Team 5 Lakers

The AT&T-Audi A7 Connected-Car

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Abstract

A successful connected car requires that it can autonomously communicate with other machines and communicate this information to the benefit of the driver. In addition, the car must quickly interpret driver inputs in order to keep them focused on driving. Because of the car's connectivity, our team hopes to improve the vehicles safety, efficiency, and productivity.

Introduction

The Lakers engineering team has been contacted by AT&T to help them create a connected-car. AT&T is the perfect partner to work with on this project because they are one of the largest communications providers in America and across the planet. In the U.S., they operate the country's largest and most reliable 4G LTE network, which enabled our team to include innovations that would be impossible with smaller communication companies. The goal of this project was to make a more connected car that can communicate with other machines (M2M) and relay this useful information to the driver. In order to accomplish our goal, we first began to do external research which included surveys and benchmarking current technologies. We combined these results with our customer needs to set target specifications for our vehicle.

After our initial specifications were set, we had to come up with concepts to turn our customer needs into realities. Several heated concept generation sessions were followed up with a rigorous concept selection process to insure that our customers would receive the best possible product. Based on the results, our team decided to connect our vehicle with specific machines and systems that would enhance the driver's productivity, infotainment and safety. Using all this information, final specifications were used to create our prototype which will be complete on May 5, 2014.

Mission Statement

Our goal is to develop a car that will interact with homes, mobile devices and other vehicles to improve personal transportation.

Customer Needs Analysis

The customer requirements were converted into specific customer needs. These customer needs were ranked, with the lowest number signifying the greatest importance. In order to satisfy each customer need, target specifications were set up. The information below is shown using a data table.

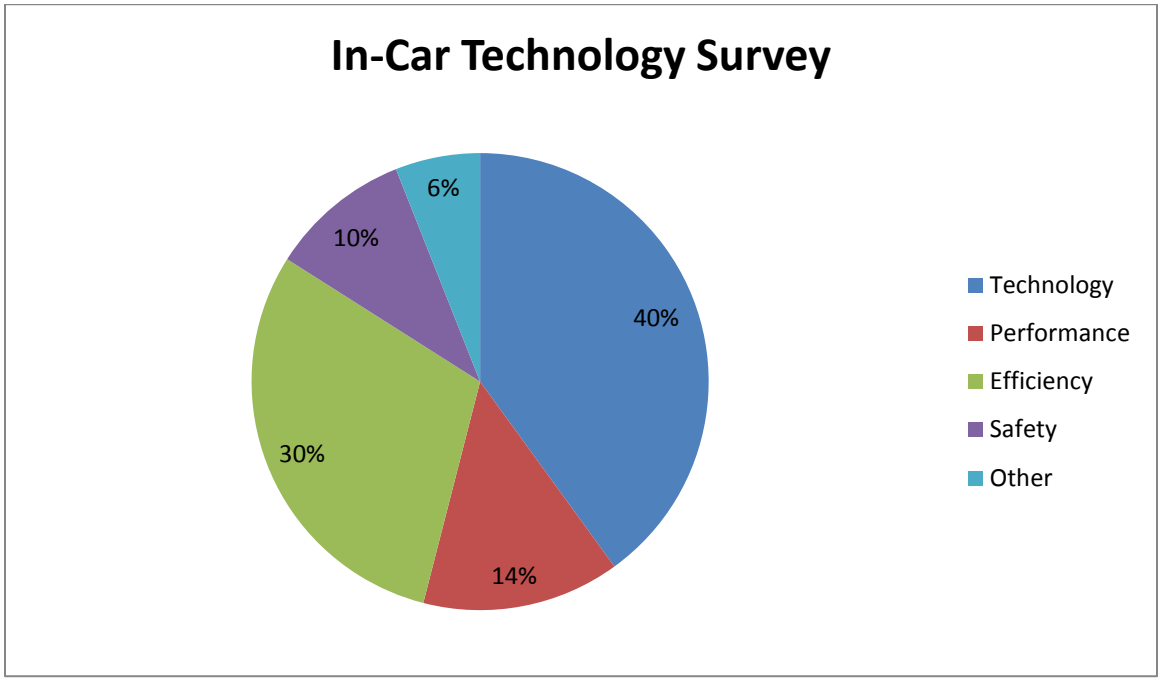
Customer Requirements	Needs Statements	Rankings	Target Specifications
The automobile has evolved beyond its original use case of traditional transport.	Need more uses from the car.	1	The car will be connected with the internet of things using in-car Wi-Fi.
The future of the automobile is dependent on the following four factors: Smart, Clean, Connected, and Efficient.	Car needs to be more autonomous.	2	Car will be able to communicate with other machines (M2M) with or without human input.
-	Car must have minimal emissions.	3	A low emission clean diesel technology engine.
-	Car must have technological and GPS connectivity at all times.	4	Car will utilize a real-time, long distance protocol.
-	Car must be durable and fuel efficient.	5	A high efficiency diesel engine.

