The Interactive Driver
Delphi

(TEAM 5)
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Introduction to Engineering Design
Section 022
Instructor: Sarah Ritter
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Executive summary:

Every year over ten thousand people die from drunk driving [2]. When choosing which megatrend our team wanted to improve, this statistic played a major role in influencing our final decision. We wanted to improve the overall safety of motor vehicles through the enhancement of connectedness and the preservation of eco-friendliness.

After finding a motivation for the project, we found that the best way to meet these goals was through a cell phone application. We observed that most people either have a smartphone or have access to a smartphone. This would make implementation of our design into society much easier. Using the GPS capabilities of phones we want to increase safety and connectedness through car to car alerts, traffic updates, and road obstruction notifications.

Introduction and Problem Statement:

We would like to alert drivers and produce a vehicle that helps to minimize human distractions, therefore reducing 60% of accidents and improving road safety. Today, we live in a world where 23% of all crashes result each year are a result of using a cell phone while driving [1]. These drivers are constantly distracted by factors outside and inside the vehicle. Some of these distractions include surrounding hazards and technology within a vehicle that requires the driver to look away from the road. Also, some people drive under the influence and are a danger to other drivers, pedestrians, and themselves. We would like to design a mechanism that will avoid potential accident through the applied use of GPS and wideband communication. This way we can communicate speed among two different drivers, road obstructions, traffic alerts, insurance information after a crash, custom messages, and dangerous driving between cars.

Background:

When initially researching potential topics for our design our team found five different topics very interesting. These topics helped to spark our interest in the safety and connectedness aspects of this project. These areas included digital receivers, connected vehicles, navigation, safety electronics, and driver state alert systems. We took a closer look into the existing driver state alert systems. These systems would notify the public of different offenses. We wanted to incorporate this technology into a drunk driving alert system. We found that most of the existing patents did not do this. The patents utilized different technologies to notify the driver when they were not performing safe driving techniques [3]. Because our group was so interested in safety we researched safety electronics. We were interested in designing an electronic system that would sense problems or damages with the vehicle. When looking into existing technologies we found that a lot of this technology is already patented and being developed [4]. Finally we further researched current navigation technologies. We wanted to find a way to reduce potential accidents by monitoring cars driving behavior through GPS. We noticed that there are similar
technologies that exist but that no single technology accomplishes what we want the GPS system to do. We were interested in utilizing the GPS on cellular devices. This strayed from the usual GPS collision avoidance systems [5]. After gathering all this information on different safety and connected technologies we knew that was the path we wanted our design to take. We wanted to incorporate navigation technologies and possibly state alert systems to help ensure safe driving experiences on the road.

**Customer Needs:**

**Table 1.** The data below shows the specific customer needs for our product and how well it satisfies them.

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Simplicity</th>
<th>Functional</th>
<th>Accuracy</th>
<th>Easy to Install</th>
<th>Safe</th>
<th>Efficient</th>
<th>TOTAL</th>
<th>WEIGHT</th>
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<td>0.5</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.5</td>
<td>3.25</td>
<td>0.047</td>
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<td>1</td>
<td>0.2</td>
<td>0.5</td>
<td>2</td>
<td>0.5</td>
<td>1</td>
<td>7.2</td>
<td>0.11</td>
</tr>
<tr>
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<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>14</td>
<td>0.20</td>
</tr>
<tr>
<td>Easy to Install</td>
<td>4</td>
<td>0.5</td>
<td>0.33</td>
<td>0.33</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>7.166</td>
<td>0.10</td>
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<tr>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>13.5</td>
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</tr>
<tr>
<td>Efficient</td>
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<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>2</td>
<td>0.33</td>
<td>1</td>
<td>7.33</td>
<td>0.11</td>
</tr>
</tbody>
</table>

As a group, we concluded that it was necessary for our design to be inexpensive, simple, functional, accurate, easy to install, safe, and efficient. The highest ranking criteria include functional, accurate, and safe. The product must be functional, otherwise it will be ineffective and customers will not want to use it. Accuracy is crucial for the functioning of the product. The more accurate it is, the more effective and useful it is. Also, it is important for the product to be safe for the customer for obvious reasons. We want to help our customer become aware of potential dangers around them, rather than create dangers for them.

