HCaI Applied Project Final Presentation

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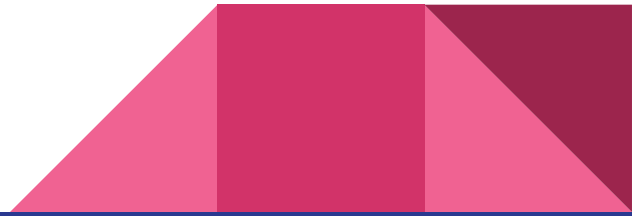


Experiment - Statement of Problem

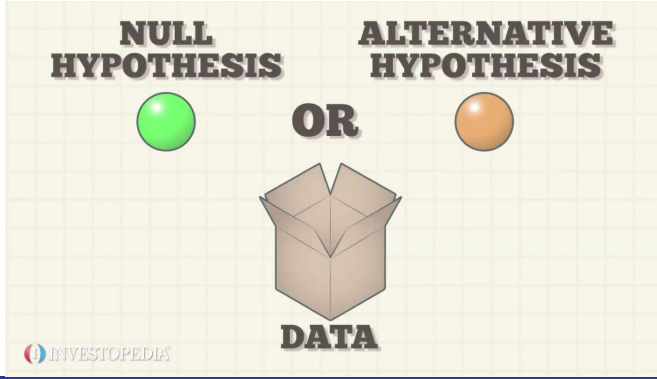
Is it good to keep the user interface screen at the bottom or at the top of the center stack screen holder?

To get an answer to the above question, we designed our first experiment to compare the different positions of the interactive interface and evaluate its impact on the response time from the driver.

Experiment - Hypothesis

Null Hypothesis: Position of the interactive interface screen has no effect on response time in using the interface

Alternative Hypothesis: Position of the interactive interface screen has an effect on response time in using the interface.



Experiment Setup - Variables

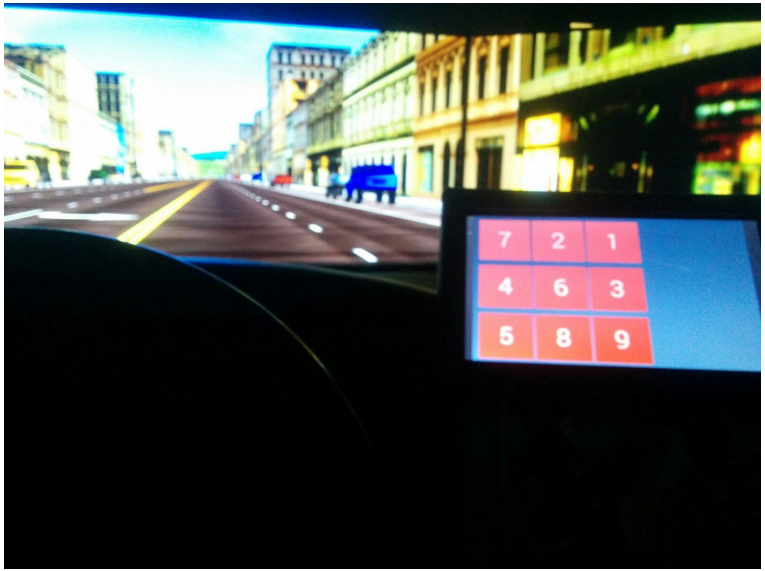
Independent Variable: Touch on the screen

Dependent Variable: Response time taken to complete a set of instructions.

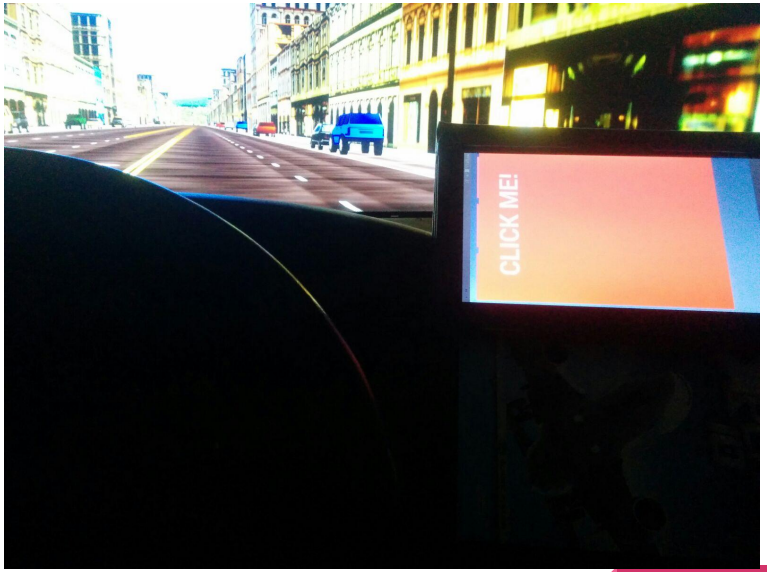
Experiment Setup

- An interface created is a web application, presented to the user on a 10” Android Tablet.
- The user was asked to enter their name into the application.
- The application has a total of 9 buttons, in randomized order to prevent learning effect over multiple drives.
- The DriveSafety Dashboard Simulator was used for this experiment.
- The volunteers were asked to drive on a previously programmed route and were given special instructions.

