ME - 423: Senior Design
Phase 1 Report
Customizable Vehicle Fragrance Diffuser

Madeline Dever
Trevor Hinds
Shannon Maroney
Christina McDonald
Advisor: Biruk Gebre
Sponsor: Terrance Dean

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"I pledge my honor that I have abided by the Stevens Honor System."

Madeline Dever, Trevor Hinds, Shannon Maroney, Christina McDonald

Abstract

The project objective is to design and prototype a customizable vehicle fragrance diffuser as an add-on to existing vehicles. The original design proposal was for a fragrance diffuser that can be implemented into the interface of new, high-end cars. However, with the time and resource constraints, the team was tasked with creating an add-on to existing vehicles that can serve as a proof of concept and can progress into a vehicle interface. This project was proposed by Terrance Dean, who stated that certain fragrances reminded him of memories. He came to Stevens Institute of Technology and proposed this idea for a Senior Design project. This prototype will allow the driver or passenger to change the scent inside of a vehicle dependent on various occasions. This report summarizes Phase 1 of 6, which includes the project objectives, problem statement, and concept generation. Certain smells remind people of an experience or memory, and incorporating this into an environment that most people use every day is an added feature that can improve tedious driving experiences. The project team created three viable concepts through a rigorous selection process to include multiple fragrances and features requested by potential customers. The following report explains each design concept and what features are included with regards to customer and sponsor needs. The project plan is developed in this phase to provide detail on how the Alpha and Beta prototypes will be produced and tested in the future project phases.

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Project Statement

Our project is a Customizable Vehicle Fragrance Diffuser sponsored by Terrance Dean. This project involves the development of a product that can be used to change the scent within a vehicle on-demand for various occasions. After years of advancements in technology, users can alter temperature and sound within a car with the press of a button or turn of a knob. Unfortunately, there are not many cars with built-in air freshening systems to alter the smell within its interior. Furthermore, there are not many products out there that give the user great control of the smell inside the car. Current products are single-use air fresheners that attach to either the air vent or hang from the rearview mirror and need to be replaced. Creating a device that is smarter, more efficient, and allows the user to have more control over the environment within the car is beneficial to the users driving experience.

The objective of this project will be to develop a product that will allow the driver or passenger to change the scent inside of a vehicle for various occasions. The product will be designed to fit discreetly in a wide range of vehicles and will accommodate a large number of pre-selected fragrances. The product will also include additional features that will set it apart from other products currently on the market while still keeping it seamless to operate and affordable for the average car owner. Some additional features currently considered include LEDs, USB ports, timers, and an automated start option.

One area that the group needs to research more thoroughly to better design and prototype this product is the different types of diffusion technology currently on the market. Understanding this technology will allow the group to create a different method of diffusion based on the pros and cons of other methods. As of right now, the main concern with prototyping and experimentation is possible challenges that may arise with refining the product. It may be difficult to create multiple prototypes outside of the required alpha and beta prototypes within the constraints.

Literature Review

In order to determine the customer needs of Caroma, the team researched products that are currently on the market. The team performed research on products that fell into three different price ranges. The team defined low tier, mid-tier, and top tier products based on their price ranges of less than or equal to $10, between $10 and $100, and greater than $100, respectively. The analysis of products in each price range gave the team a better idea of the market potential for Caroma and provided insight on how to make it a competitor in the market.

The team collected information on eight products including cost, size, amount of time the fragrance lasts, placement of the device, if it is disposable or reusable, the power source (if any), and if there is a presence of an intensity setting. *Table 1* shows the information collected for three low tiers (yellow), three mid-tier (pink), and two top tier (blue) products.

Table 1: State of the Art Review

	Cost	**Size**	**Time to last**	**Placement within car**	**Reusable?**	**Uses power? If so how?**	**Does it have intensity setting?**
Little Trees Hanging Air Freshener	$1.25	1.2 x 3 x 7.6	10 days	Hanging over dashboard	no	no	no
Febreze Car Air Freshener	$3.49	3 x 5.7 x 7.1	30 days	Clips onto car vent	no	no	yes
Yankee Candle GOOD AIR	$5.49	3 x 2.75 x 2.75	45 days	Cup holder, anywhere	no	no	no
Refillable Air Freshener Perfume Bottle	$15	1 x 2 x 1	Dependent on use	Anywhere	yes	no	kinda
USB Car Essential Oil Diffuser	$20	2.7 x 2.7 x 5.8	7 hrs	Cup holder	yes	Yes, usb port	yes
Car Air Purifier	$20	4 x 1.8 x 1.5	None	Car charging port	null	Car charging port	null
Westin White Tea Scent Diffuser	$170	2.5 x 2.5 x 5.8	300 hrs	For home use, anywhere	yes	120 V outlet	yes
TMS 100 Aroma System	$215	7.8 x 9.3 x 2.7	unknown	For home use	yes	110 V outlet	yes

Low-Tier Product

The team chose one product in each tier to further analyze in order to gain insight into customer needs. The low tier product researched was the Febreze Car Air Freshener (*Figure 1*) that costs $3.49 per device. This device is said to last about 30 days and attaches to the vents. The fragrance cartridge in the device is not refillable, meaning the entire device is thrown in the trash when it runs out of fragrance, however when the product is in use the intensity can be adjusted to meet the needs of the customer.

