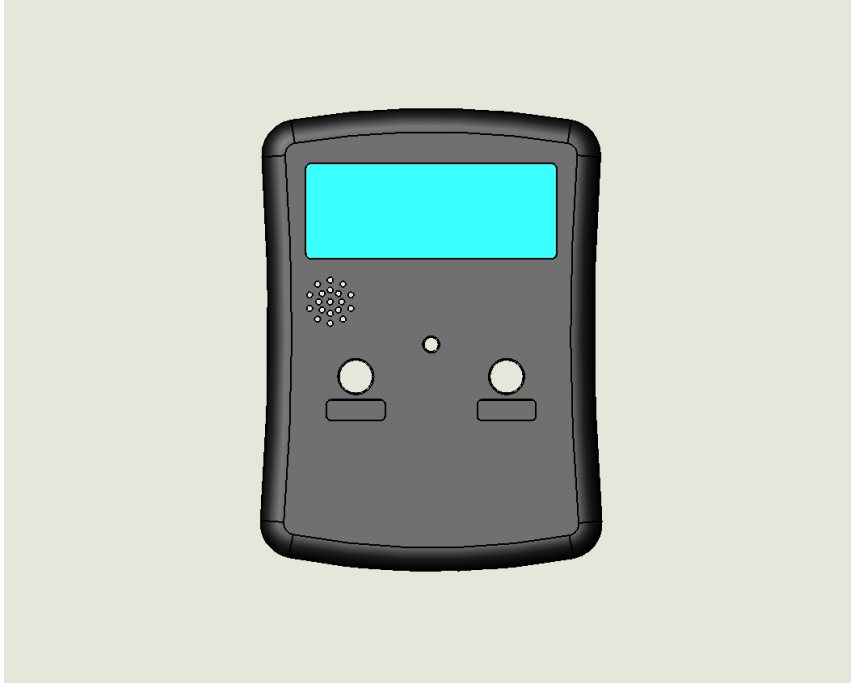


Figure 19: 3D Front View of Design Alternative 2

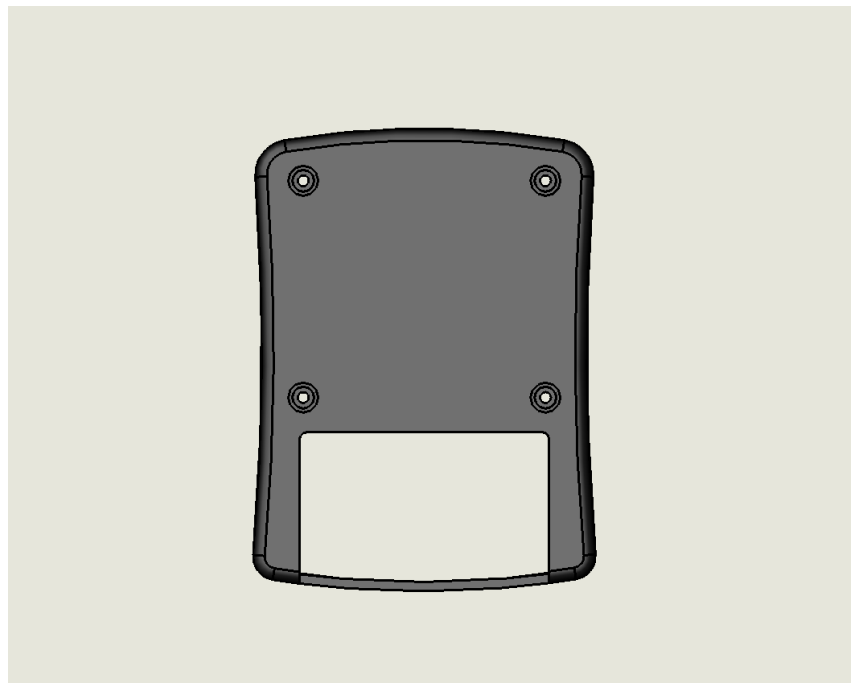


Figure 20: 3D Rear View of Design Alternative 2

To follow up with the rest of the issues brought forth by the market survey, a basic instruction manual was created. Since the product is not being produced yet, many important parts to a user manual were left out. In the future, more should be added to this in order to make it complete.

