Safe
Connected
Green
Ultimate goal is to help make zero fatalities, zero injuries, and zero accidents a reality
Passionate about creating a world with zero emissions
Technology to allow seamless connectivity in the vehicle – it’s what consumers want, and we can make it a reality
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SECTION 1 EXECUTIVE SUMMARY

Every year there are lots of car accidents caused by fatigue, distraction and poor weather condition. Our design of the product is a type of autonomous car. We aim to make the car safer and more connected that let human and car work together very well to reduce the fatalities, injuries and accidents in real life. Generally, for a single car, there are radars sensors and cameras on both sides and top of the car to accurately detect the conditions on the road and send the data to the computer on the board of the car. The compute will give the most available way by adjusting the positioning and speed of car automatically to ensure the driver a safe ride and avoid accidents. Autonomous cars would make the travel more accessible to people with disabilities and elder.
SECTION 2 INTRODUCTION

2.1 PROJECT OBJECTIVES. Identify technologies and opportunities to make cars and trucks safer, greener, and more connected.

2.2 PROJECT BACKGROUND. There are up to 50 computers buried beneath the skin of the cars and trucks that you see every day on the road. You wouldn’t know they were there. But each of them is making that vehicle safer, greener, and more connected. Many of those computers were designed and built by Delphi.

It seems every day we’re hearing in the news about “cars of the future”, ones that will park themselves, drive themselves, talk to us, use fuel more efficiently, report data to insurance companies, avoid accidents, etc. What does this mean in terms of the technologies needed, societal acceptance, and the policies and supporting systems needed to enable these safer, greener, more connected cars and trucks?

2.3 SPONSOR BACKGROUND. Delphi Automotive is a global automotive components design and manufacturing company— it is one of the world’s largest automotive parts manufacturers and provides electrical and electronic, powertrain, safety, and thermal technology solutions to the global automotive and commercial vehicle markets. Delphi operates 126 manufacturing facilities and 15 technical centers across 32 countries, utilizing a regional service model that enables it to serve its global customers. It has approximately 161,000 employees worldwide, with around 5,000+ located in the United States. Delphi operates through four segments: Delphi delivers innovation for the real world with technologies that make cars and trucks safer, more environmentally friendly, smarter, better connected, and more affordable than ever before.

Electrical / Electronic Architecture
Today’s vehicles have to be about more than transportation. They have to entertain, inform, connect, and protect their passengers. The competitive landscape is all about features and functionality. Delphi’s goal is to help auto manufacturers incorporate in-demand features without substantially adding to a vehicle’s mass or cost. And it’s not easy. But they have the electrical integration experience, the systems capabilities, and the technologies to deliver unique electrical/electronic architectures for unique needs. Major products: Wiring harnesses, electrical centers, vehicle and cell phone wireless charging, data communication cabling, hybrid vehicle charging systems.

Powertrain Systems
Delphi’s advanced engine management systems are making an important contribution to a cleaner tomorrow by minimizing the environmental footprint of vehicles. The manufacturers of
motorcycles, lawn and garden equipment, recreational products, power generators, marine engines, and other small engine products also rely on their systems-level knowledge and analysis resources. They have extensive knowledge and experience in fuel injection, electronic controls, sensors, air and fuel management, ignition systems, valve train, fuel handling, and evaporative emissions canisters. And they have a global network of 3 engineering and manufacturing resources to respond quickly and efficiently with localized program support.


Electronics and Safety
Delphi is working to build safer driving experiences that have more information, entertainment and connectivity. Their safety expertise encompasses everything from crash sensing electronics to collision mitigation. And with their radar, vision, and vehicle integration expertise, they’re enabling innovative active safety systems that help make high-performance safety features affordable in the mainstream vehicle market. These systems are designed to support their vision of a society with zero fatalities, zero injuries, and zero accidents.