Figure 1: Febreze Car Air Freshener

The team used Amazon to gather customer reviews on Febreze Vent Clips. One customer wrote, “it is too expensive to just throw into the trash after four weeks of use. Not worth it compared to other products which offer refills”. Based on this review, the customer was not happy with the single-use aspect of the product, which led the team to determine that the product to be developed must be refillable. The fragrance on the Febreze Vent Clips stated to last 30 days; however, one customer commented on actual duration, “[Febreze Vent Clips] run out super quick, even when I put them on the lowest setting.” This review led the team to determine that customers would prefer fragrances that last longer than 30 days, even on the highest intensity setting.

Besides the fragrance duration, fragrance strength is also an essential factor for customers. Several customers had complaints that the fragrance was too strong for their liking. Some reviews include, “boy; these are strong. Like makes my head hurt strong. Turned it down to the lowest [setting] and still had to get rid of it,” and “wanted to use in my car to freshen things up but they became overpowering even on the lowest setting and made the car smell like a cheap perfume. Will not be getting these again”. These reviews provided the team with insight on finding a happy medium in terms of the fragrance strength. The scent must be strong enough to fill the vehicle, but it must not be too strong to the point where it makes the passengers uncomfortable.

By reading the reviews, the team was also able to get a better understanding of where customers use this product. Although the Febreze Vent Clips are on the market as car air fresheners, one customer wrote, “I put these on the air vents in my house. Smells great,”. This review led the team to think about creating a product that is applicable in several locations, not just a vehicle. This aspect will give our product a competitive edge and broaden its market potential. By researching the customer’s thoughts on the Febreze Vent Clips, the team was able to get a better understanding of what customers are looking for in terms of refillable products, fragrance duration, fragrance strength, and product versatility.

Mid-Tier Product

The mid-tier product researched further was the USB Car Essential Oil Diffuser (*Figure 2*) that costs $20 per device. The device contains a water container in the base where essential oils can be dropped into the water and diffused in the air for up to 7 hours. This device is powered through a USB port and contains some added features such as an air purifier, LED lights, and an intensity setting.

Figure 2: USB Car Essential Oil Diffuser

Upon researching and reviewing products, the team analyzed customer reviews to gather information on customer needs. One customer wrote, “Item was not working properly after I plug it into the USB charger.” This issue could be due to a defect in the manufacturing process with regards to the mass production of USB chargers. The manufacturers of this product did not pay attention to the quality control of their products. The team changed this statement into a customer need and planned to implement it into the prototyping phase to ensure that each aspect of the product will work flawlessly during each use. Another customer wrote about the strength of the smell from this diffuser. The customer wanted a stronger smell in their vehicle. Our team

turned this into a requirement for our design to have the team's fragrance strength to be strong enough to circulate throughout the car, yet not overpowering to the point of discomfort when inside the vehicle. Another customer review highlighted the mist aspect of the diffuser. "Be careful where you place this in the car because of the water mist. This will leave a small area of water." One added feature that the team received feedback on was the importance of added features. One of the top answers from their customer survey was mist as an added feature. The team plans to engineer mist as an added feature into their final prototype. The mist must be steady but gentle with regards to how much water releases with each spray. The team understood more about customer needs while analyzing existing products and their respective reviews.

Top-Tier Product

Some of the top-tier range products seen on the market were not explicitly applicable for cars but could be used in cars if the customer desired. The team tried to focus more on the features and aspects of the product that made it luxurious and expensive, not that it was designed for use in a home. One top-tier product that was analyzed was the TMS 100 Aroma System. This product is designed to be used as a portable unit, wall-mounted, or connected to a small A/C unit. The TMS Aroma System (*Figure 3*) also uses cold-air diffusion technology to diffuse its scents. This type of technology prevents the liquid fragrance from falling and ensures consistent subtle scents throughout the space. This system can diffuse up to about 1000 square feet of space. This device also contains many additional features including customizable intensity levels, an automatic start and stop option, and a digital display on the device. Because this device is on the higher end of price, this product does not have as many customer reviews to notice a recurring pattern of the product.

Figure 3: TMS 100 Aroma System

Some information from customer reviews was still able to be obtained. One customer stated that “checks all the boxes of a diffuser (straight oil, nice size chamber, not too expensive) but [the device] does not diffuse the oil enjoyably.” Based on this information, the customer enjoys the other features of the device, including the size, price, and type of fragrance container. Based on this review, the team decided to incorporate additional features and “add-ons” to their proposed designs. The reviewer describes the method of diffusion as a puff of smoke that has a minimal scent to it. The reviewer also discusses that the product will use up a cartridge in a few days. With this information, the team decided to make this into a requirement that the product should be long-lasting. It was also noted that the method of diffusion is essential to the customer in both effectiveness and visual appeal.

Needs and Specifications

After learning about the proposed product from the team’s sponsor, Terrance Dean, the general direction of the product began to form. The device will remove harmful air particles and replace them with proper air quality and a pleasant aroma. The product’s target market is the average car owner who has a desire to control the scent inside their car. Examples of these car owners include people who may have smelly gym clothes inside their car or people who drive by waste treatment plants daily. The team aims to enhance the idea of an air freshener by creating a diffuser with additional features. The additional features will justify to customers that a reusable diffuser is worth the money.

