The Phone Cave:
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Executive Summary

The mission of this design project, as given by Delphi, is to design a technology or device that can be used to make driving safer, greener, or better connected. The motivation for this project was to design a device to limit the dangers of texting and driving on the road today. After many different ideas were discussed and developed, it was decided that the device would implement connectivity with safety to make driving in vehicles less distracting and more enjoyable. Many concepts were created to maximize connectivity while minimizing the between the driver and his phone. The concept chosen is called the phone cave, which is a clear drawer in between the front two seats of the car. Inside the drawer would be a USB cord, which provides music, charge, and texting via verbal cues, thus increasing the connectivity of the device. In addition, the removal of the CD drive allows us to decrease the weight of the car and make the car greener. Finally, the containment of the phone and the cell phone wave detector work to decrease the driver’s texting while driving, which in turn limits distracted driving and makes driving safer. These minor additions to vehicles would greatly decrease the amount of distracted driving accidents on the roads today and would make driving much safer.

Introduction

The driving purpose of this project revolves around the safety and connectivity of the driver. Distractions of the driver is currently one of the top causes of accidents throughout the world. And, in today’s society texting or using a phone happens to be the number one distraction of drivers. This design will require the driver’s phone to be connected into a port in order for the car to be enabled to start. Once the phone is in the port, a door will close on it, not allowing direct hand-to-phone access while the car is started. The great thing about this design is that connectivity isn’t compromised. Once the phone is in placed, it will be synced to the car’s system. At this point any calls or text will be audibly expressed to the driver by the system. Then, the driver will be able to reply in a hands-free manner by speaking back to the system with his or her’s customized command. While this product is geared towards safety and connectivity, green is not compromised. In order to not overuse material or electrictronics, the CD player will be taken out of the car. This transition will be seamless because CD’s are almost completely phased out of society and a CD player currently takes up a significant amount of electronic and physical material. The “Phone Cave” will successfully improve safety and connectivity without compromising the green aspect of the motor vehicle.

Problem Statement

Vision: A world where drivers do not text while driving; allowing for a much safer driver environment with less distractions.

Current State: There are a few attempts made by companies to decrease the amount of texting in cars. However, there aren’t many ways to ensure that the driver is unable to text while the vehicle is functioning.

How we are going to get there: We are going to design a device to put on the dashboard of a car. This device will hold the phone in place while the car is moving. In addition, the device will ask for the phone to be plugged in order for the car to start. If the driver doesn’t have a phone, a detector will already be activated, sensing whether or not the driver possesses an active phone. If no phone is detected, the driver will be able to start the car. If a phone is detected, it must be plugged into the port in order for the car to start. Once the
car starts, an automated door will close in front of the port, making the phone inaccessible to the driver until the car is shut off or in an accident.

Research

There are many types of cell phone holding docks available for drivers, which can be seen simply by searching online for docking systems. With many different shapes and sizes, it is not too difficult to find a docking system for any type of phone that you are looking for. While this is the case, these often take up space from the windshield, thus obstructing the view of the road slightly. From our research, we were unable to find many systems that incorporated the docking system into other parts of the car that are more aesthetically pleasing and less obstructive for the driver and with the high quality connectivity that our device offers.

Customer Needs

Displayed below are the conditions and needs of the customer necessary to maximize our customer’s satisfaction with the Phone Cave. Target specifications including ensuring the phones protection, the phones availability to the auxiliary cord, and voice control settings along with desired safety improvements are all evaluated and addressed below.