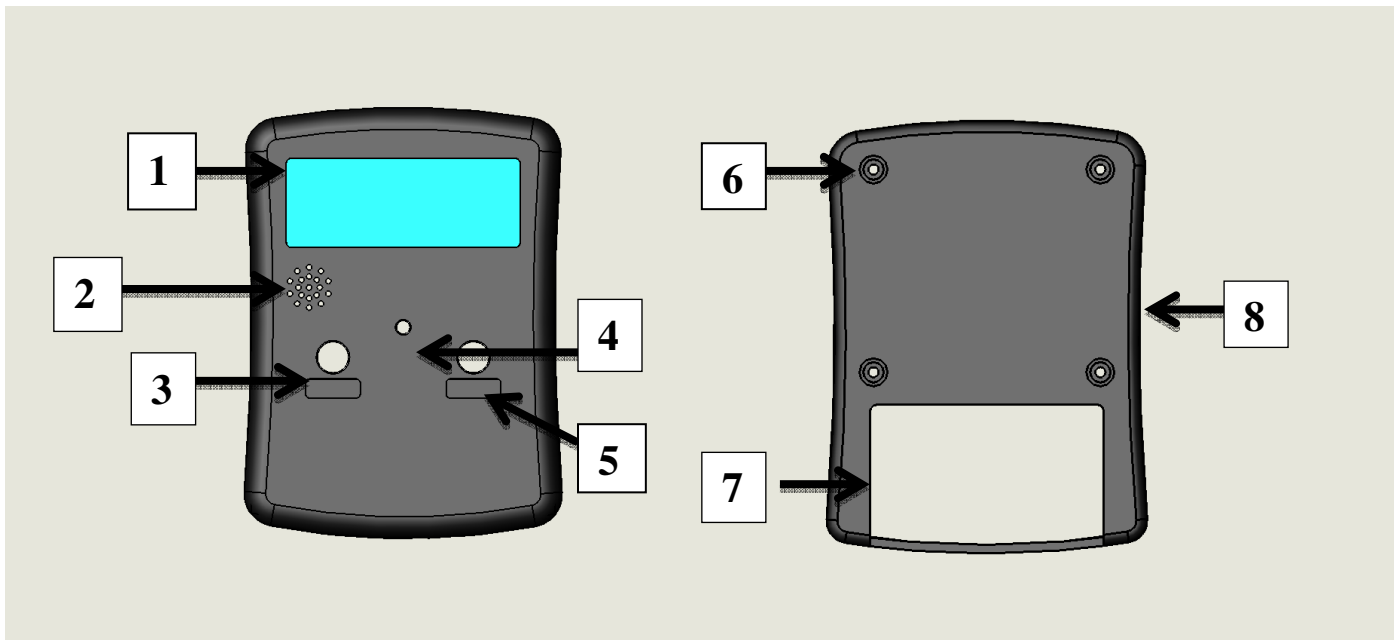
The next page contains this manual.

Instruction Manual

The following is a brief instruction manual that users should follow after purchasing this product in order to use the product successfully and without harm.

First, we want to thank you for purchasing the Wart Eliminator. We hope that you will find our product will exceed your expectations and hopefully lead you on a path to a healthier body and well-being.

Features Diagram:

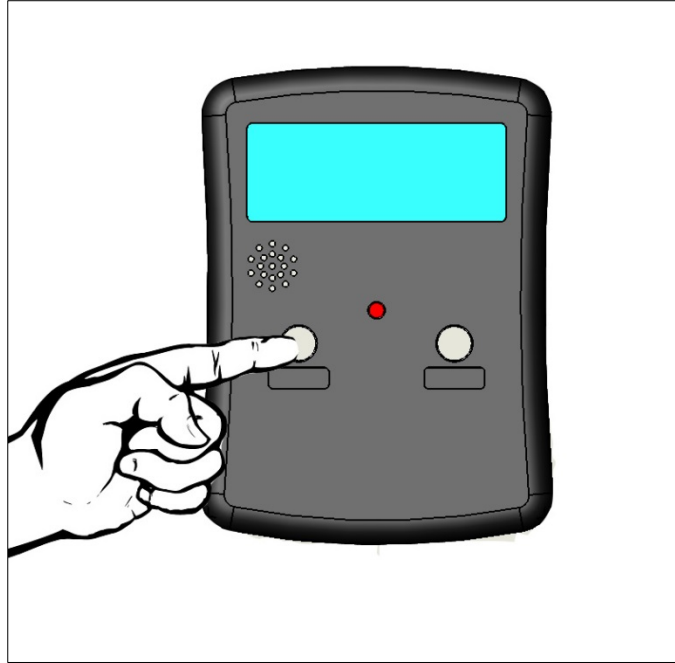


Number	Feature Description
1	LCD Display
2	Speaker
3	Low Power Button (15V)
4	Light Indicator
5	High Power Button (30V)
6	4 x Plastic Corner Grip
7	Removable Battery Cover
8	Contoured Sides