Entries in this category will focus on solutions that consumers can/will use while in the car.	Creates benefits for the driver without distracting the driver.	6	The system will talk with the driver and feature a windshield projection display.
The entries will address problems that improve Driver Safety, Productivity and Infotainment. Students should think about the			
Safety	Car must have a crash prevention system, and high crash safety test rating.	7	The car will use a real-time protocol to communicate with other vehicles.
Productivity	Optimize productivity while being non-distracting.	8	Connection to the driver's phone, computer and home.
Infotainment	Connectivity to all infotainment devices at all times.	9	Internet based entertainment features like Pandora and Netflix.

External Research and Benchmarking

The majority of our external research consisted of analyzing surveys of drivers. The best one that we came across was conducted by Accenture. The survey of 14,000 drivers in Brazil, China, France, Germany, Indonesia, Italy, Malaysia, South Africa, South Korea, Spain, the UK

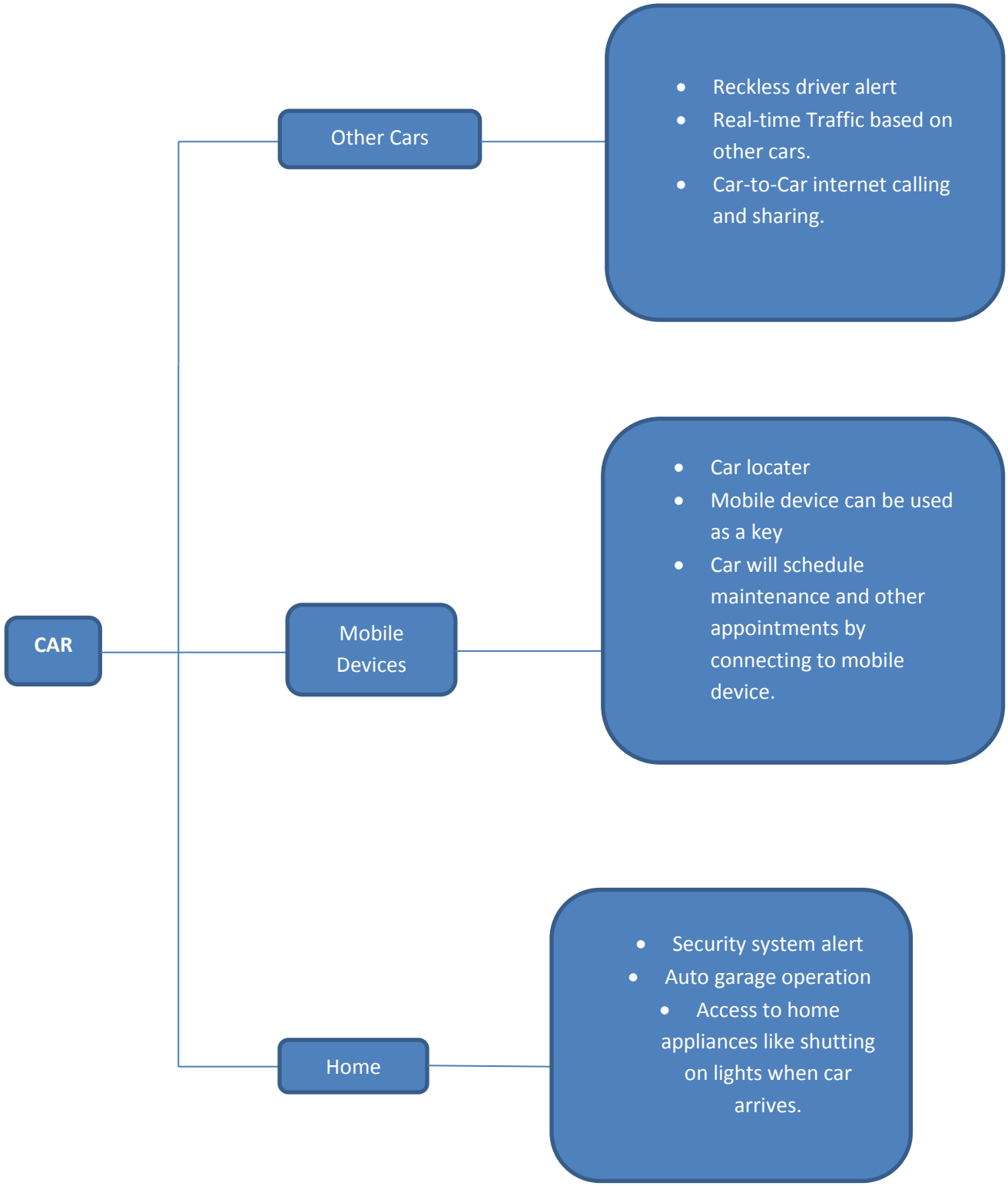
and the United States examined their current use of connected vehicle technologies and expectations for future use. Below is a pie chart illustrating what drivers want when purchasing a new vehicle.