Major products: Engine Control Module, Advanced reception systems, Navigation, displays, adaptive cruise control, radar and camera systems, parking guidance systems

Thermal Systems
Delphi meets its customers’ heating and cooling needs across a wide range of industries, with products that provide world-class comfort. In fact, they’ve been managing air, liquids, and temperature longer than any other automotive supplier in the world. They’ve virtually perfected the science, and were first to integrate electronics, sensors, and special algorithms into climate control systems to make them smarter, faster and better than ever before. This special Delphi technology creates a precise orchestration of vehicle air temperature that can be as sensitive as one-tenth of one degree. At Delphi, they call it thermal management intelligence.

Major products: Compressors, HVAC systems, powertrain cooling modules

2.4 PROJECT CATEGORIES.
Safe: Our ultimate goal is to help make zero fatalities, zero injuries, and zero accidents a Reality Protecting the driver and passenger is of utmost importance. Airbags are an example of a reactive safety feature after a crash occurs. Safety features now being designed into cars are more proactive to avoid the crash all together. Sensors are used to detect dangerous situations, and can alert the driver or even take over control of the car to avoid the situation. The use of smart phones while driving is also a major safety concern.

Green: We’re passionate about creating a world with zero emissions
Protecting the environment is also very important to the vehicles of the future. Hybrid and electric vehicles are becoming more popular as an alternative to traditional cars. There are also other alternative fuels being explored. However, by simply reducing the weight of a vehicle or having products that make engines run smarter or more efficient can dramatically improve fuel economy.

Connected: We have the technology to allow seamless connectivity in the vehicle—it’s what consumers want, and we can make it a reality.

The vehicle of the future should be optimally connected to maximize the driver’s and passengers’ experience while minimizing the driver’s distraction. Connecting the vehicle itself and all its sensors to the outside world should not be overlooked. The vehicle of the future will have 100s of sensors collecting data which may be very beneficial to others. For example, if a car is doing 5-mpg on a 65-mpg interstate, an algorithm would determine a traffic jam was present and alert other approaching vehicles of the situation. The brakes could be applied for very close vehicles, or navigation systems could re-route approaching vehicles to avoid the congestion.

Project entries in one (or more) of these three categories should first include background research into current technologies being deployed today. The project team may then choose to modify an existing feature/function or create a new technology for enhancing the vehicle of the future. The scope of the project should include a systems diagram, an example of the user experience (i.e., a Concept of Operations), as well as the approximate cost of this new feature.

Your work will involve the following

1. Identify a category and opportunity that will make cars safer, greener, and/or more connected
2. Examine your opportunity as a system and examine all inputs and outputs.
   a. Create a systems diagram
   b. Create a Concept of Operations for your opportunity
   c. Consider a life cycle analysis for the device your propose
3. Examine important aspects of your system for feasibility and adoption, such as cultural, security issues, privacy issues, etc.
4. Show how the user will interact with your system, if they are expected to do so, i.e., is there a device, and app, etc.?
5. Ensure that the solution is economically viable, i.e., will people pay for it?

2.5 PROBLEM STATEMENT. Our proposed device will solve problems including accidents, drivers being unaware, minimizing blind spots, and autonomous vehicles. The sensors and cameras on each side of the car will allow the driver to know their surroundings accurately and
quickly. With the use of radar technology, the car and driver will be completely aware of their surroundings and how quickly objects are approaching. For the autonomous car, we will be able to protect fatigued and even non-sober divers. With the sensors sending information to data computers, which is then interpreted by a main processing system, the car will be able to react to its surroundings. Our Delphi project category is an integration of connected and safe. By utilizing both of these categories, we will be able to minimize accidents on the road and maximize driver safety. We propose to do this through sensor fusion. Using cameras and radar to gather data on the surroundings of the car; a main processing system will interpret and compile the data to then be used by the car and operator.
SECTION 3 METHODOLOGY

3.1 PROPOSED DEVICE. Our proposed device is a sensor fusion system with cameras and radars for an autonomous system. Current sensor fusion systems use a variety of sensor data with camera and LIDAR being the most popular. The LIDAR sensor would typically be placed on top of the car – it can accurately measure distances up to 100 meters and does not obstruct the driver’s view. The lasers bounce off of surrounding objects, such as other cars, and then the time is recorded in order to map out the surrounding objects. It can take up to 1.3 million readings per second. Although, we decided not to use this device because it is very costly at $7,000. Therefore, we decided to use side cameras – two on the right and left side of the car and one in the rear and front of the car – to get sufficient results at a much cheaper cost. The two cameras on the sides of the car will overlap at 50 degree angle of view which would allow the car to have similar perception to our own sight. This design will accurately read distances up to 30 meters from the car. The radars on the front and rear of the car will detect the speeds of the cars in front and in back of your car, continuously mapping an occupation grid. Once the cameras and radars gather data, it is then sent to a data representation algorithm that fuses this data into an occupancy grid which can mark potential threats and determine the best alternative route.