Start Up Guide:

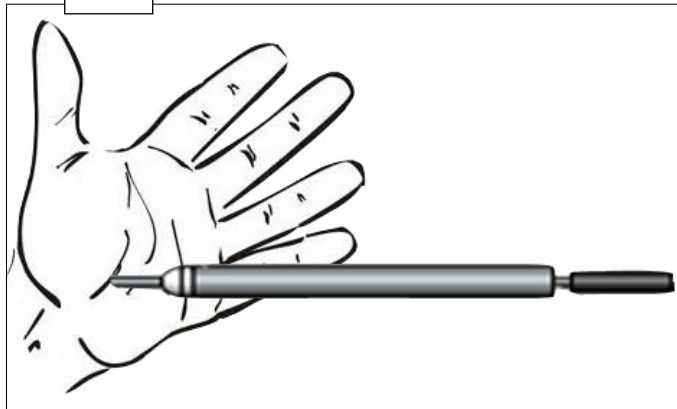
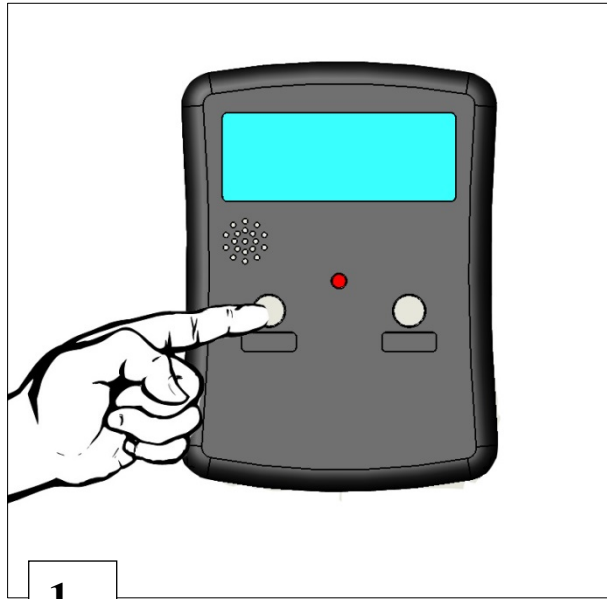
1. Turning the Wart Eliminator On and Off

- The device will turn on when a power button is pressed
 - Note: The red indicator will flash on and a beep will occur
- The device will turn itself off upon completion of the cycle after 3 minutes



2. Using the Wart Eliminator

- Press a power button on the device
 - Note: A beep should occur once pressed and will re-occur throughout the cycle
 - Note: It is recommended that first time users press the lower power button on the left
- Grab the probe and apply the tip of the probe directly to the affected region on the body
 - WARNING: Users may feel a tingling sensation or slight shock upon initial touch. This is normal and harmless.
- Continue holding the probe on the affected area until the beeping stops.
 - Note: A normal cycle lasts three minutes. If a cycle falls short of three minutes, repeat the process from step 1.
- Repeat this process using the higher power button on the right to ensure maximum effectiveness.
 - WARNING: Some users may be more sensitive to the higher power level and feel discomfort. If so, continue operating the Wart Eliminator of the low power level.



3. Continual Use of the Wart Eliminator

- Continue using the Wart Eliminator on a daily **2-3** times until the affected region is gone
 - Note: Different warts may require more use of the product

4. Questions and Concerns

- Contact customer service with any comments, questions or concerns

VI. Conclusion

The Wart Eliminator is a concept that under the right type of marketing and sales strategy could potentially be a successful product. From what was accomplished in this project, the product concept is closer to being able to be put into production. A new design has been chosen and can be justified based upon the research done. The study of the ergonomics of the product and the product survey show that option #2 of the redesign is the best option for this product. Along with the accomplished chosen design, a rough estimated cost of the product has been verified and a cost analysis prepared for the cost of its production.

Regarding the next step for this product, the research to prove the theoretical technology on curing the wart pathogen must be accomplished. Once this area can be proven, it can be justified to produce this product. Based on a sales strategy, it is hard to sale a product that cannot be guaranteed to give customer satisfaction. Anything can be sold, but selling a product that doesn't work isn't profitable. Once proven as a successful product, creating a business plan for the product is the final step before production.