Using our customer needs and external research we started to research what vehicle to use as our benchmark. Our research of existing vehicles was quite extensive as we considered all types of cars, trucks and SUVs from the major manufactures. The Audi A7 was chosen because it has an excellent initial quality report as well as a good reliability track record. The major factors in choosing the A7 were because it offered a TDI clean diesel engine with very low emissions and high fuel efficiency as well as good performance and excellent reliability. The company is set unveil the in-car Wi-Fi hotspot that will enable drivers to connect to laptops. We will build on this existing technology in our project by using this hotspot to connect the vehicle itself to other machines using a specific protocol.

Concept Generation

We used a flow-chart during the brainstorming phase to illustrate the concept generation.



Concept Selection

In order to make each of these concepts a reality, our car had to somehow connect to other cars, homes, and mobile devices or wearables. Our team needed to select what type of internet communication our car will use when connecting to certain devices and more importantly, what protocol it will use. To do this, we made a series of matrices to select the best internet and protocol for each function. We used a scoring type matrix by assigning weight to each attribute.

Internet Selection Matrix

Criteria	4g	Wi-Fi	internet over satellite (IoS)
Connection	-	0	+
Reliability	+	0	-
Security/Privacy	0	0	-
Bandwidth	0	0	-
+	2		2
-	1		1
0	3	6	3
Total	1	0	-1
Scoring Matrix			
Connection (40%)	-40	0	40
Reliability (30%)	30	0	-30
Security/Privacy (20%)	0	0	-20
Bandwidth (10%)	0	0	-10
Total	-10	0	-20

Telecommunications Provider Selection Matrix

	Verizon	T-Mobile	Sprint	AT&T
Connection	0	-	-	+
Reliability	0	-	-	+
Security/Privacy	0	0	-	+
Coverage	0	+	-	+
Total	0	-1	-4	4
Scoring Matrix				
Connection (35%)	0	-35	-35	35
Reliability (20%)	0	-20	-20	20
Security/Privacy (10%)	0	0	-10	10
Coverage (35%)	0	35	-35	35
Total	0	-20	-100	100

