

Heart Rate Sensing Steering Wheel

DELPHI



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Engineering Design 100 Section 010 Team 3

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http://www.personal.psu.edu/naq5009/edsgn100_fa14_section10_team3_dp2.pdf



Submitted To: [Dr. Xinli Wu](#)

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Abstract

The partnership project for 2014 with Delphi was one that tasked the EDesign classes with creating a system that makes cars either safer, greener, or more connective. The following report documents the efforts of Team Three to create a Heartbeat sensing steering wheel that would make cars both safer and more connective.

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1. Introduction

After completing the first design project, of creating a model dumpling maker, Team Three was tasked with creating a device that makes cars more safe, green and connective. The design process that was used for the first project was tweaked and altered slightly, but for the most part remained the same for this design project. This project was given with the incentive that the team with the best design would have the opportunity to invent in front of some of the professionals that actually work in the automotive industry. While it was a collaborative effort, the individuals involved had their knowledge of design tested, and extensive research had to be done in order to be able to argue in front of a group of people.

2. Description of design task

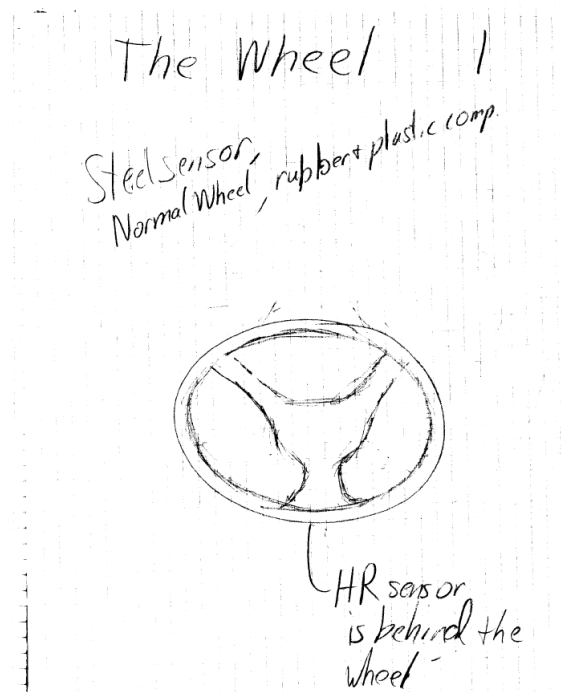
- a. Problem Statement: The problem was that accidents are frequently caused by drivers falling asleep or unconscious at the wheel, and it can be difficult to show this in post-accident insurance claims.
- b. Mission statement: The mission was to improve the safety and data recording system of a car to mitigate crashes with the intentions to provide pertinent information for after-incident vehicle collisions.
- c. Design Specifications: The area of focus selected for this design project was safe. The established goal for safety was to reach zero fatalities. While this is not realistic, setting a high goal ensures continued progress, because cars can never be too safe. Safety can be achieved through increasing the ability of the vehicle to withstand a crash or through reducing driver workload and distractions. This product should reduce crashes to due to unconsciousness and lower the response time of emergency services, decreasing the fatalities of crashes.

3. Design process/approach – design matrix

a. Table. 1

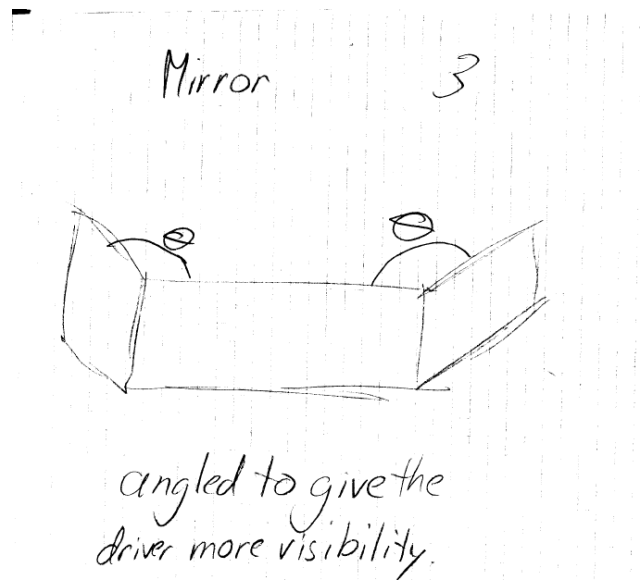
Description of concepts and their evaluation.