<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inaccessible docking station</td>
<td>Docking station enclosed with clear lid that locks in place while car is running.</td>
</tr>
<tr>
<td>Must safely hold cellphone</td>
<td>Adjustable clamps to firmly hold cell phone in place.</td>
</tr>
<tr>
<td>Must be drivable without cellphone</td>
<td>Incorporate a signal able to detect devices within the range of the driver’s seat, if undetected the car will be permitted to start, otherwise the transmission will remained locked until device is placed in docking station.</td>
</tr>
<tr>
<td>Must be able to play music from cell phone</td>
<td>Incorporate a USB outlet within the docking station that allows the cell phone to play music and charge as well.</td>
</tr>
<tr>
<td>Need to be able to take emergency calls and text</td>
<td>Voice control devices, like Siri, will be incorporated to use your cell phone while remaining in the docking station.</td>
</tr>
<tr>
<td>All possible cellphones must work in the docking station</td>
<td>We will include an adjustable docking station with a USB outlet allowing and ensuring all possible devices and their personal cords to be used.</td>
</tr>
<tr>
<td>Mustn’t compromise the green and connectivity aspects of the vehicles</td>
<td>This system will improve connectivity as well as safety, but will not compromise an eco-friendly vehicle based upon the weight. While adding the docking station, we will remove the cd drive to avoid added weight which would require more fuel while driving.</td>
</tr>
</tbody>
</table>

Concept Generation

When we first developed our design, we designed our holder to emit annoying sounds when the cell phone is not in the cave. The cell phone could play music through the auxiliary cord and can be charged through the USB port. This is the least intensive change to the car, which would greatly diminish the problem with few additions to the car.

One problem that we thought could arise is that drivers would attempt to outsmart the phone cave by putting a different phone in the cave instead of their phone, or simply putting a passenger’s phone in the cave instead of their own. Therefore, we implemented a cell
phone sensor into the concept that would set off the annoying sounds whenever cell phone waves are detected in the driver’s seat.

Another problem that could occur with these two concepts is if the driver was willing to withstand the annoying sounds in order to use their phone while driving. Therefore, we created a new concept that locks the car in park if there is a phone detected in the driver’s seat. This allows the driver to be able to use the car if they don’t have a phone, and if they do have their phone, they must put it in the phone cave before starting the car. If a driver decided to remove their phone while in motion, rather than risk the passenger’s and driver’s safety by stopping the car, the car will emit the annoying sounds to remind the driver to put the phone back.

Our fourth concept is similar to the third concept with the only difference being that the phone cave uses a USB cord to play the music instead of an auxiliary cord. This will allow the driver to go through one less step to begin driving, which makes the process quicker and more efficient.

**Concept Selection**

We developed a concept matrix in order to evaluate our four possible concepts. We chose to score our concepts based upon the criteria of safety, connectivity, green, and price, all of which show significant importance to Delphi.

<table>
<thead>
<tr>
<th>Concept Generation</th>
<th>Concept 1</th>
<th>Concept 2</th>
<th>Concept 3</th>
<th>Concept 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety (40%)</td>
<td>3 x 40% = 1.2</td>
<td>3 x 40% = 1.2</td>
<td>5 x 40% = 2</td>
<td>5 x 40% = 2</td>
</tr>
<tr>
<td>Connectivity (20%)</td>
<td>2 x 20% = 0.4</td>
<td>3 x 20% = 0.6</td>
<td>3 x 20% = 0.6</td>
<td>4 x 20% = 0.8</td>
</tr>
<tr>
<td>Green (20%)</td>
<td>4 x 20% = 0.8</td>
<td>4 x 20% = 0.8</td>
<td>3 x 20% = 0.6</td>
<td>3 x 20% = 0.6</td>
</tr>
<tr>
<td>Price (20%)</td>
<td>4 x 20% = 0.8</td>
<td>4 x 20% = 0.8</td>
<td>3 x 20% = 0.6</td>
<td>3 x 20% = 0.6</td>
</tr>
<tr>
<td>Totals</td>
<td>3.2</td>
<td>5.0</td>
<td>3.8</td>
<td>4</td>
</tr>
</tbody>
</table>