3.2 RATIONALE FOR SELECTION. This device will hopefully solve the problem of fender benders, but it can also help police determine which driver is at fault if there were to be an accident since the car’s computer system would have data on the surroundings. In 2012, there were an estimated 9,754,000 accidents according to nhtsa.gov. Many accidents are caused by outside distractions or fatigue. By integrating a sensor fusion system into modern cars, the car will be given a chance to react should the driver not realize a potential danger. This sensor fusion system can be used to develop autonomous cars, or be used as a way to alert a driver that a course of action needs to be taken. The ultimate goal of our device is to make driving safer and more accessible as well as reducing the accident rate.

3.3 CUSTOMER NEEDS. Our system must be inexpensive and provide a detailed map of the surrounding so that the customer can have a way to determine what course of action to take. If the customer wishes to use our product for an automated system the occupancy grid must be able to provide sufficient data for the software to determine an appropriate response. However, if the sensors are used for an alert system instead, the occupancy grid must be able to provide accurate data quickly so that the driver can be alerted.

3.4 OBJECTIVES AND GOALS. In 2012, there were 33,561 fatalities due to car accidents – that’s approximately 92 deaths per day. Our goal is to reduce this number significantly by employing autonomous cars. Google’s car reads up to 16GB per second which is high, so we ...
would like to reduce this number. By deciding to avoid the use of a LIDAR system we can reduce both the amount of gathered data and the overall cost of the car. Autonomous cars would make travel more accessible to people with disabilities and the elderly.

3.5 CONCEPT OF OPERATION The sensor fusion system that we have developed will undergo multiple tasks. The first task is to read the surrounding. Once the cameras and radar gather data from the surrounding, computers read this data and create an occupation grid which is essentially a map of the surroundings. The car will typically have 6 sensors/camera surrounding the car – two on either side and one in the front and rear of your car along with a radar system on the front and rear. The radar aspect of the system can sense movement around your car as well as the hardness of objects. The cameras sense more features of the objects around you, such as color. By combining the data observed by both systems the car can determine if an object is a potential threat or something like a piece of cardboard that can simply be driven over.

3.6 SYSTEM CONTROLS. There will be a main system that interprets and fuses the data into an occupancy grid, from this the car can determine what the necessary actions are that need to be taken. Once the occupancy grid has been mapped, the car can alert the driver of potential threats, and suggest possible courses of action; or the car can perform the necessary action to avoid collisions.

3.7 SYSTEM MODEL. The blue triangles represent the field of view of the cameras we incorporated into our car, while the green triangles show the radars. The radars are narrower and longer because they can read up to about 70 meters while the cameras can only read 30 meters accurately.
3.8 **DAY-IN-THE-LIFE.** Say you are driving on a highway behind a truck that has a load in its bed. Suddenly you feel your phone vibrate and as you look at your phone, an object falls from the poorly secured load on the truck. The autonomous driving function is not turned on so the driver is still in control. Being on your phone you don’t realize an object has fallen, however the cars radars and cameras immediately picked up on this object directly in front of you. The radars determine that it is a hard stationary object that must be avoided. From this description the car alerts you of the object, the car uses its occupancy grid to determine that the safest route is to merge into the right lane. Because you were distracted you may not have noticed the object in time to react had the car not sensed it and given you a safe alternate route.