Customer Survey

Based on general ideas the team had of the product, a customer survey was created to get feedback from prospective customers. The team used the survey to learn more about possible competitors as well as the customers' reasons for using air purifiers or diffusers in their car. The group chose to conduct this customer survey to gather data from a wide range of prospective customers. The group created this survey as a google form and shared the survey with peers, family, and family friends. Currently, seventy-four people of varying ages and backgrounds took the survey. The survey age demographic is mainly in the 25 and under age range due to a large number of peers who took the survey. The questions asked in the survey are located in *Appendix A1*.

Customer Survey Results

Some of the most common competitors were the Yankee Candles hanging air fresheners and the Febreze Vent Clips. Forty-one people reported they currently use diffusers to improve the smells within the car. Forty-six people stated they used diffusers to produce a pleasant aroma. The team asked prospective customers what their potential price range for this product would be as well as the most ideal location within the vehicle. Based on the feedback, 83% of people

would pay less than $20, while 17% would be willing to pay $20 to $50. Twenty-three people preferred their air freshener/diffuser to be attached at the vents while thirty people though suction cup mounting was least ideal (*Figure 4*). Potential customers also gave feedback about what power source they would like to use for their device. The results stated that twenty-one people prefer their diffuser to be solar-powered while another twenty-one people ranked no power source as their lost ideal power option (*Figure 5*). Finally, the survey asked what additional features people would want to be included in their device. The team gave some concrete answers and a 'write-in' option for those who had more ideas with regards to his product. Some of the top features included timers, USB ports, and fragrance mist. Two needs that the team gained from this survey were affordable cost and device location. Customers are not willing to spend hundreds of dollars on this add-on to their vehicle, so the team needs to design concepts with these constraints in mind. The team also noted that most people preferred their devices clipped to the vents. This aspect of the product was not a requirement or need for the product, but it was something to be noted in future design concepts.