**Final description**

Based upon our concepts, we found that concept 4 was the clear winner and overall the best choice for our system moving forward. Concept 4 was tied for the safest option with option 3, giving it a great advantage over 1 and 2. What put it above Concept 3 was its connectivity. Concept 3 required the use of two cords, an auxiliary cord and a USB cord, to play music and drive the car, while concept 4 required just the USB cord for both actions. This simplified the device, and made it a more efficient and appealing product, which is why it was chosen as the best concept.
System Diagram 1

System Diagram 2
System Diagram 3

System Diagram 4
Scenarios

To operate a vehicle with our system installed, the driver would unlock and enter the car. Upon turning on the ignition, a cellular phone antenna mounted in the steering wheel or dashboard will activate, detecting any cellular data emissions in the proximity of the driver’s seat. If active cell phone emissions are detected, the vehicle will become locked in park until a cell phone is placed in the docking area and connected via USB, and the device door is closed. If no cell phone activity is detected by the antenna, the car will not be locked in park, allowing the driver to operate the vehicle without a cell phone. If for some reason the driver’s cell phone were to be off when the car is started, but the cell phone is turned on as the vehicle is in motion, the antenna will detect the cellular data activity of the cell phone and an annoying beeping noise will be emitted, prompting the user to pull over and place the cell phone in the docking station.

Total Cost Analysis

The total cost of our system is relatively low. The most expensive components would be the high sensitivity cellular antenna and the motherboard containing the computer. As far as materials go, we expect the box and USB cord to be relatively inexpensive, costing no more than $50. The cell phone antenna, depending on its size and accuracy, ranges from $50-200. The voice control system must be programmed into the vehicle, which will cost approximately $50. With the inclusion of the cost of labor, we estimate the price to be around $500, because a lot of the circuitry and components involved are already incorporated into most modern vehicles. These components include a dash-mounted touchscreen, a phone to vehicle interface, and a media center/sound system.

Life Cycle Analysis

All the materials in the car are made from long lasting materials, such as recycled rubber, recycled plastic, and a circuit board. While durability of the material isn’t an issue, the technology involved may shorten its life cycle. For example, the USB port could be replaced with a more powerful port, which may require replacement of the device’s port. Additionally, higher speed port drivers may eventually be required in order to keep up with developing technology, which could require a replacement of the motherboard, though an upgrade like this would likely not occur for at least a decade after production.

Conclusion

The final concept offers many different features to enhance connectivity, while also greatly improving the safety on the road by minimizing texting while driving. With the phone out of sight and the connectivity coming through the speakers, the driver will be able to keep concentrated on the road and will likely not be as distracted as drivers are today. Also, by removing the outdated feature of the CD Drive, we were able to decrease the weight of the vehicle and decrease its environmental impact.

From this project, we were able to brainstorm many different ways to prioritize safety, enhance connectivity, and minimize environmental impact, which often required somewhat small changes to pre-existing technology. There were already docking systems available in
the market, just none that offered the combination of connectivity and ensured safety that
the Phone Cave does; therefore, with a simple change of making the docking system
mandatory to drivers with phones and improving the connectivity, the Phone Cave was
much more effective in its mission than its competitors. Hence, while creating a whole new
technology or device to enhance one of the goals is one way to solve the problem, it is often
easier, quicker, and more effective to take pre-existing technology and use it to help
develop and build on ideas.

Our device makes the world a much safer place by limiting distracted driving. Should our
device go through more research and development, it would be tested in vehicles to work
out any problems with the connectivity. Also, customers would be surveyed to see how they
like each of the concepts and how they can be improved to allow for the best product
possible. The Phone Cave is an important step to ensure that texting and driving is no
longer done in society today, as it is the cause of many accidents that could be prevented
without distracted driving.
Appendices

Pictured below are the solid works prototype along with the planned and desired placement of the docking station within the center console. We chose to place the system in the center console to avoid distracting the driver while remaining in a convenient and appropriate location.

The planned inclusion of a system able to detect any signal from a cell phone within the range of the driver’s seat is necessary in successfully implementing this docking station. Below are the ranged sensors that will continually alarm if a cell phone is detected within range without a cell phone in the docking station.