If this product can be proven as a successful cure, the opportunities for success are very high because at this time, some warts only have temporary cures and reappear at unknown times. The social impact would boost this product on a trail way to large sells and customer satisfaction. Providing an inexpensive cure to the home user is the goal of this product and reaching this would benefit society tremendously.

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Appendix

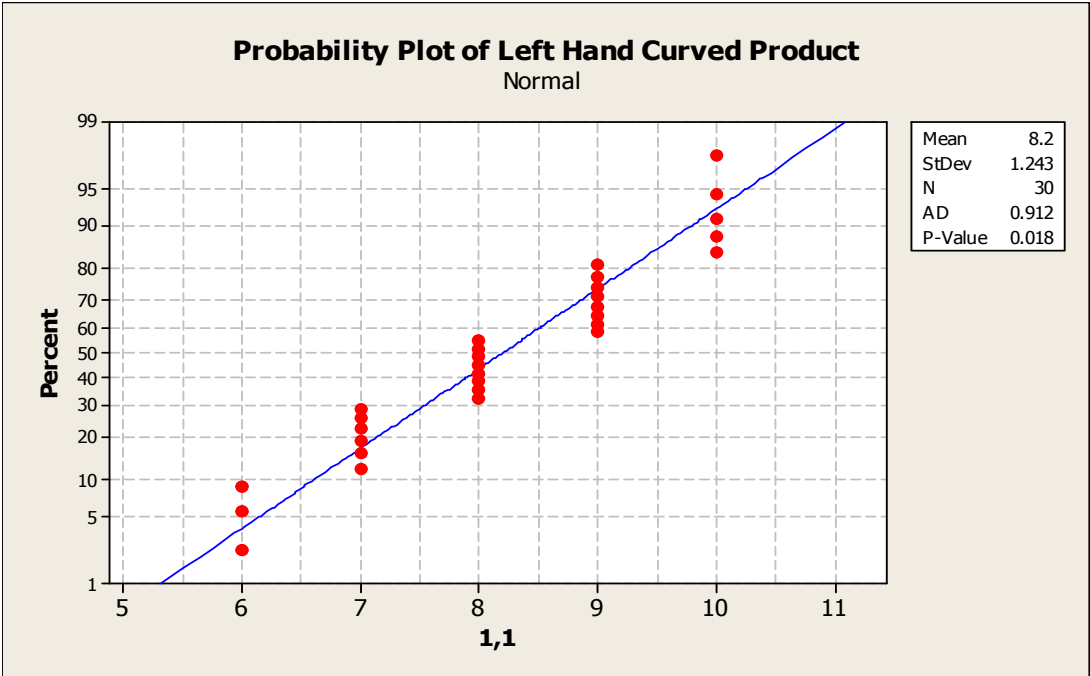


Figure 21: Probability Plot for Left Hand and Curved Product

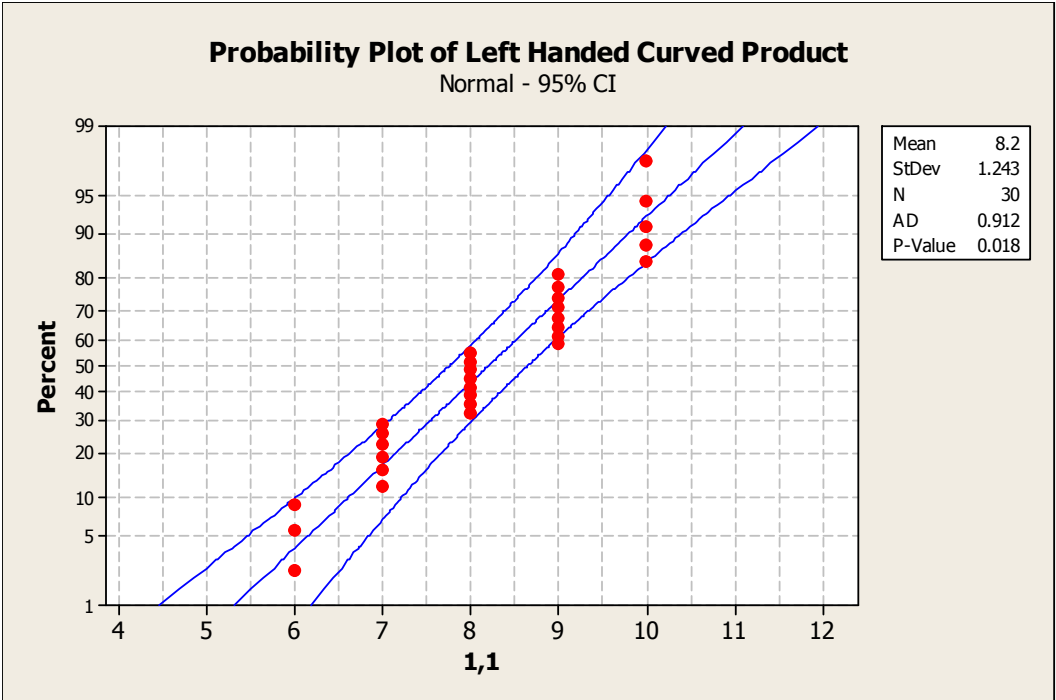