**Concept Generation:**

When making a decision as to where we wanted to take our design the classification tree played a major part in the organization of our ideas. When we proceeded to create our design tree we knew what our end goal was. We wanted a product that would function in the form of a smartphone application and help to improve the overall safety and connectedness within cars. We also knew we wanted this to happen through the use of data collection, a user interface, and connection to other cars. By adding this to the tree we were able to better organize and analyze where we could go next with our idea. Within the data collection portion of our model we were
able to decide upon three different categories. One being an emergency call button, another being GPS location, and another being the current time. When brainstorming how the user interface would function we wanted to create an easy to use and easy to implement phone application. This user interface would also function using internet access, or cell phones data connection. Finally when considering this designs ability to connect to other cars we expanded on four different ideas. The first being a car to car communication system. This would allow cars to convey information to one another through our application. Our next connection idea would be a blue tooth system to promote our car to car connection idea. (This idea was later rejected because of bluetooth’s short connection distance.) This lead to our third proposal which was the use of internet connection for its longer range. Our final branch of this tree was a SMS messaging idea. (This idea was also later rejected for its inefficient ability to convey live information to the consumers.)
Concept Selection:
Table 2. The data below displays the scoring matrix for the design selection.

<table>
<thead>
<tr>
<th></th>
<th>Functional (0.23)</th>
<th>Accuracy (0.20)</th>
<th>Safe (0.20)</th>
<th>Cost Effective (0.047)</th>
<th>Easy to Install (0.10)</th>
<th>Simple to Use (0.11)</th>
<th>Score</th>
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<td>0.4</td>
<td>0.4</td>
<td>0.188</td>
<td>0.5</td>
<td>0.55</td>
<td>3.188</td>
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<tr>
<td>Surround Sensors</td>
<td>1.15</td>
<td>0.6</td>
<td>0.4</td>
<td>0.188</td>
<td>0.4</td>
<td>0.55</td>
<td>3.288</td>
</tr>
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<td>Interactive Driver</td>
<td>1.15</td>
<td>0.8</td>
<td>0.6</td>
<td>0.188</td>
<td>0.2</td>
<td>0.44</td>
<td>3.378</td>
</tr>
</tbody>
</table>

The three designs included the Black Box, Surround Sensors, and the Interactive Driver. The Interactive Driver scored the highest on our scale, and the Black Box scored the lowest. The black box is intended to send car and driver information to authorities in the case of an accident or emergency. It would also send location coordinates. The main idea behind this is to prevent hit-and-run accidents. The Surround Sensors design is supposed to alert the driver of objects in his or her blind spots in order to prevent accidents. The Interactive Driver is the design we chose. Its function is to alert drivers of potential dangers with time to react and avoid the dangers. It does this by monitoring traffic patterns and updating the information to the application for users when any irregularities occur consistently.

Final Design Discussion:

Our final design, the Interactive Driver, is a cell phone application. We found that this was the best design because it could help fix a widespread, serious issue: accidents caused by drinking and driving. In order to make a driver’s experience safer, this application alerts the driver of upcoming dangers, such as drunk drivers, reckless drivers, vehicles out of control, potholes, broken road, or other obstructions. By monitoring traffic patterns along the road with GPS location, the application sends its recordings to a database. If there are any consecutive irregularities in the flow of traffic, the application will send out an alert to any drivers in the vicinity. Therefore, drivers near the possible danger will be aware and have time to watch out for what is ahead. Overall, the driver can avoid getting into an accident. While using the phone application, the user can view locations where frequent accidents occur, observe traffic patterns, and report emergencies. The Interactive Driver scored highest in all categories except for “easy to install” and “simple to use.” This is because creating the application would not be easy, but once it is created it would be easy for users to download onto their phones. As far as simplicity goes, the application may be confusing at first for people who did not grow up using cell phones. However, once the application is set up, it is very independent and does most of the work by itself.
**Systems Diagram:**

This system diagram shows how we wanted the application to function. We wanted the system to take in and process three main components. These components include GPS coordinates, driver discrepancies, and observed emergencies. Using the data collected from these three components it would feed the driver live updates. These updates would consist of information including traffic patterns, incident reports, and live car to car communication. It would be able to, in real time, deliver updates to the driver concerning surrounding vehicles and application users. This system diagram was an effective way to analyze exactly what we wanted to see within our application system.

**Prototype of Application:**

**Home page:**

This is our homepage of our system application. We wanted it to be simple and effective. Within this homepage there are two options. The first being start and the second being settings. From here if you already have your settings worked out for the most effective use of this application you would proceed to hit start to dive into the provided features within this application. If you have yet to adjust your settings that will be your first step when using this system.

**Settings:**

Within the settings this is where the user would ensure the most safe and effective use of this application. Here there are options such as Bluetooth, Location Services, Notifications, and Voice Communication. This would allow the user to use this system safely and hands free. Enabling the Bluetooth setting would allow for the application to run through the car’s stereos without the need
for the driver to use their hands. Enabling the Location Services allows for the application to track the driver’s behaviors and alert others of inconsistencies. Enabling the Notifications would allow the driver to receive real time updates of potential hazards. And finally enabling Voice Communication allows the driver to hear the live updates the app provides without having to read the notifications directly off of the device.