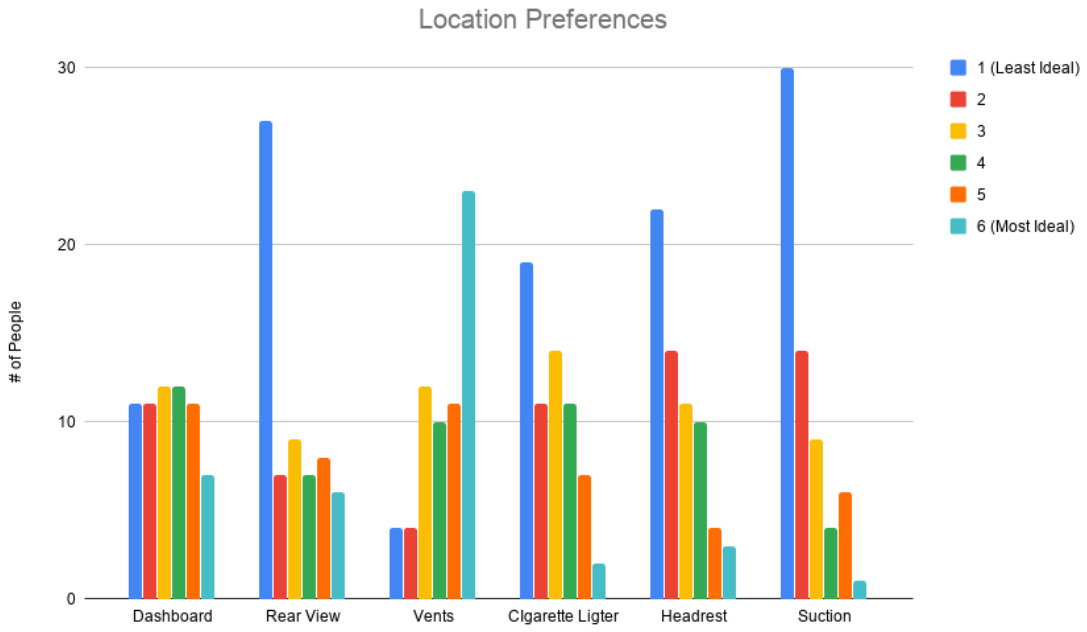


Figure 4: Location Preferences of Diffuser

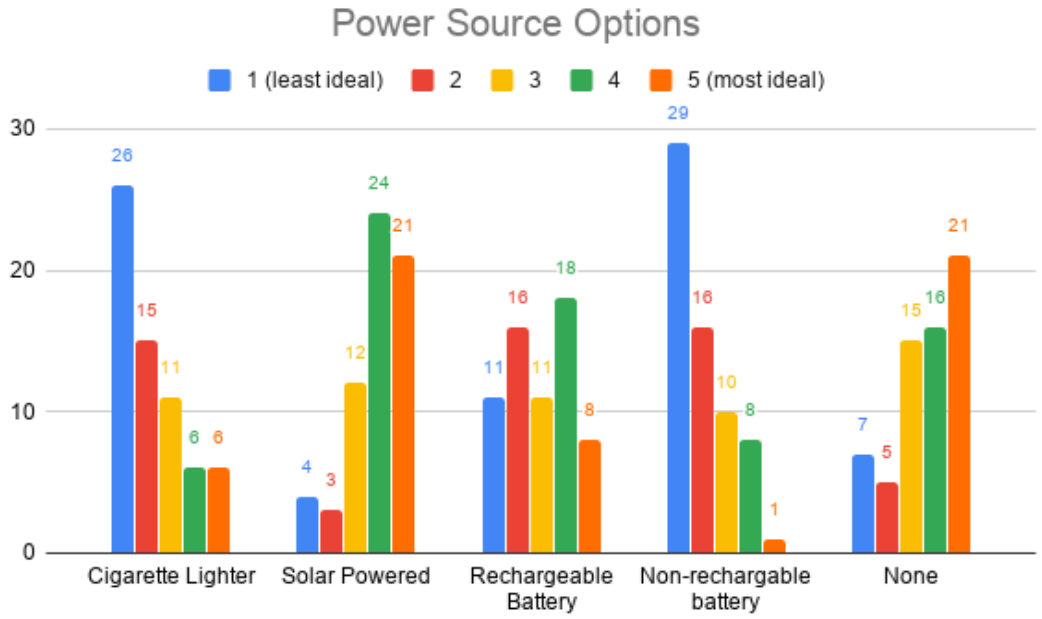


Figure 5: Power Source Preference of Product

The team incorporated data from the State of the Art Review to create more needs and specifications. Based on data from the low-tier products, the team learned that customers are not content with single-use air fresheners because they are too expensive to throw out every few weeks. This turned into a customer need that all designs must be reusable. Customer reviews also created a need for a longer fragrance duration because the low-tier products currently on the market do not fulfill customer needs. Lastly, the team understood the importance of an intensity setting for conceptual designs. Some reviews stated that the fragrances were too strong or too weak, so the group created a need for intensity control. While reviewing the mid-tier products, the team noticed there was a need for quality control during the manufacturing process. Another need was the incorporation of added features into the team's product. Customers liked the mist feature but found it a bit faulty due to how the product was manufactured. The team plans to add additional features to the final design, but steps must be taken to ensure that they are functional. Based on data collected from the top-tier product, it was discovered that users enjoyed the automated features of the product such as the programmable start/stop times and the ability to run three automated cycles throughout the day. Another critical piece of information learned from this review was that the method of diffusion is essential. This refers to both its effectiveness and its appearance. Unlike the top-tier product, the team plans to design a method of diffusion that is both effective and not distracting to the driver. With these developed needs, a Customer Needs Table was created (*Table 2*).

Table 2: Customer Needs Table

		Customer Needs Table	
Categrory	**Index**	**Need**	**Priority**
Cost	C1	The product must be relatively inexpensive	2
Cost	C2	The product must be reusable because single use products are not economically smart	1
Performance	P1	The product must have a variety of settings to adjust to all customers' scent preferences	3
Performance	P2	The product must effictively diffuse scent through the car without distracting the driver	1
Performance	P3	The prduct scents must be long lasting	4
Performance	P4	The product must have other additional features on top of being a diffuser	4
Performance	P5	The product must have a feature allowing scents to be easily interchangeable	3
Maintenance	M1	The product fragrance cartridges must be easy to remove and replace	2
Health/Safety	H1	The product must have the ability to purify air in the car	1
Durability	D1	The product must be long-lasting	3
Durability	D2	The product must withstand different loads and forces that act in a car	2

Concept Generation

Before brainstorming began, the team created a concept combination table (*Table 3*) that outlined each option for the different aspects of the device to be considered. These different aspects include mounting locations, the number of fragrance options, power source, mechanisms for control, added features, and type of fragrance cartridge. Each team member brainstormed three design concepts each, 12 total. From these 12 concepts, the team used a pugh matrix to narrow the concepts down to six choices. Each of the six options was presented to the project advisor and sponsor in order to gain additional feedback. The team determined that there two sets of design concepts that were relatively similar and could be combined. This left the group with four concepts to analyze through a selection matrix (*Table 4*). From the selection matrix, three final design concepts were chosen to develop further in phase two of the project. Each concept is anticipated to fall into each price range, low-tier, mid-tier, and top-tier. To provide visual clarity on which aspects are included in each design, a specific concept combination table is provided.

Table 3: General Concept Combination Table

Concept Combination Table					
Mounting Locations	**Fragrance Options**	**Power Source**	**Mechanisms for Control**	**Added Features**	**Fragrance Cartridge**
Dashboard	2	Cigarette Lighter	Buttons on Device	LED Lights	Wax
Rear-View Mirror	3	Solar	Phone App	Timers	Gel composition
Vents	4	Rechargeable Battery	Small Remote	Mist	
Cigarette Lighter	5	Non-Rechargeable Battery	Dial	USB Ports	
Headrest		None	None	Air Purifier	
Suction Cup					