Experiment Setup

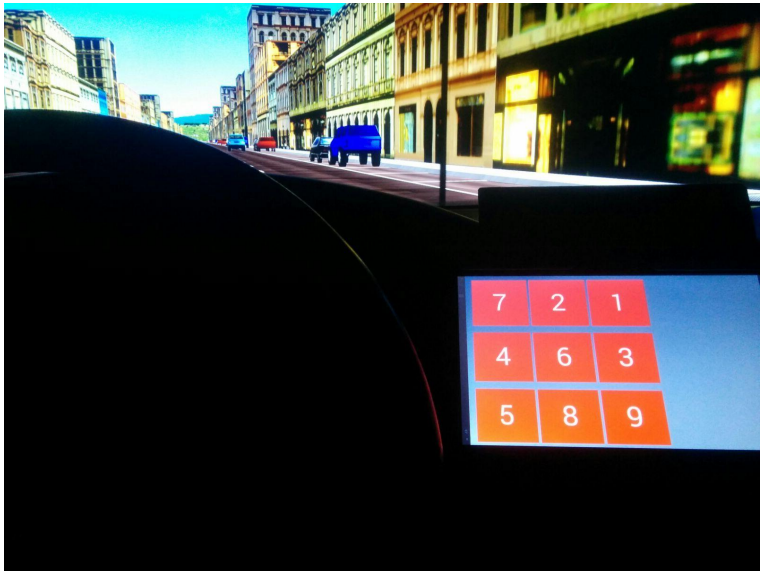


Top of the center stack

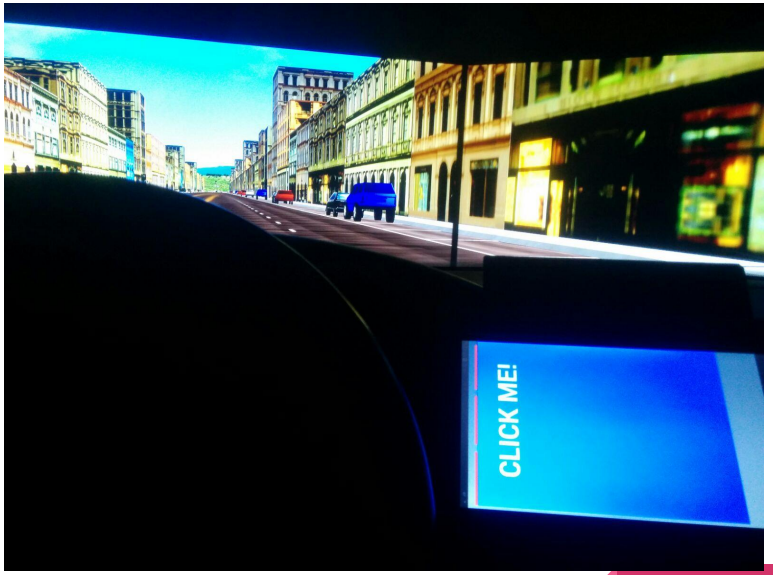


Top of the center stack Popup

Experiment Setup



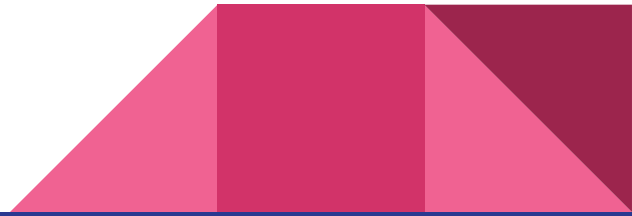
Bottom of the center stack



Bottom of the center stack Popup

Experiment Setup

- The following conventions have been used throughout the experiment:
  - Top of the center stack: The tablet is placed on the top of the center stack holder
  - Bottom of the center stack: The tablet is placed at the bottom of the center stack holder
  - Metric used is reaction time in milliseconds
  - Reaction time (in milliseconds): Automatic logging of the time on the server in milliseconds



Steps of Execution

Number of Participants = 52

Steps :

- Each participant was first given a test drive of the simulator, to get him/her accustomed to it.
- Each participant was asked to drive the same route twice.
- The user interface screen was placed in two secondary positions.

Steps of Execution

The instructions were as below:

- While performing the primary task of driving , the driver was asked to touch the buttons in order at three locations on the route :

Button Sequence	Location
451	Very first left turn when the cars would be coming from different directions
396	When the cars suddenly change on the freeway
278	On the last left turn of the simulation when the cars bump into each other on the side

Steps of Execution

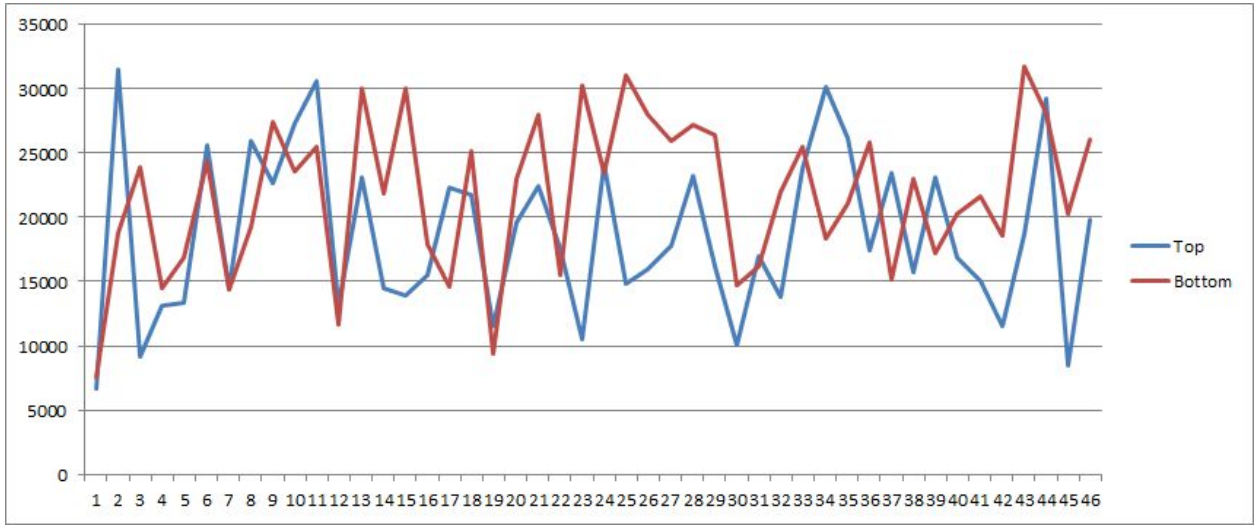
- To increase Cognitive load on the driver, the number sequence is randomized for each click.
- The user interface screen will be in landscape mode for the top and bottom positions.
- A sudden coloured message “Click Me” pops up in the secondary site of the driver before the driver meets pedestrians on the way