Menu:

Once the user has adjusted all the necessary settings they will proceed to the menu page to look at the available features within the system. These features include traffic patterns, common incident locations, an emergency report option, and finally the drive option. The first three features are to be used when stationary or not driving. These features are for looking over before a trip or after. They are not to be used while operating a vehicle. When the driver is ready to start their trip and wants to utilize the live updates they can start the drive feature.

Traffic Patterns:

This is the traffic patterns feature of the application. This is for the user to view prior to or after their trip. They can observe different traffic patterns within a 50 mile radius to them. The app provides this information through the data collection of other Interactive Drive application users in the area. When the application observes many other users moving abnormally slow in an area it registers this information as a traffic jam or slow moving traffic and relays this information to other system users.

Incident Locations:

The incident locations feature of this application allows the user to view areas around their current location where accidents frequently take place. They will be able to see not only where these accidents occur but how frequent and how severe the incidents happen to be. The application will do this through the data collection of accidents that other system user either observed or suffered themselves. This data would be stored and sent to users as they request to view it.
**Accident Report:**

The accident reporting feature of this application allows users to call 911 and alert the authorities of an accident or other emergency. This will be able to be done manually just like any other phone or through voice commands. When the driver is in the “drive” feature of this application they will be able to hands free alert authorities of an accident they may have witnessed while driving. This reported information will be used to collect a database in the incident locations tab.

**Concept of Operations (Scenarios):**

In this image a distracted and reckless driver (Car A) is approaching another car (Car B). The Interactive Driver app records the movements of Car A using GPS coordinates and time of day information. If Car A deviates from the common path taken by most cars on that road too many times, the app sends an alert via internet on the phone to the server. The server then identifies app users within a 5 mile radius of Car A and send them a warning about an upcoming reckless driver. In this case Car B is receiving the warning.

In this image Car B represents multiple cars and the different paths represent the paths taken to avoid the pothole. Most cars will swerve or move to avoid a pothole and these sharp movements are recorded by the app and immediately sent to the server via internet. The server then correlates the data with data sent from other cars that passed through those GPS coordinates. If the server has data from multiple cars in that same area it means that multiple cars have swerved to avoid some road obstruction there. The coordinates from where the information was relayed to the server can be used by other cars to identify approximately where the obstruction is.
In this image a car is coming up on a turn. This car is also receiving an update on their Interactive driver app telling them that they are approaching a frequent accident zone. These zones are determined using the call button on the app. Whenever that button is used the location is recorded and sent to the server. Once the button is pressed by enough people in one area, the area is labelled a frequent accident zone. The information about frequent accident zones in a 50 mile radius are downloaded by the app, using WiFi, before the car begins driving. If a driver leaves this radius the information updates.

This image shows a car (Car A) at an intersection with another car (Car B) approaching. Car A can use the Interactive Driver app to see how fast Car B is approaching and whether Car B is decelerating to allow Car A to turn. When Car A approaches the intersection the app searches for other app users in the vicinity. If it finds one (Car B in this case) approaching the intersection it downloads GPS coordinates and the time and uses this information to determine how fast the car is going and whether it is decelerating or accelerating. It then updates the user in Car A by speaking.

**Cost and Feasibility Analysis:**

Overall, the cost for the development of the app is projected to be approximately $108,000, as compared to the price of other applications with similar features. This is a one-time cost that will be surely worth the benefits of safety and connectedness. Also, this cost eventually will eventually be recovered by Delphi because the app will be sold to smartphone providers and cell phone companies. The app will need to be sold in order to ease its implementation into the market. It will be a pre-installed app and no cost would be assumed by consumers to ensure accessibility to more than 95% of drivers. Because the app would be pre-installed, it would help raise awareness about the app and therefore encourage people to use it. Ongoing costs associated with maintenance of app would depend on the size of the servers used to store data on the application and how many people use the app on a daily basis. For a large server, it would cost roughly $6,000, which is a relatively inexpensive after the app’s developmental costs have been
covered. Because the app is free, advertisements also could easily cover this cost and even become a source of profit for Delphi and the cell phone providers. Although the app would be an option and not obligated by law, it would be easy to implement into the market. Today, we live in a world where smartphones are more accessible than they have ever been, therefore chances are that an individual who can afford a car, owns a smartphone. This means that the app would be easily obtainable and therefore a feasible option to combat obstacles that affect driver safety. In terms of privacy, the app would protect its users by making all data anonymous and not connected to a specific individual. Users do not have to make an account to use the app, and would only send personal data when chosen to, such as choosing to call authorities to report an accident. However, individuals may feel that although the app does not link individuals by name to a car, it can be capable of sending the whereabouts of all individuals at all times to government. This should not be such a huge concern because the government is most likely capable of doing this without the added use of the app. The government could regulate the app if necessary by adding or deleted features that it feels everyone should have. For example, the government could regulate the app by requiring it to add a feature that improves road safety by requiring the app to notify authorities where a possible drunk driver is located, therefore disincentivizing drunk driving.