Table 4: Concept Selection Matrix

Selection Criteria		**Concepts**															
		2		**5**		**6**		**7**		**9**		**10**		**6&9 Combo**		**5&7 Combo**	
	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Cost	13	7	91	5	65		0	4	52		0	7	91	3	39	6	78
Aesthetic	10	5	50	6	60		0	8	80		0	9	90	6	60	8	80
Number of Fragrances	5	8	40	4	20		0	10	50		0	2	10	5	25	8	40
Ease of Use	10	8	80	7	70		0	7	70		0	9	90	8	80	8	80
Manufacturability	13	5	65	7	91		0	5	65		0	8	104	4	52	6	78
Ease of Restock/Replace	7	10	70	8	56		0	8	56		0	8	56	8	56	8	56
Fragrance Duration	4	2	8	4	16		0	7	28		0	5	20	7	28	7	28
Size	7	4	28	5	35		0	7	49		0	8	56	6	42	7	49
Weight	3	10	30	9	27		0	8	24		0	10	30	5	15	8	24
Environmental Impact from Product Life	4	1	4	7	28		0	7	28		0	9	36	6	24	7	28
Additional Features	5	0	0	5	25		0	5	25		0	3	15	7	35	5	25
Independent of Car	5	0	0	0	0		0	0	0		0	0	0	10	50	0	0
Device Duration	7	3	21	8	56		0	9	63		0	8	56	9	63	8	56
Variation of Intensity	7	0	0	8	56		0	8	56		0	0	0	9	63	7	49
	Total Score	**487**		**605**		**0**		**646**		**0**		**654**		**632**		**671**	

Low-Tier Design Concept

The proposed low tier concept design is in *Figure 6* below. This design uses the power and airflow of air vents to its advantage to disperse the scent throughout the car. This proposed design fits around the rim of standard car air vents and clips into the air vents to stabilize it. The fragrance cartridges for this product are designed to be switched in and out if the customer wants to use a new scent. These cartridges can be used repeatedly and should be switched depending on the person's current preference.

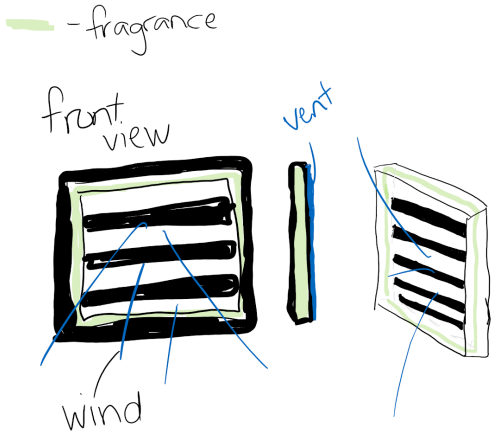


Figure 6: Caroma Vent Clip

This product is designed to have a sleek and non-intrusive look within the car because it will appear to be a part of the air vent. The fragrance cartridge is located directly below the front cover of the device. Because of its location within the vents, the air exiting the air vents will pass through this cartridge and pick up a scent along the way. The fragrance cartridges for this product are designed to be easily changeable and removable. If the user wants to switch between different scents, the front cover of the diffuser can be removed to show the entire fragrance cartridge to switch out. These cartridges will be specially made to be rotated frequently without wasting any fragrance. This device also incorporates air purifying technology to help filter any air that enters the car through the vent. The concept combination table for this design is shown below *(Table 5)*.

Table 5: Low-Tier Concept Combination Table

Concept Combination Table - Low-Tier Design Concept					
Mounting Locations	**Fragrance Options**	**Power Source**	**Mechanisms for Control**	**Added Features**	**Fragrance Cartridge**
Dashboard	2	Cigarette Lighter	Buttons on Device	LED Lights	Wax
Rear-View Mirror	3	Solar	Phone App	Timers	Gel composition
Vents	4	Rechargeable Battery	Small Remote	Mist	
Cigarette Lighter	5	Non-Rechargeable Battery	Dial	USB Ports	
Headrest		None	None	Air Purifier	
Suction Cup					

Mid-Tier Design Concept

The mid-tier concept design is in *Figure 7* below. This device is meant to be powered by the vents. This design contains four fragrances that are only open one at a time. On the open portion of the circle, some shutters can be adjusted depending on the user's desired fragrance intensity.

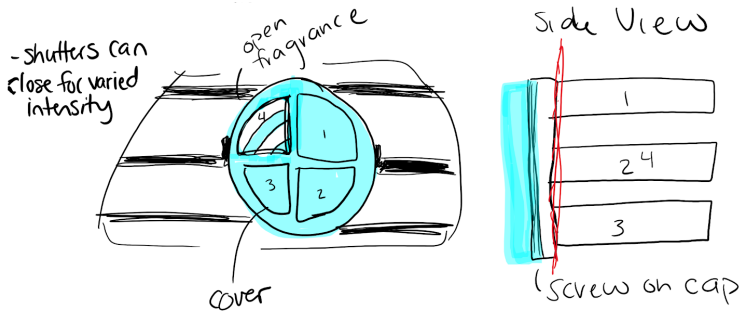


Figure 7: Caroma Fragrance Wheel

This device fits between the vents with two fragrances in the space above the vent and two below. The fragrances will either a gel or wax that reacts naturally with the wind through the vent. However, the chemical composition of the fragrances will be defined in future prototyping processes. This device contains more than one fragrance, which can be suitable for multiple occasions. The fragrances are also customizable for the user so each can decide which fragrances they wish to bring into their car. The fragrances will be refillable in a quarter-cylinder shape that slips right into the fragrance casing. The customer has the choice of fragrance by spinning the cap 90 degrees. This device also contains an air purifier between the fragrance and the shutters to increase air quality inside the vehicle. This product aims to be within the average price range for vehicle fragrance diffusers and can be an easy addition to any vehicle. The concept combination table for this design is shown below in *Table 6*.