1. The first concept that we considered was a modified steering wheel. This steering wheel would have an integrated heart-rate sensor. The heart rate sensor would serve a double purpose. It would both be able to connect to a phone app to provide the user with health related data, as well as serve as a way for the car to detect if the driver was undergoing a serious health issue while driving. (FIG.1)

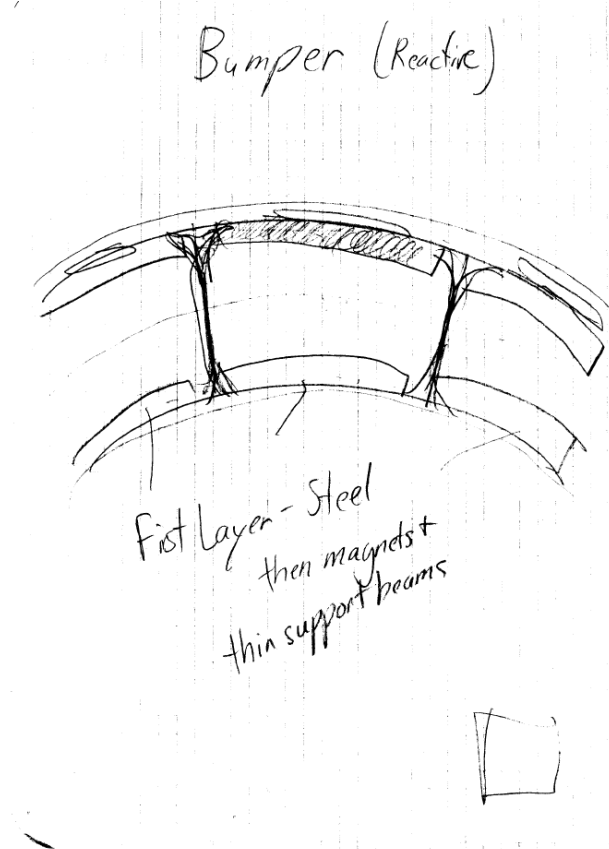


2. The second idea that we had was a set of sensors placed on the outer edge of the car. These would act as pressure sensors to gather information for accident claims. A sensor like this would be able to record whether a car was in motion during a collision and the exact direction from which it was hit. (FIG. 2)

3. The next concept that we had was a slight change to the rear view mirror. We would add two partitions to each side of the mirror that would increase the driver's visibility on both sides and hopefully eliminate the blind spot of the driver. (FIG. 3)



4. The final idea that we considered was a special bumper that would reduce the impact that a passenger would experience in the event of a crash. (FIG. 4)
- b. Concept Selection Matrix



(Table 2)

Table 2 shows the Concept Selection Matrix that Team Three used to narrow their initial

Design Matrix				
	Wheel	Mirror	Bumper	Pressure Sensors
Efficiency	3	3	2	4
Effectiveness	4	3	3	3
Concern for Safety	4	2	4	1
Cost efficiency	3	4	1	3
Feasibility	3	4	2	3
Marketability	4	2	4	1
Reliability	2	4	3	3
Total Score	23	22	19	18
Continue?	Yes	No	No	No

idea down to the one that they ended up pursuing.

c. Description of Idea Selected

For this project, there were three possible areas of focus: safe, green, or connected. Safe was the final choice because while green and connected are important, they are luxury rather than critical. In brainstorming, multiple ideas were discussed including an adjusted mirror to eliminate blind spots, sensors in the bumper for claims purposes, a reactive bumper, and a heart rate monitoring steering wheel. After analyzing the ideas based on cost, effectiveness, reliability, and feasibility, it was clear that the heart rate sensing steering wheel was the best idea to develop further. An additional bonus of this idea is that instead of focusing on reducing the damage from a crash, it reduces the likelihood of the crash itself.

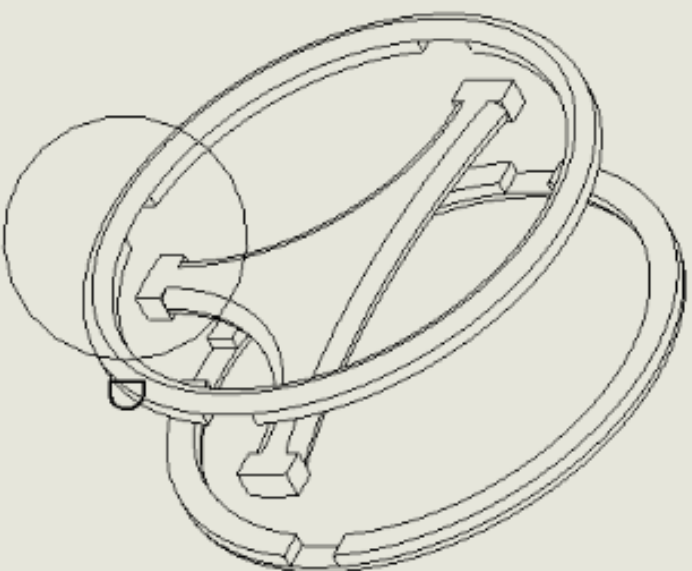
4. Prototype/Model

FIG. 5 Shown to the right, is the back of the steering wheel prototype. This shows that the sensor is metal and along the back of the wheel.



FIG. 6 Shown to the left is the steering wheel prototype as the driver would see it. The sensor would not be visible to the driver, so the normal aesthetics of the wheel would not be affected.





DETAIL D

SCALE 2 : 5

5

1

4

3

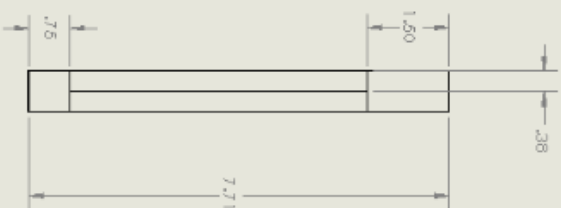
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1

Group 3 Design Project			
TITLE Wheel Assembly Drawing			
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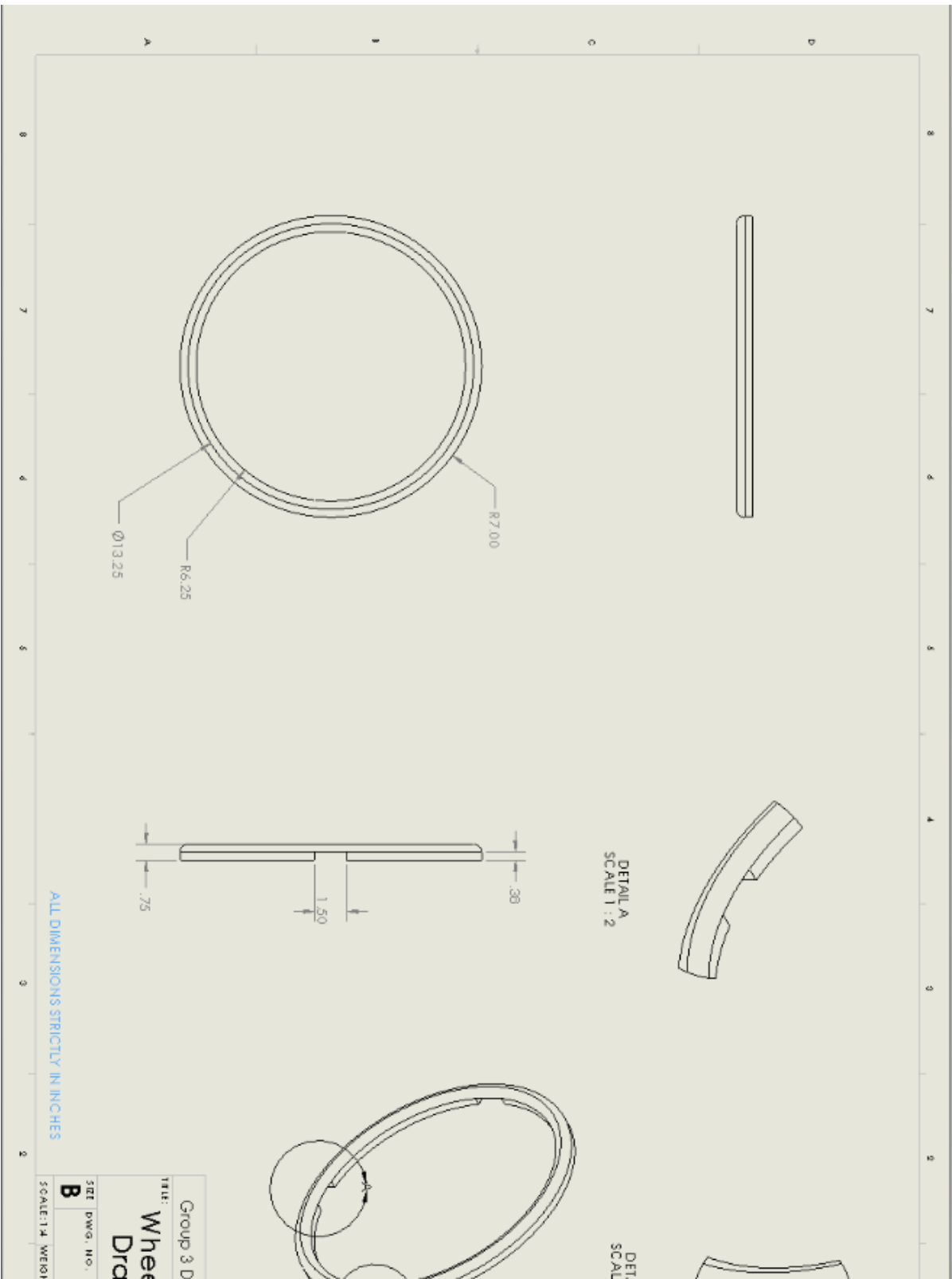


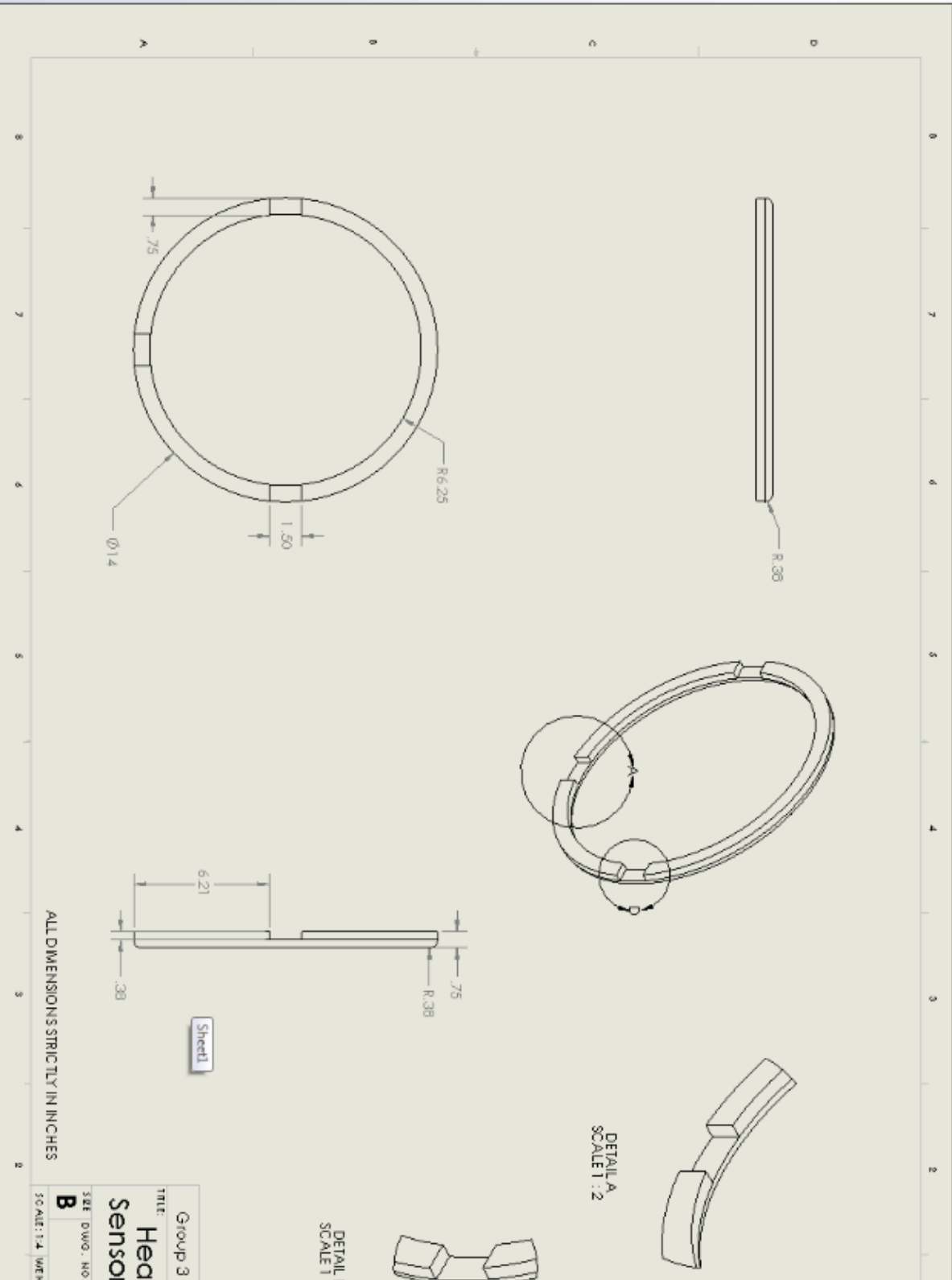
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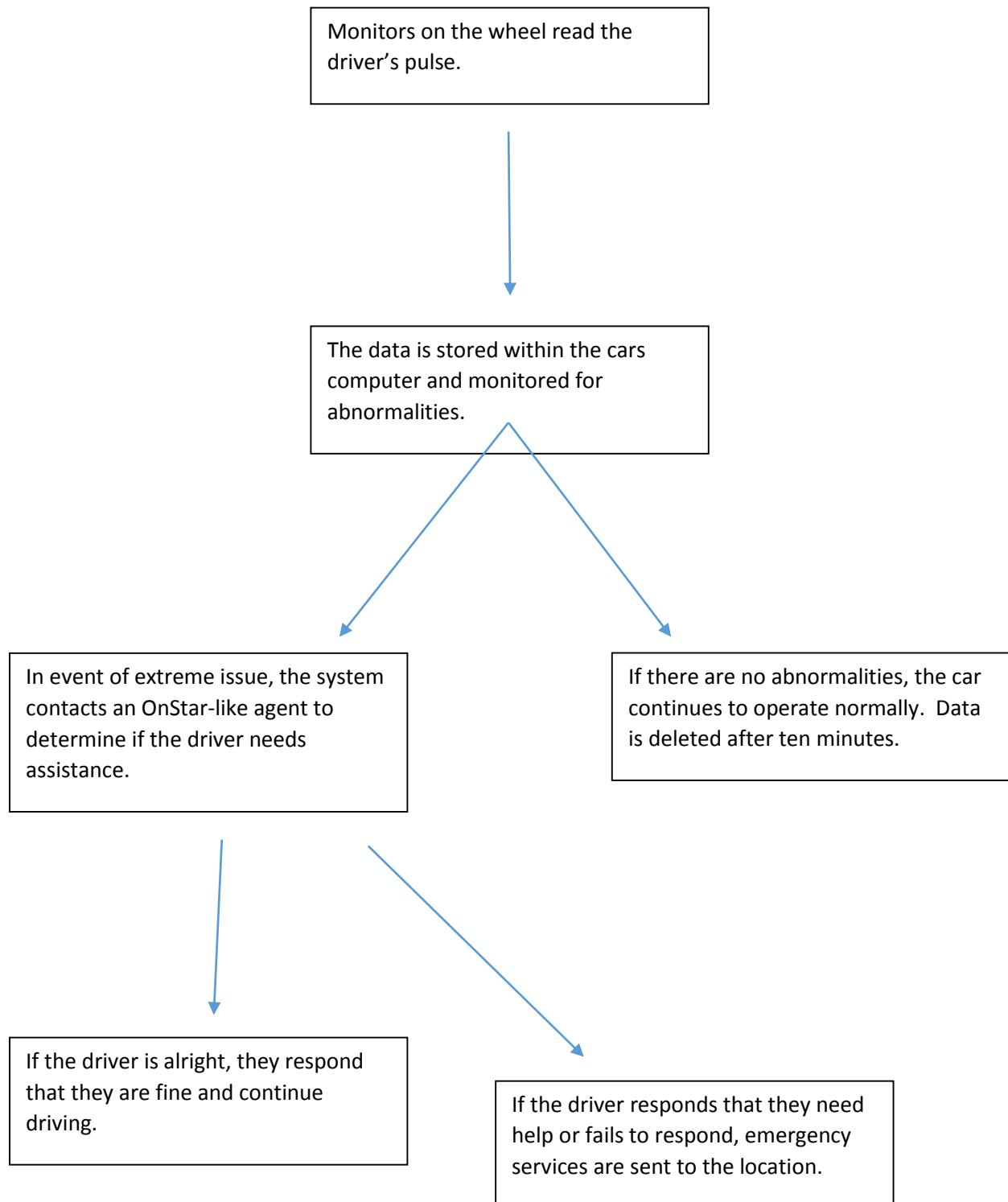
ALL DIMENSIONS STRICTLY IN INCHES

Group
TITLE
Whe
D
SIZE DWG. N
B
SCALE 1/4" = 1"





Systems Diagram



5. Analysis

Life cycle analysis

Material used- stainless steel, plastic, leather

Production of materials: Stainless steel has a large environmental impact initially. The mining for the iron and the smelting process to turn the ore into steel produces a significant carbon footprint. However steel is 100% recyclable.

The plastic would have a significant environmental impact. Mining for crude oil to produce the plastic would pollute the air. Heating the plastic to mold it would also produce some amount of pollutants, whether it's electrically heated or heated by combustion.

Manufacturing the animal hide is also quite hazardous to the environment. Raising animals requires huge amounts of pastureland that will eventually be unusable due to waste pollution.

Product life: The use of the sensor itself would require a minimal amount of power. Similar heartbeat sensors require 40-70 micro amps of power. Which doesn't equate to a significant amount of fuel burned to power this device.

End of life: Since the sensor would almost entirely be comprised of metals the product could be broken down and recycled completely.

The center of the wheel is entirely made of plastic. Most plastics today can be almost, in not entirely, recycled.

Leather even though it is biodegradable will still produce methane as it decomposes, which is directly related to the greenhouse effect.

Part	Cost
Steering Wheel	\$30.00
Sensor Pads	\$40.00
Data Storage	\$5.00
Failsafe	\$5.00
Calling System	\$30.00
Total	\$110.00

A typical car costs about \$19,000. The total cost of our system is only about \$110.00, which is quite cheap relative to the cost of the car. In addition, our product replaces the cars current steering wheel, making the actual change in cost only about \$80.00. This low cost makes the product extremely affordable to the market searching for cars.

Concept of Operations

I. Goals and Objectives of System

II. Features

III. Operational Processes

I. Goals and Objectives of System

This system was design with the intention of making a car both safer and more connective. With this in mind, its function has two main objectives:

1. To provide the user with useful information that they can use in their everyday lives.
2. To help prevent automobile accidents by alerting the authorities if the driver may be in poor health.

II. Features

The basis for all of the features of our system is a Heart-rate sensor that would be built into the steering wheel of a car. This would measure the Heart-rate of the driver via a stainless steel sensor along the back of the steering wheel. Coupled with a capacitive sensor, the heart-rate sensor would only operate when skin is touching it, and therefore would not receive interference from gloves and other objects that could be near the steering wheel.

Some of the features that this system would offer to a user are as follows:

1. The wheel would be built with standard Bluetooth technology, and therefore could be tethered to a smart phone. Health and fitness apps are growing in popularity and the wheel would be able to provide your phone with hours of useful resting heart rate data. This information is a measure of overall fitness, and if tracked over a long period of time can be of very practical use to the driver.

2. Additionally, most cars are now equipped with an On-Star system, which contacts a third party if the driver has gotten into a crash and may be unable to contact the authorities themselves. Most of the time, these systems cannot prevent crashes because they have no way of detecting if a crash is likely to happen soon. However, when coupled to a heart-rate monitor, this could change. If the heart-rate sensor detects severely unhealthy heart rates for an extended period of time, it will

activate the On-Star system so that someone can talk to the driver and make sure that they are alright and fit to be driving.

III. Operational Processes.

1. The stainless steel surface would be capacitive, so the small current running along it would be interrupted when it is touched by skin. The wheel would detect this, and the Heart-rate sensor along the back of the wheel would be turned on.

2. Once the sensor has been turned on, the wheel will take the heart rate of the driver using the fingers that are wrapped around the wheel.

3. This data will be recorded, averaged, and stored in 15 second intervals. If paired via Bluetooth to a phone, it will be sent out every 15 seconds. If there is no pairing, 5 minutes of data will be stored on board any recording more than 5 minutes old will be deleted.

4. If the storage device registers 30 seconds of data above 195 bpm, or below, 45 bpm, then the On-Star system onboard the car will be activated. This will not change the driving dynamics of the car at all, because it could be a false alarm, it will merely call a third party to ask the driver if they are alright and if they need help.

Note: Some screws and wires are also necessary to attach wheel to car. The wheel would have the same life cycle as a normal wheel with these aspects. 901

Assessment of important aspects of your system for feasibility and adoption

Our design was based around the single feature of a heart-rate sensor. We adapted the heart rate sensor into the part of the car that we felt had the most contact with the driver. The heart-rate sensor was placed along the back edge of the steering wheel.

Adding a heart-rate sensor to the car gave us a lot of options to improve the car. The car can now be more connected by sending the heart-rate sensor information via Bluetooth to a smartphone to track personal fitness. The car can now also be safer by monitoring the heart rate of the driver. If the driver's heart rate reaches an abnormal level, a responder can phone into the car and check on the driver similar to how the on-star system works after a crash. If the driver does not respond or needs states that he/she needs help, the online responder can send police and medical help for the driver. Another purpose for the heart-rate sensor could be the aid in accident reports. If the heart rate of the driver is recorded during the crash and stored with other

information in the black box of the car, it can help determine if the crash was the result of a medical emergency such as a heart attack. This can help with insurance purposes.

We believe that our design is feasible and should be easily adapted into modern cars and future cars. The original design should be compatible and fit in most cars but could be adjusted for certain car models if needed. Our current design is simple to express important aspects of our design but would be updated if put into use to include more modern features on the wheel such as radio controls.

6. Summary and Conclusions

Team 3's task at hand was to improve vehicle's safety, emissions, or connectivity. Through much discussion and research it was decided that safety was the most important aspect. It was concluded that installing a heart rate sensor in the back of the steering wheel would increase the rate of survival for heart related incidents. Sensing irregularities or abnormalities in the heart can predict seizures, strokes, and heart attacks. By having this system linked with a 3rd party operator such as OnStar response time for medical services can be significantly reduced. Upon receiving feedback, minor changes could be made such as: integrating more biometrics beyond a simple heart rate sensor or reevaluating the connectivity aspect through the Bluetooth-Smartphone tether.


7. Power Point Slides



Design Project Two


EDSGN 100
Prof. Xinli Wu

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Problem

- Safe, Connective, or Green?
- To us, safety was the most important
- A lot of modern safety features are only used after a crash
- To work toward zero fatalities, we need to work on prevention



Concepts and Research

- Some initial ideas
- Medical emergencies account for roughly 25% of all major car accidents
- An Improved Steering Wheel
- Background Research



Design

- Sensor along the whole back of the wheel
- Most of the technology exists
- Inductive surface
- Data Collection






Implementation

- Accident Prevention
- Possible Situations
- Bluetooth Capabilities

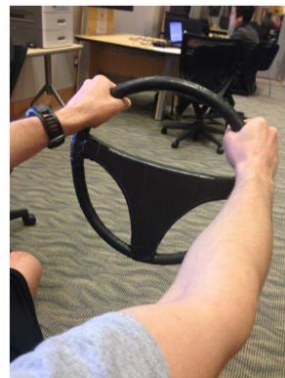
8. Brouchure



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“Safer, Greener, more connected”



DESIGN PROJECT #2

Heartbeat sensing steering wheel

Team #3



Design

This product has the following design features:

- Open ended design (to be tailored to different manufacturers)
- Inductive heart rate sensor
- Stainless steel sensor
- Info can be relayed to handheld devices (via Bluetooth tether)



Intended uses

- Monitor the drivers heart rate to call an OnStar operator to possibly dispatch medical services in the event of a heart related issue.
- Send information to a tethered device for self assessment.
- As future cars progress the product can potentially stop the car safely itself in the event of a medical incident.
- In the event of the crash (signaled by the airbags deploying) the sensor automatically saves the most recent recorded data for post crash data analysis.



Photo caption



Connectivity

Through the product a user could tether a mobile device to the system. With the iHealth app and similar apps on the GooglePlay store users have the resources to monitor and track their heart activity.

This information can be used for assessing physical fitness, overall health trends, and possibly even heart related problems in a long term.

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