Results

After eliminating outliers and unsuccessful attempts, we successfully recorded response times for 46 participants. Here are the aggregated results:

	Placement	451	396	278	Popup	Total
Total Time	Up	167541	163750	152133	375252	784848
	Down	209915	168545	180379	442671	1001510
Average Time	Up	3642.196	3559.783	3307.239	8157.652	**17061.91**
	Down	4563.37	3664.022	3921.283	9623.283	**21771.96**

Results


35000
30000
25000
20000
15000
10000
5000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
Top
Bottom

Conclusion

- The total average time for “Center Stack Up” position is **17061.91 ms**
- The total average time for “Center Stack Bottom” position is **21771.96 ms**
- This shows a difference of **4710.05 ms** on average.
- This shows that the Top position has much faster response time on average.
- This proves the hypothesis that the position of the interactive interface screen has an effect on response time in using the interface.

HCAI WEBSITE

Website URL:
http://humancarinteraction.com/

Created Using:

- Weebly
- HTML/CSS/JavaScript

LITERATURE REVIEW

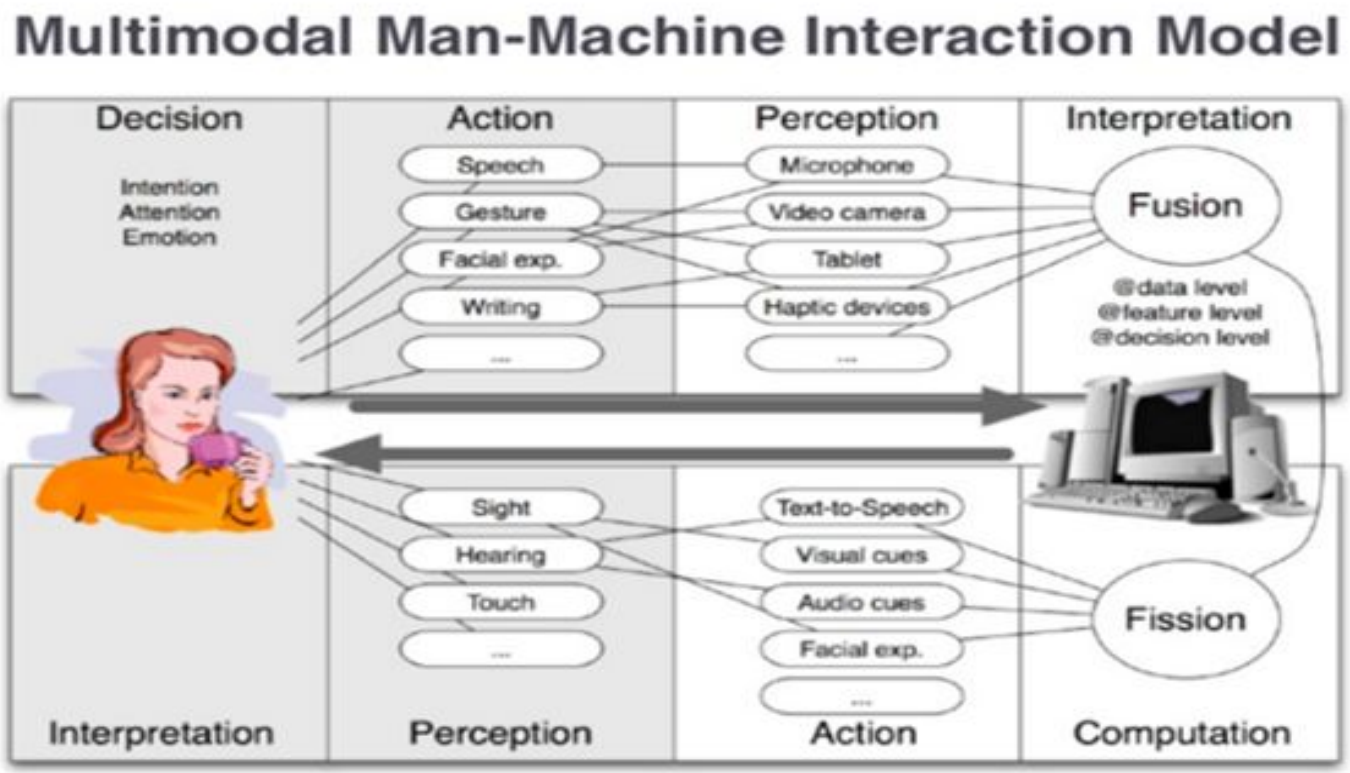
Multi-Modal Interaction

- Multimodal Interaction is a situation where the user is provided with multiple modes for interacting with the system.
- Multi-modal systems as those that process two or more combined user input modes such as speech, touch, visual and learning in a coordinated manner with multimedia system output.