Table 6: Mid-Tier Concept Combination Table

Concept Combination Table - Mid-Tier Design Concept					
Mounting Locations	**Fragrance Options**	**Power Source**	**Mechanisms for Control**	**Added Features**	**Fragrance Cartridge**
Dashboard	2	Cigarette Lighter	Buttons on Device	LED Lights	Wax
Rear-View Mirror	3	Solar	Phone App	Timers	Gel composition
Vents	4	Rechargeable Battery	Small Remote	Mist	
Cigarette Lighter	5	Non-Rechargeable Battery	Dial	USB Ports	
Headrest		None	None	Air Purifier	
Suction Cup					

Top-Tier Design Concept

The proposed top tier design concept is shown in *Figure 8* below. The device is to be placed behind the rearview mirror, next to where an EZ Pass device is located. The device contains three fragrance cartridges that are replaceable when the customer wants to try a different scent or when the fragrance runs out. The fragrances are replaced by opening the sliding compartment and merely pulling the cartridge tab out, and putting a new one in the desired compartment.

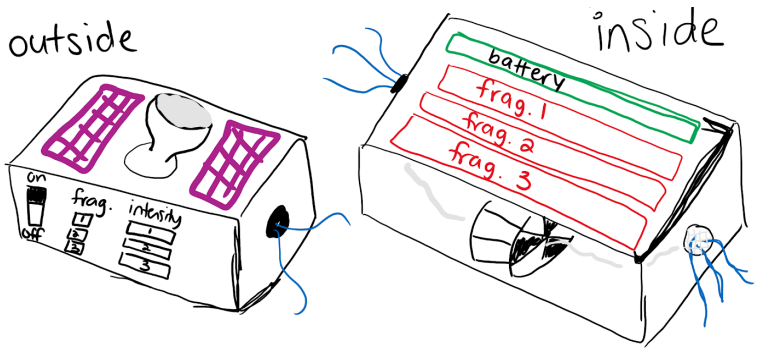


Figure 8: Caroma Solar Sticker

The product has two holes on the left and right sides, one to pull air in, and the other to push air out. The product is powered by solar panels that will charge the battery and store the power until the customer is ready to use it. The side of the product that is facing the driver will have several buttons, on/off, three fragrance choices, and three intensity settings, low, medium, and high. The battery will power a fan when the customer chooses the settings of their choice. The fan passes air through the fragrance and disperses it into the air. An additional feature of this product is air purification. When the air is pulled into the device from the first hole, it will pass through a filter that will purify the air before adding the fragrance and releasing it. This product will make a great addition to any vehicle as it removes bad particles from the air, and replaces it with a fragrance of choice. The concept combination table for this design is shown in *Table 7*.

Table 7: Top-Tier Concept Combination Table

Concept Combination Table - Top-Tier Design Concept					
Mounting Locations	**Fragrance Options**	**Power Source**	**Mechanisms for Control**	**Added Features**	**Fragrance Cartridge**
Dashboard	2	Cigarette Lighter	Buttons on Device	LED Lights	Wax
Rear-View Mirror	3	Solar	Phone App	Timers	Gel composition
Vents	4	Rechargeable Battery	Small Remote	Mist	
Cigarette Lighter	5	Non-Rechargeable Battery	Dial	USB Ports	
Headrest		None	None	Air Purifier	
Suction Cup					

Technical Analysis

With the completion of Phase 1, three design concepts were generated and will be analyzed further while keeping in mind the best aspects of each concept in order to come up with a productive and successful product. To complete the technical analysis, the team must attack areas that relate directly to the design of the product and its functionality. In phase 2, areas of technical analysis include the duration of fragrance diffusion when set on various intensities; the required airflow in order to evenly spread the scent throughout the entire car; the required voltage needed to power the fan and other mechanisms within the product; the battery life of the product; and the product's ability to withstand forces and temperatures met within the car.

Airflow will depend on whether the concept analyzed uses the built-in air vent or its fan to disperse the fragrance effectively. If using the air vent, which is already designed to create a sufficient airflow throughout the car, there is not much analysis that needs to be done. Using a separate fan, the team will need to calculate the amount of air the fan must displace over time to effectively change the scent within the car evenly and quickly. After finding the required size of the fan, the team can decide if it is a viable option and then calculate the voltage needed to power this fan. Some concepts include solar power to recharge the battery within the device, but it is also essential to see how long the device will last on one full charge.

Accelerating, decelerating, turning, and going over bumps and potholes put forces on everything within the car. Therefore, a technical analysis must be done so that the method of attaching the product to the car is strong enough, so it will not fall off while driving. This issue can be resolved using methods such as using a suction cup, a standard clip mechanism, or velcro. Depending on the weight and size of the product along with natural forces felt by the car, the strength required for the attachment mechanism can be calculated. Finally, cars can be subject to a wide range of temperature. For example, the interior of a car can reach up to 150℉ on a hot summer day. Therefore a technical analysis must be done to ensure that the product can function and withstand the temperatures within a car.