Figure 22: Probability Plot for Right Hand and Curved Product

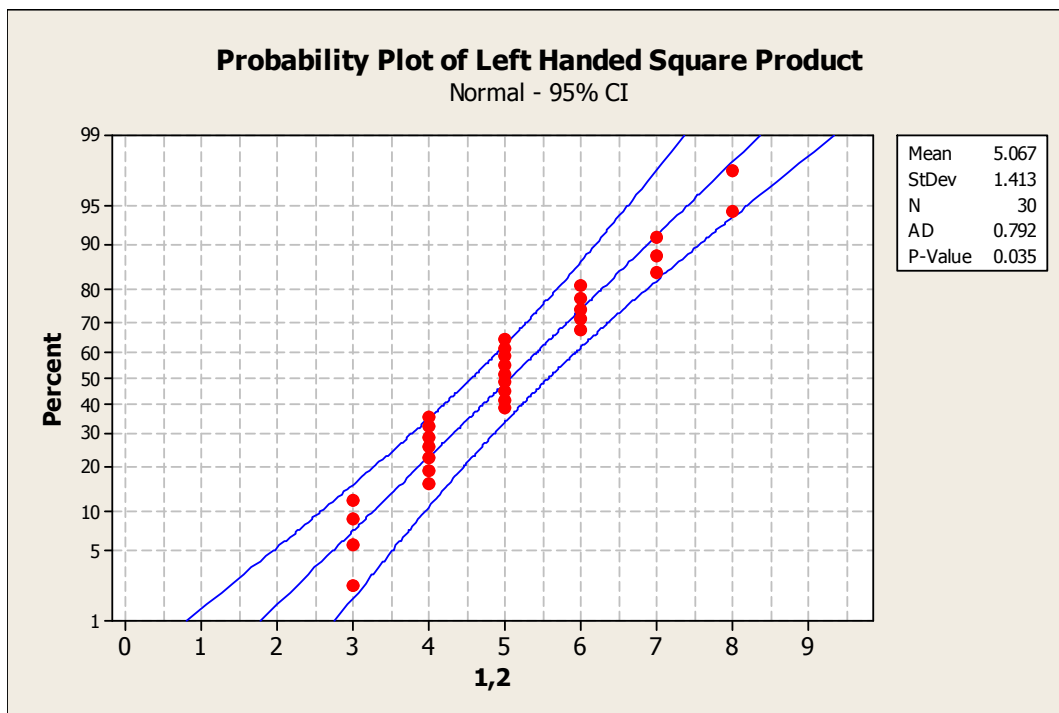


Figure 23: Probability Plot for Left Hand and Square Product

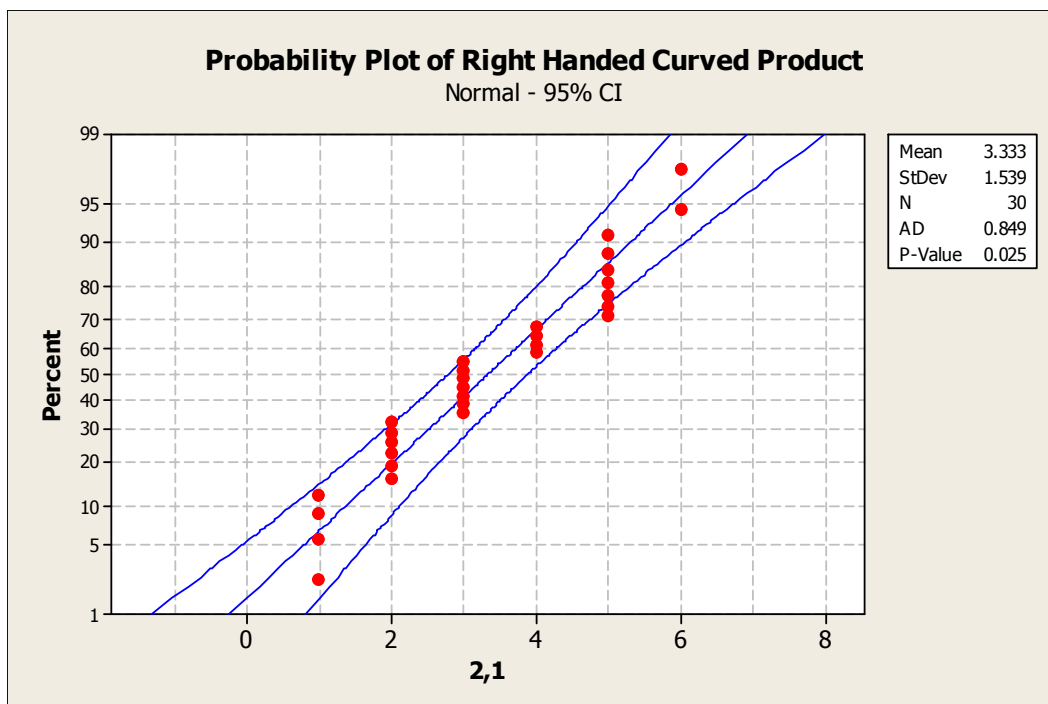


Figure 24: Probability Plot for Right Hand and Curved Product

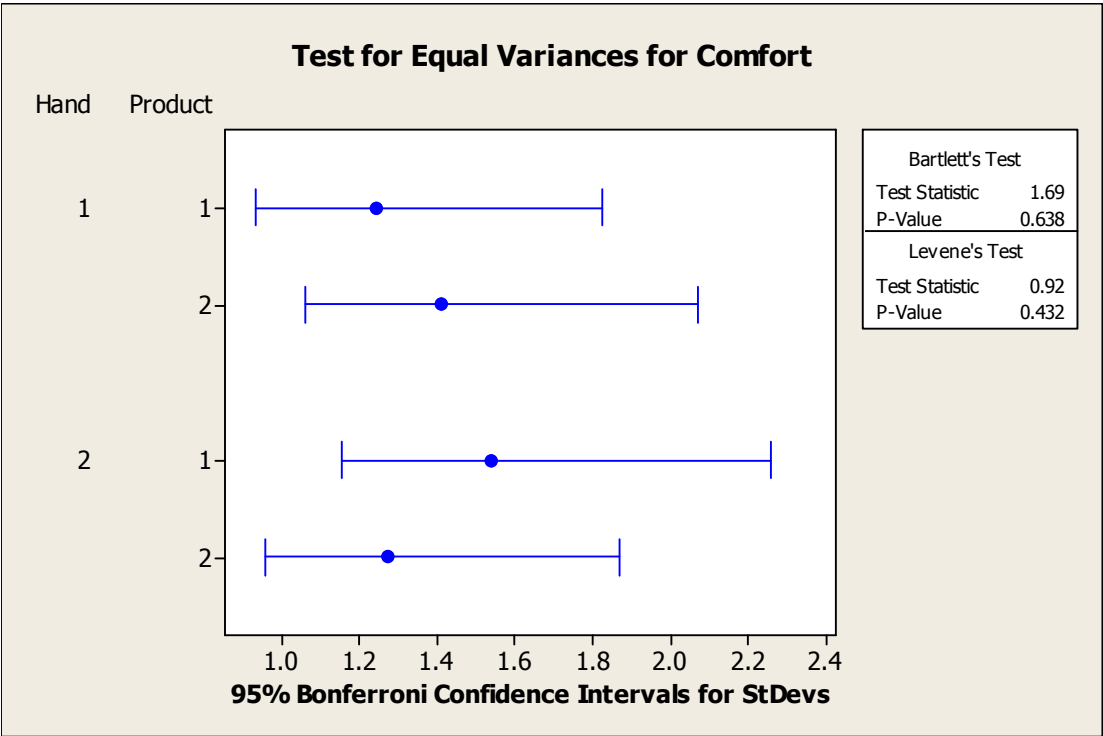


Figure 25: Test For Equal Variance