There are 2 types of MMI:

Sequential Multimodal: User switches between the modes of interaction but cannot use the modes together.
Simultaneous Multimodal: allows user to use more than one mode at a time to interact**.**

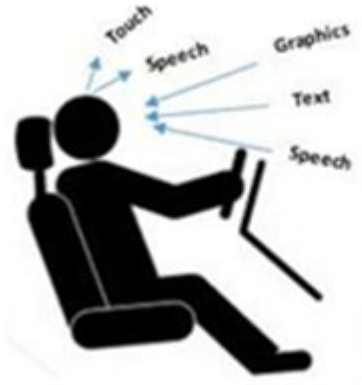
Multi-Modal Interaction



Modes of Input and Output

Input Modes

- Visual
- Speech
- Touch



Output Modes

- Text
- Audio
- Learning

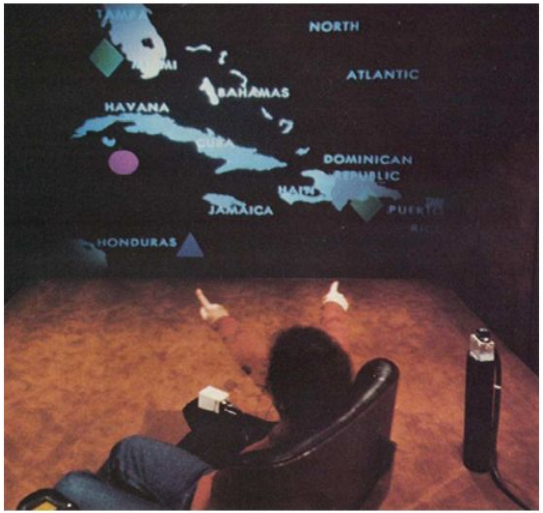
Challenges and Opportunities

Challenges:

- *Multimodal input Integration*
- *Security and Privacy Issues*

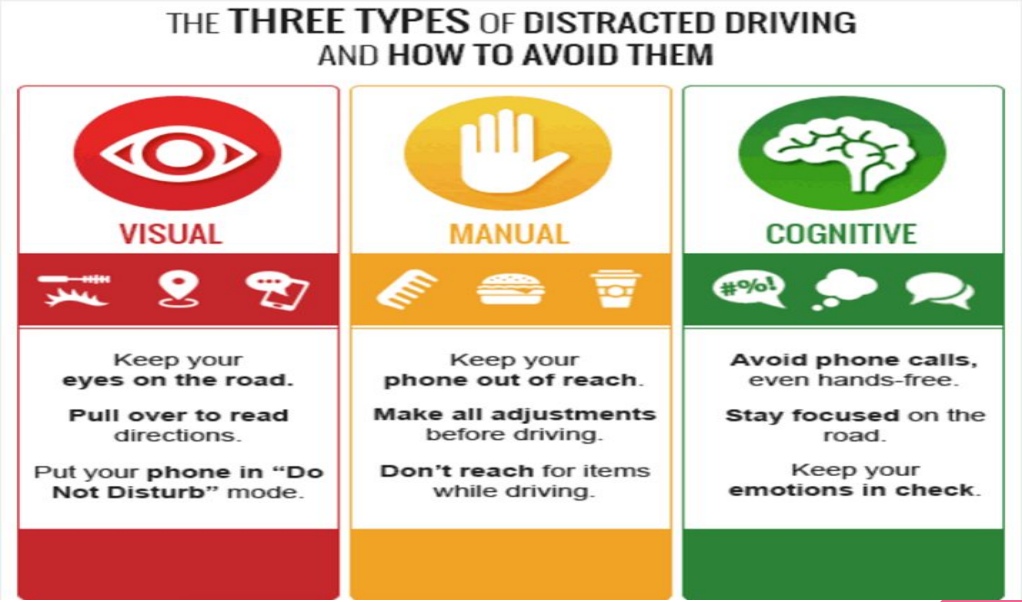
Opportunities:

- *Multimodal In-Car Enhanced Interaction System.*
- *Put-that-there.*



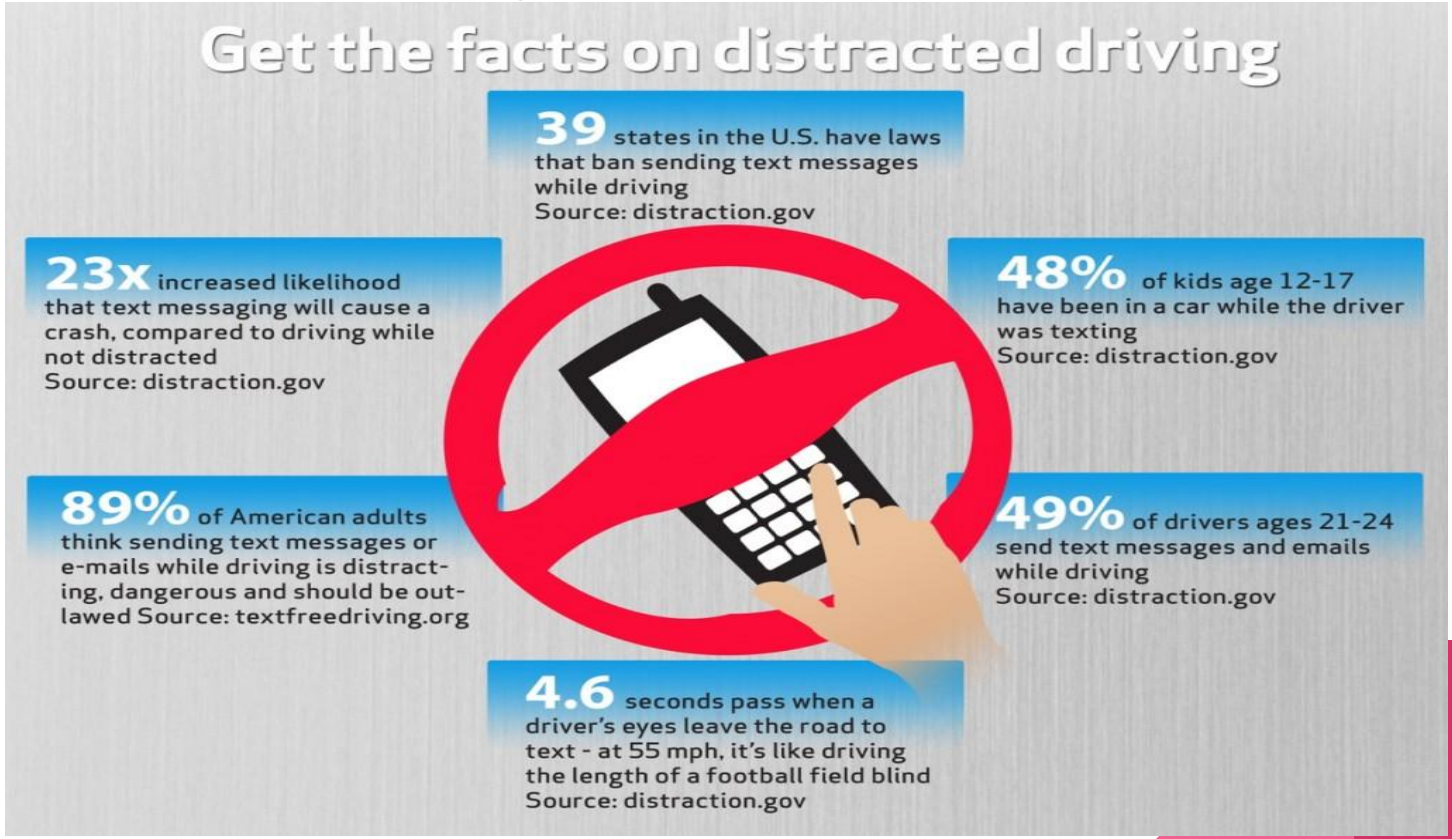
Driver Distraction

- Distracted driving is any non-driving activity that takes the driver's attention from the primary task of operating the vehicle and increases the risk of crashing.



Each day in the United States, more than 9 people are killed and more than 1,060 people are injured in crashes that are reported to involve a distracted driver" Centers for Disease Control and Prevention

Driver Distraction-Key Facts & Statistics-distraction.gov



Government Efforts

- All the states continue to pass distracted driving laws.
- States are making efforts to enforce the laws.
- Use of Social Media and Technology
- Focus to the teen drivers
- Partnering with other public and private firms
- Improved the data collection practices

Report "2013 Distracted Driving: Survey of the States "released by The Governors Highway Safety Association (GHSA)

Speech Recognition (In-Car Voice Recognition)

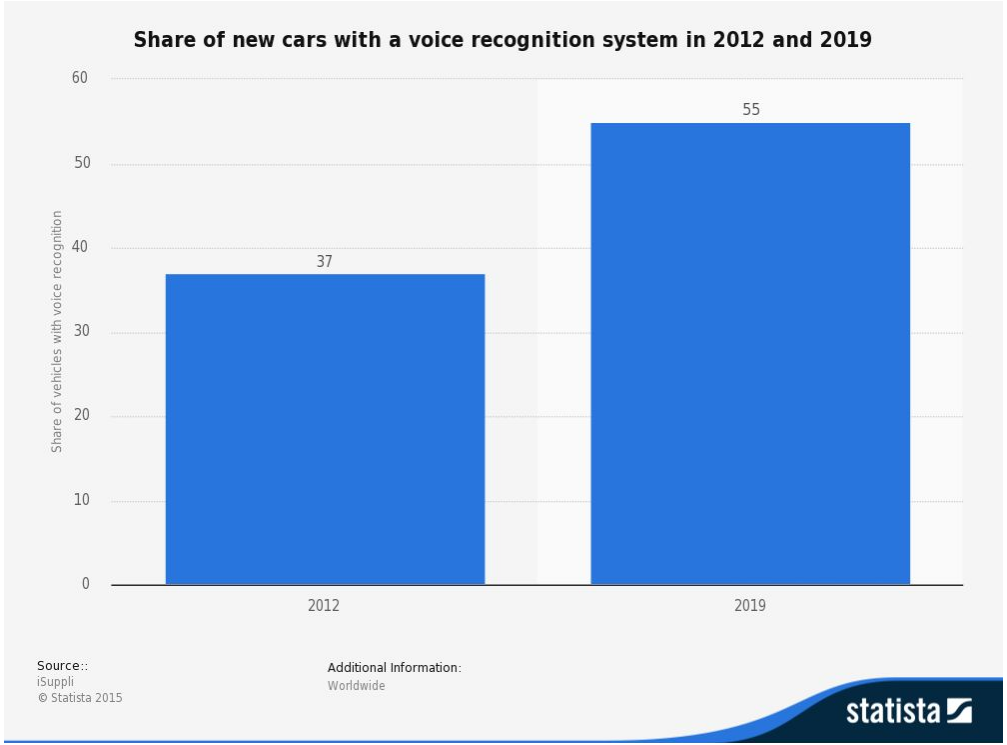
- Speech recognition is a process of converting spoken words into text.

- Speech Recognition system classified:
  - Types of Speech Utterance
  - Types of Speaker Model
  - Types of Vocabulary

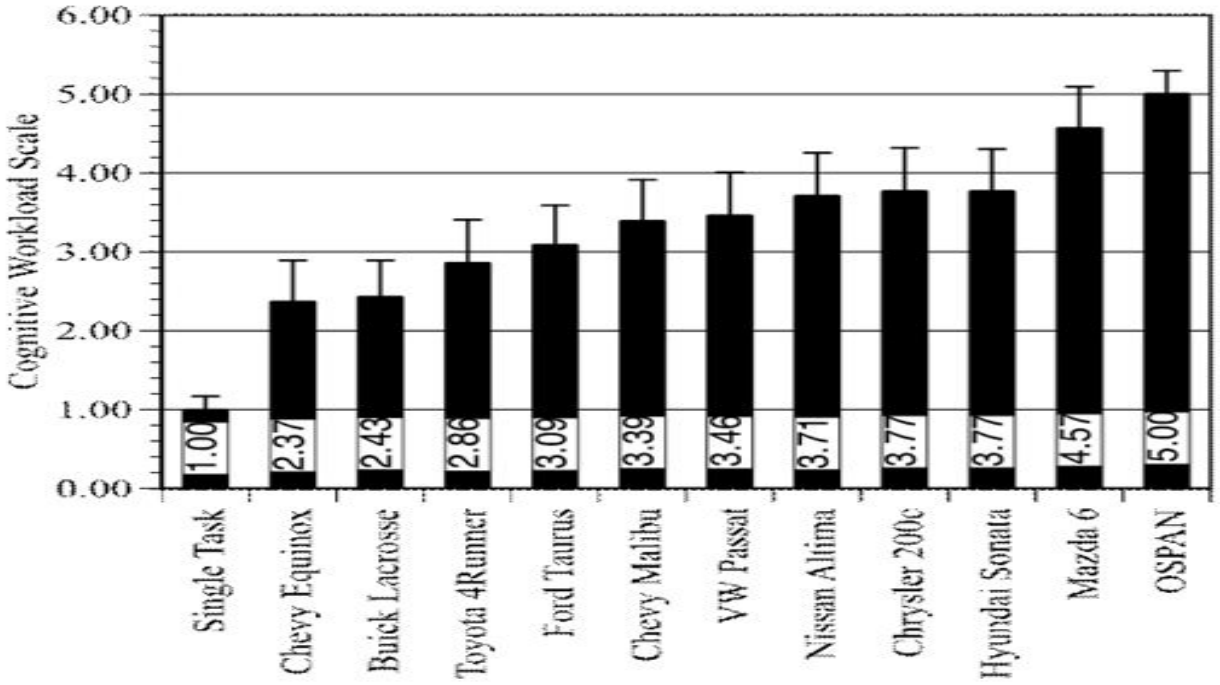
Speech Recognition -Challenges

- Vocabulary size
- Speaker dependence vs. independence
- Isolated, Discontinuous or continuous speech
- Language constraints e.g.: "Red is apple the.“
- Environment conditions inside the car

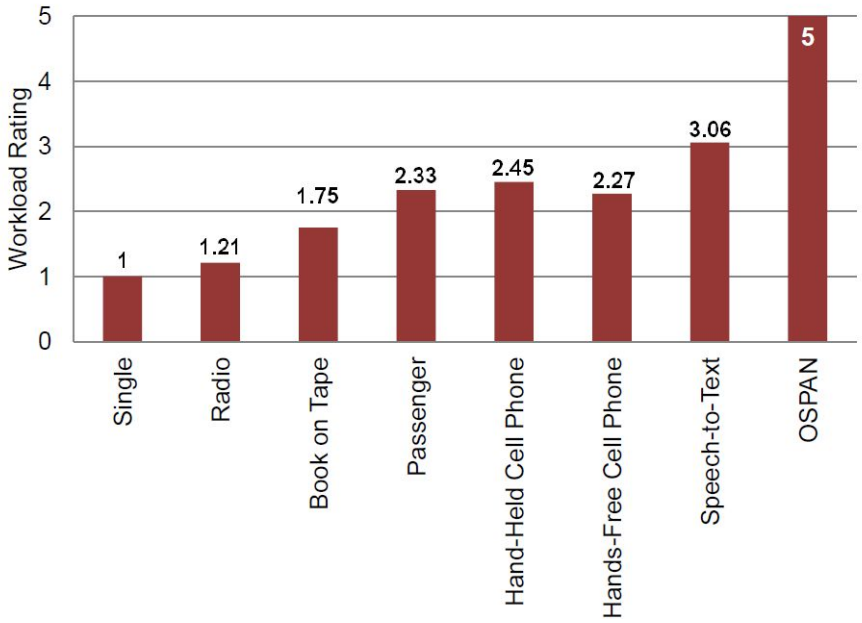
Statista Survey 2015



Cognitive Workload As Per AAA -October 2015



Speech to Text Cognitive Distracting (AAA -2011)

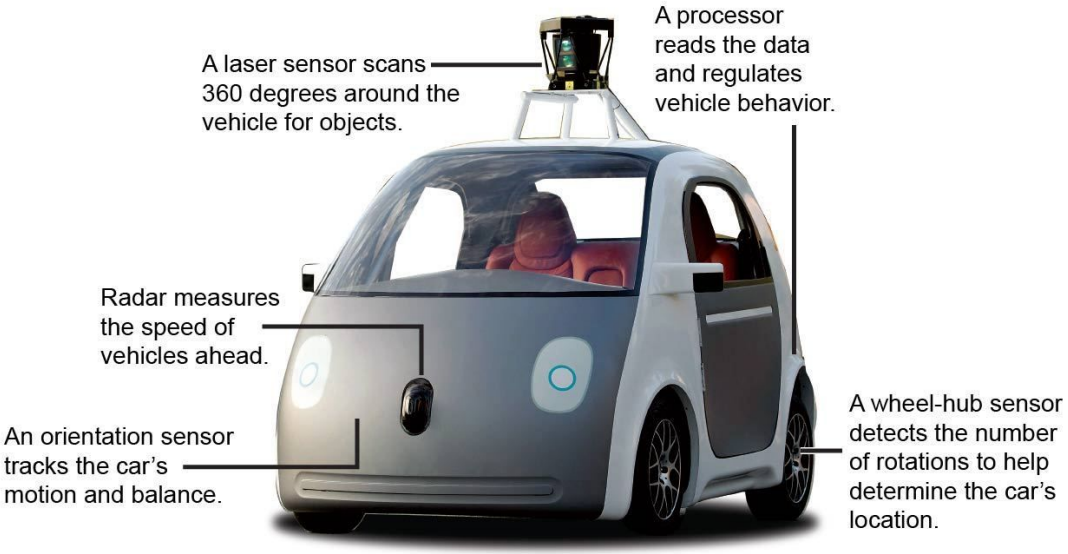


Future in Speech Recognition System

- QNX Helps Automakers Gear Up for Integrated Driving Experiences at 2015 CES
- Advanced Auto Safety Report 2014-Telematics survey
- Voice recognition and gesture controls by ECN staff,2014
- https://www.youtube.com/watch?v=ykz482zneAw

Autonomous Cars

- Known as a un-crewed vehicle, driverless car, self-driving car and robotic car.
- Capable of fulfilling the main transportation capabilities of a traditional car.
- Senses its environment and navigation without human input.