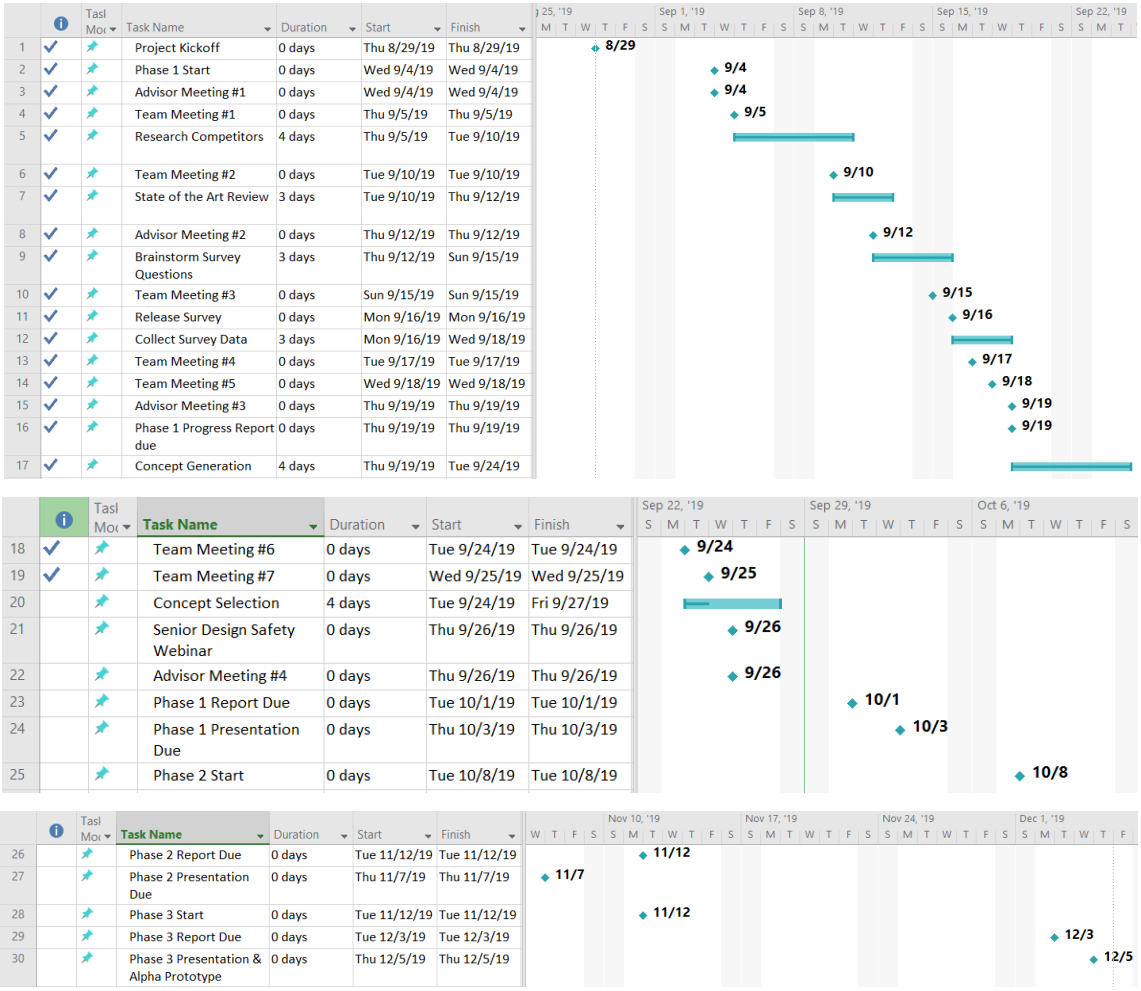
Project Plan

This project will run for the duration of the 2019-2020 academic year. By the end of the fall semester, the team will have completed the first three phases with the final deliverable being an alpha prototype. By the end of the spring semester, the team will have completed the sixth phase and will produce a beta prototype. The beta prototype will be a working prototype that can be used in any vehicle.

In order to stay on track and ensure that the project progresses, the team keeps an up to date Gantt chart (*Table 8)*. The Gantt chart keeps track of all team meetings, advisor meeting, minor deliverables such as the state of the art review, concept generation, concept selection, and

significant deliverables such as phase report and phase presentation deadlines. The Gantt chart is a living document that is continuously updated to reflect meetings and any changes to project deadlines.