3.9 **LIFE CYCLE ASSESSMENT (LCA).** The radars and cameras will be steel cased for protection and because of this we will be using natural resources. However the radars are less than 10 cm by 10 cm. Because of the small size there is a minimal environmental factor. The radars and cameras that we use are shock absorbing and were design for automotive use. Because of this we recommended that each sensor be tuned up every two years for the first 6 years. After this point we recommend a yearly checkup as long as the car is in use. Should there be a failure the car owner can choose to ship us the part back while receiving a 10% discount on the repair. Should the repair be user caused (i.e. damaged in an accident) the repair will be covered mostly by insurance, but if the sensors fails naturally the repair will be done for free. Therefore, most of the environmental factors will be caused by the transportation of the parts since we can ship all small parts in bulk.

3.10 **ECONOMIC ASSESSMENT.**

<table>
<thead>
<tr>
<th>Project Definition</th>
<th>End Usage</th>
<th>Methodology</th>
<th>Expected accuracy range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>Concept Screening</td>
<td>Judgment, Analogy</td>
<td>L: -20% to 50% H: +305 to +100%</td>
</tr>
</tbody>
</table>

The demands of this device will increase as we develop contracts with bigger companies, due to this we estimate a low start in production that will raise as our product becomes more recognized in the market. Our preparation estimate is roughly $250 for each camera and $100 for each radar, the total cost for the sensors would be $1700 along with another $300 for the computer and data recognition. The total cost of production is $2000 with an intended market value of $3000.

3.11 **PRODUCT DEVELOPMENT AND MARKETING.** The first objective that we would do is to develop a car that employs our sensor fusion system. After this is done we would test the car on the roads in a state such as Michigan where testing of autonomous vehicles is allowed. Our main goal is not to sell to the public but to develop contracts with large automotive production companies such as Ford and GM. In order to launch our product we would initially start with government and university contracts and expand out once our name is established. Our main location would be near Detroit, Michigan due to the high volume of automotive developers. However, we would not invest in internet or commercial advertising, instead we would rely on
proposals and Beta Testing. Typically we would offer our product for $3,000 per unit with discounts for large purchases, the volume solely depends on the contracts that we are offered.
Our design will change the world of cars completely. The autonomous car will keep drivers and passengers of cars safe, leading to a decrease in accidents per year as well as a decrease in deaths due to car accidents. Since many people drive fatigued and distracted, the autonomous car will hopefully eliminate that issue since it will take over control and/or alert the driver of the unsafe driving that may be occurring. Aside from the safety features, the GPS system is a nice bonus for car owners because the car will recognize where and when to turn rather than having the driver try to read all of the passing road signs as well as trying to quickly switch lanes, for example, when trying to get on an exit ramp.

As with any technology, there is a chance it can malfunction. We are hoping to avoid that, but in the case that something goes wrong, we have included safety switches to manually turn off the autonomous features of the car. If something were to happen, we hope that the driver will recognize the car is acting improperly or unusually and will then take control and then take the car in for maintenance. As humans usually have a better understanding of how to process their surroundings, the autonomous car will be able to gather more information and evaluate it more quickly and more in depth than the human mind. Ultimately, the processing of information and the reaction of the autonomous car compared to a human is quite equivalent, making our team believe that our design’s chance of failure or malfunction is less likely than a human becoming distracted and or fatigued. A car always has a chance to malfunction, but with the advancement of technology, our new design will easily outweigh the traditional car.

The implementation of a new feature to a car always leads to an increase in price, though we do not believe our design will increase the price of cars that significantly. The fact that cars can interface with each other will ultimately create much safer roads for everyone. Many people are against the rapid advancement of technology around the world, but people will soon be able to appreciate new design when it could possibly save their lives. The chances of falling asleep while driving, the distractions present, and the improper evaluations of road conditions that currently exists, leading to accidents, can simply be eliminated with the implementation of our autonomous car design.

The introduction of this new design will not be too difficult to be adopted by automakers around the world. There are currently cars that detect lane departure and other things such as when a car in front of yours stops abruptly, so there will only need to be an advancement in the technology rather that the complete creation of new technology. Automakers will need to upgrade their cameras and/or sensors to accommodate this new design. They will also need to better incorporate the GPS system into the car in order for the car to take directions from the GPS. The adoption of this new autonomous car technology should be quite easy for automakers to accomplish.

"CURRENT PROJECT." SEDTAPP. The Pennsylvania State University, Web. 06 Dec. 2014.