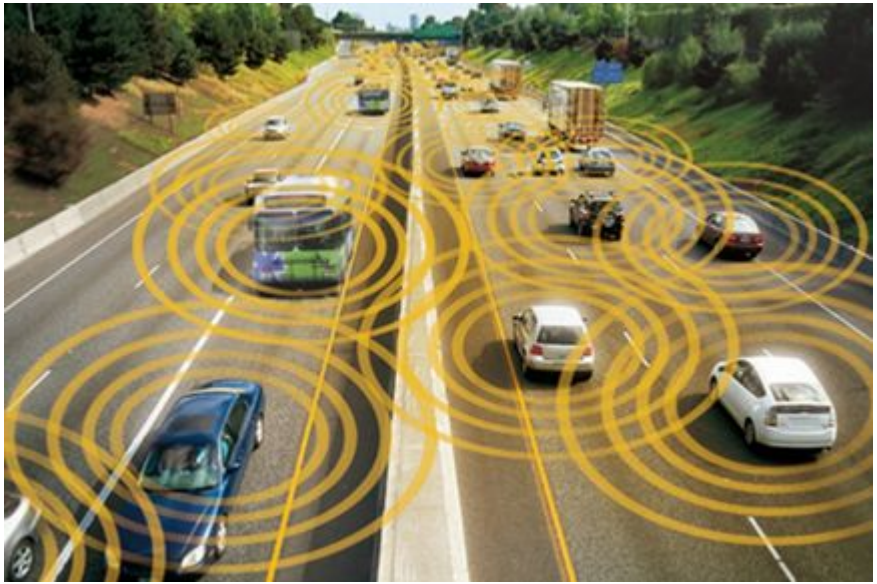


Source: Google

Raoul Rañoa / @latimesgraphics

Autonomous Cars

By definition, autonomous vehicles are capable of updating their maps based on sensory input, allowing the vehicles to keep track of their position even when conditions change or when they enter uncharted environments.



Autonomous Cars

There are four good reasons that make perfecting driverless car technology something that we should push for:

Traffic

One of the long-term goals of the autonomous driving movement is to connect vehicles with each other as well as the roads themselves in a way that are not possible with human drivers.

Productivity

Being able to use drive times to do work, spend time with family, or simply relax is a clear potential benefit of having an autonomous car.

Autonomous Cars

Handicap Transportation

Driverless vehicle technology isn't simply for convenience or safety. It's possible for those who are completely unable to drive themselves to realize the freedom of "one's own wheels" through autonomous vehicles.

Fewer Accidents

Some think the trade-off of fewer drunk, unskilled, or distracted drivers outweighs the potential drawbacks of non-human road interactions.

Autonomous Cars as a microcosm of IoT

Autonomous Cars as a microcosm of IoT

- The path to a mature development of IoT-aided robotics applications requires several pivotal issues to be solved, design methodologies to be consolidated, and strong architectural choices to be discussed.

- Recent advances in communications, controls and embedded systems have changed this model, paving the way to the Intelligent Vehicle Grid.

- The car is now a formidable sensor platform, absorbing information from the environment (and from other cars) and feeding it to drivers and infrastructure to assist in safe navigation, pollution control and traffic management.

- The next step in this evolution is just around the corner:
  the Internet of Autonomous Vehicles.

Cyber Cars

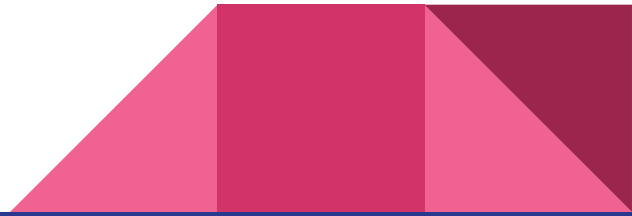
- Is a car that is equipped with Internet access
- Provide automatic notification of crashes, notification of speeding and safety alerts
- Includes smartphone apps, navigation, roadside assistance, voice commands etc

Pros of Cyber Car

- Emergency services
- Vehicles of the future are expected to sense and "see" things
- Vehicles will also know the condition of the vehicles around them
- This technology can be used in school buses and delivery vehicles
- It can provide lane departure warnings to drivers.

Cons of Cyber Car

- With so many features and constant back and forth with the car, driver distraction increases.
- Opportunities for hackers, criminals or governments to spy on drivers increases.
- Can cause auto malfunctions and/or accidents.
- Due to constant connectivity, increased data collection may cause privacy concerns.



Hacking of cyber cars

CAR	ATTACK SURFACE	NETWORK ARCHITECTURE	CYBER PHYSICAL
2014 Jeep Cherokee	++	++	++
2015 Cadillac Escalade	++	+	+
2014 Ford Fusion	++	-	++
2014 Dodge Ram 3500	++	++	--
2014 BMW X3	++	--	++
2014 Chrysler 300	++	-	++
2014 Range Rover Evoque	++	-	++
2014 Toyota Prius	+	+	++
2010 Toyota Prius	+	+	++
2014 Infiniti Q50	++	+	+
2014 Audi A8	++	--	+
2010 Infiniti G37	-	++	+
2014 BMW 3 Series	++	--	+
2014 BMW i12	++	--	+
2014 Dodge Viper	++	-	--
2014 Honda Accord LX	-	+	+
2010 Range Rover Sport	-	--	-
2006 Range Rover Sport	-	--	-
2006 Toyota Prius	-	--	--
2006 Ford Fusion	--	--	--