Table 8: Project Gantt Chart



	Task Name	Duration	Start	Finish
1	Project Kickoff	0 days	Thu 8/29/19	Thu 8/29/19
2	Phase 1 Start	0 days	Wed 9/4/19	Wed 9/4/19
3	Advisor Meeting #1	0 days	Wed 9/4/19	Wed 9/4/19
4	Team Meeting #1	0 days	Thu 9/5/19	Thu 9/5/19
5	Research Competitors	4 days	Thu 9/5/19	Tue 9/10/19
6	Team Meeting #2	0 days	Tue 9/10/19	Tue 9/10/19
7	State of the Art Review	3 days	Tue 9/10/19	Thu 9/12/19
8	Advisor Meeting #2	0 days	Thu 9/12/19	Thu 9/12/19
9	Brainstorm Survey Questions	3 days	Thu 9/12/19	Sun 9/15/19
10	Team Meeting #3	0 days	Sun 9/15/19	Sun 9/15/19
11	Release Survey	0 days	Mon 9/16/19	Mon 9/16/19
12	Collect Survey Data	3 days	Mon 9/16/19	Wed 9/18/19
13	Team Meeting #4	0 days	Tue 9/17/19	Tue 9/17/19
14	Team Meeting #5	0 days	Wed 9/18/19	Wed 9/18/19
15	Advisor Meeting #3	0 days	Thu 9/19/19	Thu 9/19/19
16	Phase 1 Progress Report due	0 days	Thu 9/19/19	Thu 9/19/19
17	Concept Generation	4 days	Thu 9/19/19	Tue 9/24/19
18	Team Meeting #6	0 days	Tue 9/24/19	Tue 9/24/19
19	Team Meeting #7	0 days	Wed 9/25/19	Wed 9/25/19
20	Concept Selection	4 days	Tue 9/24/19	Fri 9/27/19
21	Senior Design Safety Webinar	0 days	Thu 9/26/19	Thu 9/26/19
22	Advisor Meeting #4	0 days	Thu 9/26/19	Thu 9/26/19
23	Phase 1 Report Due	0 days	Tue 10/1/19	Tue 10/1/19
24	Phase 1 Presentation Due	0 days	Thu 10/3/19	Thu 10/3/19
25	Phase 2 Start	0 days	Tue 10/8/19	Tue 10/8/19
26	Phase 2 Report Due	0 days	Tue 11/12/19	Tue 11/12/19
27	Phase 2 Presentation Due	0 days	Thu 11/7/19	Thu 11/7/19
28	Phase 3 Start	0 days	Tue 11/12/19	Tue 11/12/19
29	Phase 3 Report Due	0 days	Tue 12/3/19	Tue 12/3/19
30	Phase 3 Presentation & Alpha Prototype	0 days	Thu 12/5/19	Thu 12/5/19

The sponsor of this project, Terrance Dean, decided the team budget. He decided to give the group $1,000 to design and prototype their project. The team also receives $700 from the Mechanical Engineering Department to put towards the product development. Nothing is definite with regards to how the budget will be allocated in the project. The team knows they must set aside money for prototyping in the PROOF Lab.

Table 9: Team Budget

Total Budget: $1,700		
Supplies	Cost	Cost Available
PROOF Lab 3D Prototyping	$60	$1,640
Chemical Compound for Fragrance Gel	$300	$1,340
Compound for Fragrance Wax	$200	$1,140
Raw Metal/Plastic	$100	$1,040

The preliminary budget includes generalized materials needed to create each concept produced by the team. These costs are estimates because the team does not have any concrete material plans besides the generalized materials above.

Conclusion

The team aims to deliver a product that meets the customer needs as well as satisfy the project's sponsor. This prototype will mainly be a proof of concept for a new technology and will inspire future products. The goal is to create a viable prototype that can be advanced with outside technology and eventually be implemented into the car manufacturing process. Phase 1 was the preliminary planning stage for the team to determine which direction they wish to go in with regards to this project. After many hours of brainstorming, the group created concepts that can serve as add-ons in a vehicle and can further be engineered into the vehicle's interfaces as an added feature. The primary design concepts are also subject to change after technical analyses and prototyping. The Gantt Chart and Team Budget are living documents that will shift throughout the year.

References

1) Brenda. “Top 10 Best Portable Essential Oil Diffusers for Your Car Traveling.” *Air Life Better*, 21 May 2019, www.airlifebetter.com/essential-oil-car-diffusers/.
2) “Car Air Freshener: Febreze CAR.” *Air Fresheners & Odor-Eliminating Products*, www.febreze.com/en-us/products/products-by-type/car-vent-clip-freshener.
3) “Good Air®.” *Yankee Candle Company*, Yankee Candle, www.yankeecandle.com/wbrowse/good-air/_/N-8ii.
4) “Scent Diffuser.” *Westin Hotel Store*, Westin Hotels, www.westinstore.com/product.aspx?scent-diffuser.
5) “TMS 100 Aroma System (1,000sq.Ft).” *TMS*, The Magic Scent, www.themagicscent.com/shop/2-technologies/tms-100/.
6) Ways. “Best Car Essential Oil Diffuser.” *Byways*, 3 July 2019, www.byways.org/best-car-essential-oil-diffuser/.

Appendix

Appendix 1

Survey Questions

1. What age range do you fall into?
2. Do you currently use air fresheners/diffusers in your vehicle?
    a. If yes, what kind of air freshener/diffuser do you currently use in your vehicle?
    b. What kinds of scents do you / would you like to have in your vehicle?
3. What purpose would an air freshener/diffuser/purifier have in your vehicle?
4. How much are you willing to pay for a reusable air freshener/diffuser/purifier?
5. How many fragrance options would satisfy your needs?
6. What is your opinion on the following mounting locations for an air freshener / diffuser / purifier?
7. Is there mounting location not mentioned in the question above that you would prefer?
8. What is your opinion on how to power the air freshener/diffuser/purifier?
9. How would you control the air freshener/diffuser/purifier?
10. What types of features would you like to have on your air freshener/diffuser/purifier?
11. Is there any reason you wouldn't purchase an air freshener/diffuser/purifier?