**Life Cycle Analysis:**

In terms of the application’s life cycle assessment on the life of any aspects of the car, it holds an advantage over ideas because it does not bear any impact. This is because the app operates independently of the car and does not affect any of the existing components related to the car. It also means that this option is advantageous over other possible ideas because it is able to improve the megatrend of safety and connectedness, while conserving the megatrend of environmental friendly. If anything the application would improve the life cycle of a car because less accidents would occur on the road, and potholes would be avoided. Therefore the cost for yearly car maintenance would drop. The application improves driver awareness of the road around them, therefore making the road more safe. In terms of the application itself, its life cycle depends on the life cycle of a typical smartphone which is roughly around 2 years. However, the actual life of a smartphone is much longer, although upgrades of technology could make a device obsolete. This 2 year “life cycle” is a result of many people upgrading their smartphones to a more updated one every 2 years. Because of this, this makes the application potential significant. Constantly, new upgrades and features can be made to the app to improve its connectedness and performance. Overall, with the idea of this application, improvements will be made to the car without sacrificing any aspects of the car.
Conclusions:

After being introduced to this Delphi design project our group had to consider problems with society that we may not have considered before. We had to look deeply into the three megatrends, safety, connectedness, and eco-friendliness. This forced us to analyze and critique current methods within these megatrends and see if there is room for innovation or improvements to already existing technologies. After researching and collecting background information related to these three megatrends we felt that safety was the most important trend to us. We wanted to further look for a way we could improve this field and increase the overall safety in motor vehicles within society.

In the beginning of our design process and brainstorming we found that we were coming across many ideas that involved connectedness as well. We found that in order to improve safeness in motor vehicles we could increase connectedness between them. With this came the idea for the phone application, Interactive driver, where we used connectedness between vehicles and data collection to improve safety. We modeled an application that would use the GPS on cellular devices to track the behaviors and patterns of drivers. With this we would be able to gather information about traffic patterns, reckless driving, road obstructions, accident frequency and accident location. With this information being given to the driver almost instantly it would greatly impact the safety within motor vehicles. They would be alerted of things like potential reckless driving, potholes, heavy traffic, and frequent accident locations to avoid.

With any idea comes pros and cons. With the Interactive Driver application there were many pros. We could see how this collection of data would positively impact the safety of society and increase the connectedness between different motor vehicles. But we could also see some downfalls or cons to this design idea. For this idea to be completely successful and work at its most efficient potential it would need to be adopted by a large number of people. In order for the information that is being delivered to the drivers to be highly accurate a large number of people must be using this application. Also it may be difficult to implement into society. People might have a problem knowing they are being “tracked”. This system would run through the GPS location services on their cellular device. This could cause some paranoia among users and in turn result in the idea being rejected by many.

Even with these cons our design group still believes that the pros definitely outway the cons. Every year pothole damage on motor vehicles costs drivers 6.4 billion dollars in damage expenses [6]. With the implementation of this application this number would drastically fall. Humans do not drive efficiently. We get caught in traffic almost daily. While sitting in traffic your car is guzzling and wasting gas. Annually americans waste about 1.9 billion dollars in gas sitting in traffic congested roads [7]. With the use of the live traffic updates our application would provide this would again drastically bring down those wasted dollars. But the most important feature our system has to offer is its hazard updates. Our application would update drivers on potential road and driver hazards. This is to help keep the roads safe. Every year
around 40,000 people are killed in automobile accidents. With the use of our application this number could drastically be lowered and lives could be saved [8].

With all these ideas being considered we can see this application, or something similar, being adopted in the near future. We believe that the best way this design could be implemented is if it is a pre-installed application on smartphones. If users see it is already on their phones, and are aware of the positive features, then it will be used. For this application to function properly many people need be utilizing the system. We think that the best way for that to happen is for the system to already be installed within the user’s phones.

Our design team was able to take away a lot from this Delphi design project. But one of the main lessons our team learned was the ability to use existing technology to solve or combat issues. In this case we were attempting to improve the overall safety and connectedness within motor vehicles. In order to do so we designed ideas that used already existing technology and applied it in our own unique way. This showed us that through the application of different technologies we are able to improve upon global issues and further innovate existing technologies.

References: