AT&T Project
- Connected Cars

Team A:
Minjun Zhao
Yingying Zheng
Yifan Zhang
Yuk Shun Wong

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I. Introduction

Executive Summary

The AT&T Company has the need for a new generation of car which include the four features Smart, Clean, Connected, and, Efficient. In the past few decades, there is an increasing rate of car accidents because of distracted driving. In addition, many people complain that it’s hard to remember where they park their cars especially when the parking lot is big. The objective of this project is to design a car which eliminates driver’s distractions and connect cars with cellphones. And new device should provide convenience in life such as finding parking location through smartphones.

In the develop process, several concepts are generated to fulfill the customer needs. We designed a system to connect with cellphones as well as a system connecting with AT&T wireless network. We also designed an evaluating system involving evaluating the distracting behavior of the driver in order to make driver alerts when some emergency happens. Besides, security assessment would also be built in the whole car system. A well designed entertainment system which would not cause cognitive overload will be built in the car system. Overall, the car will be built with minimized budget and environment-friendly materials. Several contemporary technologies are conducted to meet our customers’ needs. All of the selected concepts has been fully considered.

Several potential risks are presented in the design. When the car fails to alert as the driver’s multi-tasking, the resulting car accident could be severe. And many cellphone don’t have service in the underground parking lot. As a result, the driver can’t find his car through his cellphone.

Abstract

Team A from Engineering design class is working on the connected lives with one of the biggest telecommunication company AT&T. The sponsor company provided us three design projects which are connected homes, connected cars and wearable. Besides, we chose to cooperate with IoT (The Internet of Things) and M2M (Machine-To-Machine). The goal of the project is to connect smartphones and vehicles together.
Introduction

AT&T is one of the world’s biggest telecommunication companies. Though officially founded in 1983, its history can indirectly trace to Alexandra Bell’s Bell Telephone Company in the 1800s. With years of development and improvement, AT&T offers various services including phones, Internet, and TV. The company has reached outside the boarder of the United State, providing services for over 225 countries.

Mission Statement

Team A designed the overall systems centered at the cars to make the future cars smart, clean, connected and efficient. The system can improve the driving safety and usability of the nowadays cars. The car systems will be easier as well as safer for the driver to use by installing self-measurement and control system. The in-car facilities like air conditioning system and entertainment system are designed more automatic. The car will use clean energy to eliminate the pollution. Most importantly, the cars will be connected with other devices like mobile phones and your houses. By using the apps in your phone, the car can be located, unlocked or started. In general, the cars are supposed to be manufactured by recyclable and reusable materials.

Rationale for the connected cars

Team A has the desire to design a car that is clean, smart, efficient, and connected. We want to use modern technologies and advanced concepts to develop a mature model of car that can satisfy our customers both physically and psychologically.

Team A sees the need that today’s people need a safe, clean, and efficient car that not only can reduce car accidents but also provide the maximum enjoyment while driving.

Comparing to the need of designing a modern house, Team A thinks that the most emergent need of modern people is to have a clean, smart, safe and
efficient car. Therefore, we come up with an idea to design a car that has some special programs aimed to have customers build their desired car with cleanness, safety, smartness, and efficiency. In our project, we decide to cooperate with AT&T to accomplish this goal.
II. Analysis of Customer Needs

Customer Requirements

Our team is given a project introduction from the AT&T Company. In the chart below, we converted the project introduction into the customer requirements.

<table>
<thead>
<tr>
<th>The automobile has evolved beyond its original use case of traditional transport. The future of the automobile is dependent on the following four factors: Smart, Clean, Connected, and Efficient.</th>
<th>The cars designed by our group need to be smart to use, use clean energy and connected to the devices like phones.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries in this category will focus on solutions that consumer can/will use while in the car. The entries will address problems that improve Driver Safety, Productivity and Infotainment.</td>
<td>The new design needs to improve driving safety efficiently and make driving experience easier and better.</td>
</tr>
<tr>
<td>Students should think about the various problems and enhancements they would like to see addressed in their daily lives as they spend time in the car.</td>
<td>The design needs to solve the realistic problems existing in nowadays driving.</td>
</tr>
<tr>
<td>Usability will the key in this category as the focus must be on limiting Driver Distraction while maximizing the Driving Experience.</td>
<td>The design needs to be minimizing the distraction while maximize the driving experiences.</td>
</tr>
<tr>
<td>Areas of focus include; Combating Driving While Distracted (DWD), switching costs, situational awareness, cognitive overload, multitasking, vehicle alerts, haptics, and security assessment.</td>
<td>The design will mostly focused on improvement in driving experiences and safety and connections between other things.</td>
</tr>
</tbody>
</table>
Other Surveys

We took surveys at several areas of State College (Penn State downtown, Walmart on Atherton Street, Nittany Mall). We’d like to know if our new technology of cars is welcomed and if they meet customer needs. We approached people and asked those who drive on a regular basis the following questions:

- What do you think is causing car accident the most?

![Pie chart showing causes of car accidents]

- Do you have trouble finding your vehicle in a big parking lot?

![Pie chart showing trouble finding car]

- Yes
- 2nd Qtr
Research of cars

Tesla is a car company focus on manufacturing electric car. The model S from Tesla is their first car model, and it is a sedan car powered by electricity. The battery of Model S is placed on the bottom of the car, in order to help Model S to achieve even higher torsional rigidity and a lower center of gravity. The battery also designed for safety, it would maintain consistent temperatures to prevent cells from overheating. For the entertainment, the Model S has a 17” touchscreen on the middle of the dashboard. The screen can display and controls many functions, such as digital instrument cluster, and steering wheel controls seamlessly integrate media, navigation, communications, cabin controls and vehicle data.

Our research of cars generally focused on the technology installed on the cars nowadays. Take the C-Class sedan of Mercedes-Benz for example; it’s a luxury car with an economic price. The C-class has many technologies to improve the driving safety. There is a back-up camera for drivers to have a better vision when they’re reversing their car. “Distronic Plus” is a technology that uses radar to detect the speed of car in front of you, and in order to alert you to brake when stopped traffic ahead. An active blind spot assist system is also installed in the
cars, which help the driver detect the potential danger in the blind spot. This system can definitely include in our car designs.

Another useful feature is the car can be keyless started which make driving experiences more convenient. Some types of cars also have a function allow the car to remote start the engine when the key is detected within a certain distance. We can use the phone app to replace the key and connect the car and key together to allow longer distance control. These features are now widely used in current cars, but we can easily improve and combine these features to brand new designs and functions.

**Needs statements**

1. The car needs to be environmentally friendly.
2. The vehicle and the smartphones are able to interact with each other.
3. The car is able to make responses according to driver’s behaviors.
4. The car is able to make responses according to its surroundings.
5. The car allows the driver multitask in a safe condition.
6. The new design needs to eliminate the distractions.
### III. Establishment of Target Specifications

#### Product Spec Metrics & Matrix

<table>
<thead>
<tr>
<th>#</th>
<th>Weight</th>
<th>Customer needs</th>
<th>Concept</th>
<th>Center steering wheel rating</th>
<th>Weighted Score</th>
<th>Control steering wheel rating</th>
<th>Weighted Score</th>
<th>Multi-functional instrument board rating</th>
<th>Weighted Score</th>
<th>Wireless connection to devices rating</th>
<th>Weighted Score</th>
<th>Internet rating</th>
<th>Weighted Score</th>
<th>Recyclable Materials rating</th>
<th>Weighted Score</th>
<th>Alert systems with distance rating</th>
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<tr>
<td>2</td>
<td>20%</td>
<td>Interactions with other devices</td>
<td>3</td>
<td>0.6</td>
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<td>0.2</td>
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<td>3</td>
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<td>Alert driver when distracted</td>
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<td>6</td>
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<td>Eliminated distractions</td>
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<td>Continue?</td>
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<td>no</td>
<td>yes</td>
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</tbody>
</table>

#### Set target specifications

- The steering wheel of the car is equipped with control panel of the whole car
- Private wireless base station connecting phone and car control system
- Distance sensor equipped in the outside of the cars
- Proper alert system

#### Existing structures and designs

Steering wheel:
- EPAS-Electric Power Assistance equipped in the wheel
- Center control system equipped on the wheel i.e. we can using the wheel to control other parts in the car like radios
- Bluetooth wireless equipment using to answering the phone while driving
- Alert system and distance sensor:
- flashing light and sound alerting system
- Parking assistant system

**Cost Model**

Case of the steering wheel:
$200
Metal structure of the wheel:
$70
Microphone:
$30
Wireless router:
$50
Cellular modem:
$50
Touch screen:
$200
LED light:
$10
Speaker:
$30
Sensor:
$100
Vibrating system:
$100
Control System:
$100

**Total Cost:** $940
IV. Concept Generation

Clarify of the problem

As the specifications indicates, the customer requirements need to be fulfilled by several different systems in the car working together. In order to simplify the design process, the different systems need to be combined to a single system in order to be operated easier.

The design project mostly related to the IoT and M2M. For the IoT part of our project is the alerting system so that a new and efficient way to make the driver alert about the situation should be designed. M2M is related to the wireless connection between the car system and our mobile phones. The connecting method need to be designed.

Develop the Function Diagram
Literature Review

There are many apps design for cars already: full internet capabilities, GPS tracking, Blue Tooth, etc. all makes it possible to connect cars and smartphones together. With the development of technology, those existing functions perfective its performance and more ways of control start to come out. Before the phones are able to control the cars, the car should install a compatible hardware with security systems. Then the smartphone requires a remote control app. nowadays, those apps are available on iOS and Android. Once the appropriate app is installed, the driver can control his car through his phone. Currently, the commands are limited and simple.

Patent Search

Anywhere Company starts to develop the program of the connection between phones and vehicles for several decades. For example, once Anywhere Unit (G1) is activated, the phone number is authorized to command the car. People can make easy command such as “lock/ unlock the door” and “roll the windows up/ down”; some easy commands such as “locate vehicle” also apply. The electric power steering wheel is a sensor system which is responsive to the measured steering wheel torque. The system is controlled by circus located inside steering wheel sending return-to-center command. The controller adjusts the speed of command based on the speed of vehicle and the steering wheel torque angle.

Patent number: US 4624334 A

Brainstorming

- Center control steering wheel:
  Control panel of main function of the car
  Intellectualized voice control system like Siri
  Using phone to analyze data (connected with phone)

- Wireless connection to devices and Internet:
  Bluetooth, Wi-Fi, Cellular network provided by AT&T
Using the phone app to control the main functions of the car

- Alert system with distance sensor:
  Common sound and light system, vibrating system installed in steering wheel
  Sensor to detect driver’s behavior
V. Concept Selection

Based on the concepts generated in the brainstorming parts, we came up with ten concepts: central control panel, voice control system, connecting phone, Bluetooth, Wi-Fi, cellular network, common alert system, vibrating system, drivers’ physical sensor and LED touch screen. However, central control panel, common alert system is widely used in nowadays cars. We should definitely design a car with these features.

Selection Matrix

<table>
<thead>
<tr>
<th>Concept</th>
<th>Voice control</th>
<th>Connecting phone</th>
<th>Bluetooth</th>
<th>Wi-Fi &amp; Cellular network</th>
<th>Vibrating system</th>
<th>Drivers’ physical sensor</th>
<th>Touch screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Interaction with driver</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2 Long distance interaction with other devices</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>3 Short distance interaction</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>4 Alert Efficiency</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5 Elimination of Distraction</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 Easy to use</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>7 Multitasking</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
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<td>8 Smart function</td>
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<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Concepts combination and improvements**

- Vibrating and common alert system
- Central control panel, voice control, and touch screen

**Selected concepts**

- Comprehensive alert system
- Central panel with voice control system
- Wi-Fi and cellular networking
VI. Establishment of Final Specifications

Maintenance Requirements

The steering wheel is considered to be one of the most important parts of the vehicle. It should be maintained in care. It should be regulated with the car every year and some of the parts should be taken extra care.
- Change the LED screen every 6 years
- Inspect the cables every six months
- Clean the microphone every eight months
- Change the rubber every four years
- Do not use magnetic device around steering wheel

Examination of Manufacturing Processes

The manufacturing of the steering wheel, which contains our main design, is carefully guarded because it is responsible for the efficiency and safety of our whole design. The total cost of our design is under budget of $1000, but it is still guaranteed to be high quality,

The main cover of the steering wheel is made of resin, which can provide both comfortableness and extra stableness for the driver’s hands. The touch screen is made of liquid crystal, which is not only durable but also provides great view for the driver. The antenna serves as a bridge between the drivers’ mobile phones and their cars. The signal sent between phones and antenna is a form of electricity so we have to make our antenna conduct electricity every well. While the silver and copper are pretty good conductors, we also have to take the cost and other elements into consideration. After carefully selection, we decided to use aluminum as our antenna material. It turns out that not only dose aluminum conduct electricity very well, it is also not that expensive. We can use this material to produce an efficient product with affordable prices by most common people.
Final specifications

After the selection matrix and final discussion, we decided to use the steering wheel to satisfy most of the customer needs, that is to say we are designing a car centered at the steering wheel.

- Use clean energy
- Equip with distance sensor around the car’s body
- Central Control steering wheel connected to other parts of the car

Features of the steering wheel

- Central control panel
- Comprehensive alert system (light, sound, vibrating)
- Voice control system
- Wi-Fi and cellular networking (4G-LTE provided by AT&T)
- A touch screen controlling all equipment (like radio, air conditioner) in the car
- Phone holder which allow the phone to be charged and well connected
VII. Conclusion

Team A has gone through a series of systematic procedures to design an advanced, connected car via the communications between car and ATT mobiles. The core concept of our design is to maximize the entertainment, minimize the distraction, and eliminate any safety concern while drivers are driving. We utilize the modern high technology of ATT, specifically internet and wireless connections, to create a clean, efficient, and safe driving environment for our customers.
VIII. Design

Design
References

Introduction Part

http://www.att.com/gen/investor-relations?pid=5711

Literature Review Part


Patent Research

http://www.google.com/patents/US4624334
http://www.connect2car.com/

The customer needs derived from the statement of Work - AT&T: Our connected Lives