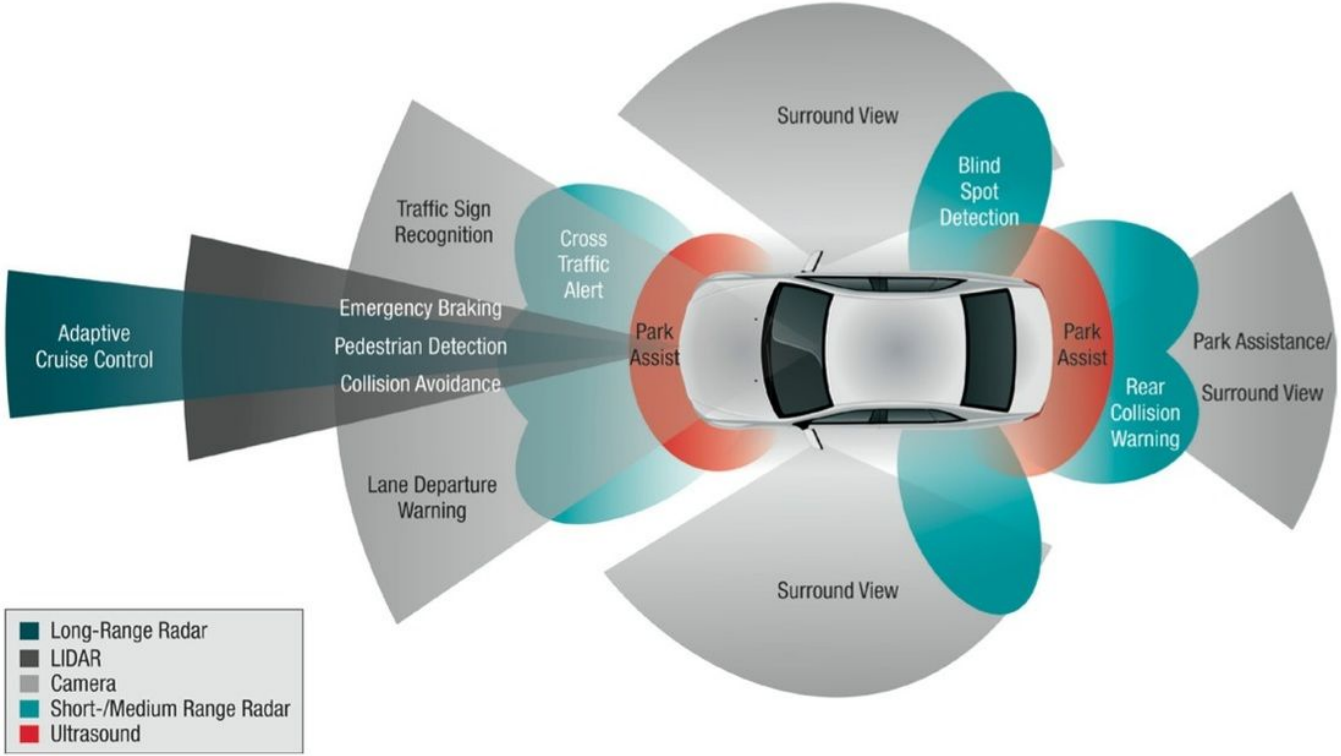
A '+' sign means a car is 'more hackable', and a '-'sign represents a 'less hackable' vehicle.

A car's wireless **'attack surface'** includes the range of features that could be hacked, including Bluetooth, Wi-Fi, mobile network connections, key fobs, and tyre pressure monitoring systems.

The **network architecture** includes how much access these features give to the vehicle's critical systems, such as the horn, the steering and brakes.

http://video.wired.com/watch/hackers-wireless-jeep-attack-stranded-me-on-a-highway

Automatic Driver Assistance System (ADAS)



Classification of ADAS

- Lane Change Assistance Systems
  - Lane Departure Warning System (LDWS)
  - Blind Spot Detection (BSD)
- Forward or Rearward looking Systems
  - Collision Warning Systems: Pedestrian Detection System (PSD)
  - Rear Cross Traffic Alert (RCTA)
- Cruise Control Systems
  - Adaptive Cruise Control (ACC)
  - ACC with Stop & Go
- Adaptive Light Control Systems
- Park Assistance System (PAS)
- Night Vision System (NVS)
- Traffic Sign and Traffic Light Recognition Systems
  - Traffic Sign Recognition System (TSRS)
  - Traffic Light Recognition System (TLRS)
- Navigation and Map Supported Systems
- Vehicle Interior Observation and Driver Monitoring Systems
- Autonomous Driving

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- http://mcsac.fmcsa.dot.gov/documents/DriverDistractionStudy.pdf
- http://www.dmv.org/articles/april-is-distracted-driving-month/
- http://www.fastcompany.com/1817205/can-autonomous-cars-really-make-roads-safer
- http://www.wired.com/2014/12/nokia-here-autonomous-car-maps/
- http://www.wired.co.uk/news/archive/2014-08/19/terrible-idea-robot-car-ethics
- http://www.wired.com/2015/01/nasa-nissan-join-forces-build-self-driving-vehicles-earth-space/
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- http://cordis.europa.eu/result/rcn/45177_en.html
- http://www.serpentine.ch/telechargement/plaquettes/407.01_CyberCars-Leaflet.pdf
- http://www.transport-research.info/web/projects/project_details.cfm?id=45941%20
- http://arxiv.org/ftp/cs/papers/0510/0510059.pdf
- http://viewpoint.sasken.com/wp-content/uploads/2013/06/car-630x210.jpg
- http://www.wallstreetdaily.com/2015/02/06/connected-cars/
- http://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/
- http://www.dailymail.co.uk/sciencetech/article-2719866/The-20-hackable-CARS-revealed-Report-lists-smart-vehicles-risk-having-systems-hijacked.html

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THANK YOU!