House to Car Protocol Selection

	Wi-Fi	MQTT	Bluetooth	XMPP	DTLS
Connection	0	+	0	0	0
Reliability	0	+	+	0	0
Ease of use	0	0	0	0	0
Security/Privacy	0	-	-	0	+
Range	0	+	-	0	0
Real Time Connectivity	0	0	+	+	0
0	6	3	2	5	5
+	0	3	2	1	1
-	0	1	2	0	0
Total	0	2	0	1	1
Scoring Matrix					
Connection (20%)	0	20	0	0	0
Reliability (10%)	0	10	10	0	0
Ease of Use (5%)	0	0	0	0	0
Security/Privacy (5%)	0	-5	-5	0	5
Range (30%)	0	30	-30	0	0
Real Time Connectivity (30%)	0	0	30	30	0
Total	0	55	5	30	5

Car to Mobile Device Protocol Selection

	Wi-Fi	MQTT	XMPP	DTLS
Connection	**0**	**+**	**0**	**0**
Reliability	**0**	**+**	**0**	**0**
Real-Time Connectivity	**0**	**0**	**+**	**0**
Range	**0**	**+**	**0**	**0**
Total	**0**	**3**	**1**	**0**
Scoring Matrix				
Connection (30%)	**0**	**30**	**0**	**0**
Reliability (20%)	**0**	**20**	**0**	**0**
Real-Time Connectivity (20%)	**0**	**0**	**20**	**0**
Range (30%)	**0**	**30**	**0**	**0**
Total	**0**	**80**	**20**	**0**

Based on these matrices, in car WI-FI was the internet source that was chosen mainly for its reliability. AT&T was chosen as the telecommunications provider because it is the largest provider in the world and has the best coverage in America. The MQTT protocol was selected for the house-to-car because of its good range and low bandwidth usage. MQTT was also selected for the car-to-mobile device because of its low battery usage and speed. MQTT was selected for car-to-car communication because of a combination of the aforementioned attributes.

Design

The final design of our car looks quite unchanged from the standard Audi A7. The interior remains quite similar to the existing car as well. Most of the concepts that we generated already exist on their own such as lane drifting alert. Our car will incorporate these existing technologies and communicate these results to other vehicles, homes and wearable devices. The

fact that most of the technologies already exist on their own means that the cost of the vehicle will not increase dramatically. The only thing our team needs to do when assembling the prototype will be to bundle all of these systems together so that they can communicate with each other and relay this information to the driver if necessary. The estimated cost of the connected vehicle will be $5,000 dollars above the initial MSRP of $70,000. In addition to this fee, the internet service provided by AT&T will have a monthly charge very similar to the rate of owning a second cell-phone.

Final Specifications:

- 3.0 liter, 6 cylinder engine.
    - Clean diesel technology achieves 38 highway and 24 city mpg.
- Audi Presence will use an active radar system to assist the driver in near collision situations.
- $70,000 MSRP with an estimated connected cost of $75,000.

Conclusion

In conclusion car met all of the customer needs. The safety was increased by using automatic driver assist systems to help the driver avoid accidents. This connected to other vehicles safety systems alerting the driver if someone was driving recklessly on their route. The car communicated with the driver via voice, gave the driver heads-up displays on the windshield and even made appointments for maintenance on their mobile devices. To satisfy our efficiency, we used a clean burning diesel engine. Our car is connected to everything that is important to the driver via the futuristic MQTT internet protocol. By being connected to everything and making the driving experience safer and more productive for the driver, our mission is complete.

References

www.mercedesbenz.com

www.audiusa.com

www.bmw.com

www.ford.com

www.chevrolet.com

www.toyota.com

http://newsroom.accenture.com/news/strong-interest-in-new-in-car-technologies-by-consumers-in-emerging-economies-could-influence-demand-accelerate-rollout-of-next-generation-connected-vehicle-technologies-accenture-research-indicates.htm

www.att.com