

# REMOTE SERVICE PROVIDER

AUTONOMOUS  
LEVEL 3-4 VEHICLE

*WE STAY IN THE LOOP, SO YOU DON'T HAVE TO*

**AV**  
**ON DEMAND**



**DESIGN  
FORWARD** 

**1.**

**Challenge**



## DEFINING OUR PROBLEM SPACE



### Questions we asked ourselves in the beginning:

- How can we improve the experience in AVs to make them feel more safe, reliable, and accessible for all types of riders?
- How can we take into consideration the jobs of professional drivers?
- How do we ease the transition from semi-autonomous to fully-autonomous vehicles?



## D4SD CHALLENGE & TOPIC

**Problem:** AVs aren't completely reliable – they still expect the rider to takeover in certain difficult conditions. How can we allow all types of riders to travel freely in AVs without having to worry about a possible takeover event?



# 2.

## **Research, Observations, and Solution**





## DISABILITY IN AMERICA

- ★ 1 in 7 people in the US (57 million) have a disability, and for a large subset of the disabled community, transportation remains inaccessible and unreliable for their needs.
- ★ AV legislation is being discussed, but not so much as to how AVs can accommodate riders with disabilities.
- ★ Ride-sharing companies are not completely reliable for riders with disabilities.

# INTERVIEWING AT PB, MISSION VALLEY, VA HOSPITAL

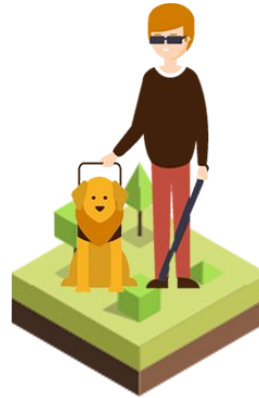


## OUR SOLUTION

**Solution:** AV onDemand eliminates all rider takeover responsibilities and improves accessibility within autonomous vehicles by connecting each vehicle to a service provider to remotely handle the AV whenever the situation arises.

# THE REMOTE A.V. SERVICE PROVIDER PROCESS

AV onDemand connects a service provider to an AV that operates on existing ride-sharing infrastructures and acts as a facilitator when the vehicle experiences technical difficulties in dynamic environments.



CARRIED OUT BY  
PASSENGER



CARRIED OUT BY  
SERVICE PROVIDER



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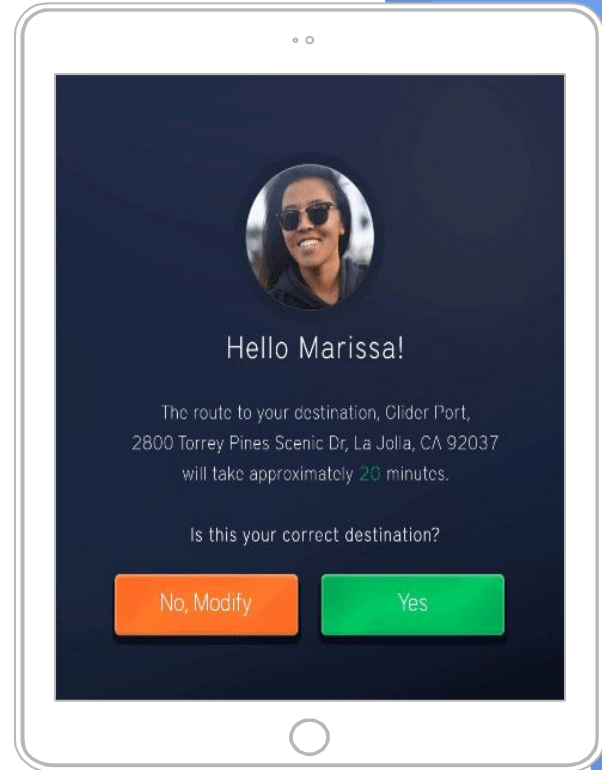
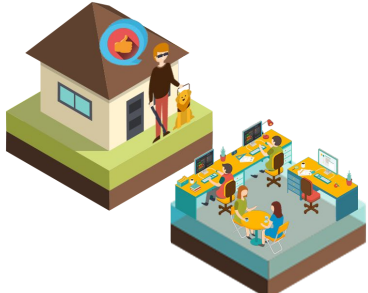
3.

## **AV onDemand Process**

## 1. PASSENGER ORDERS **SERVICE**

- ▶ Rider enters and confirms destination
- ▶ A service provider can be summoned throughout the entire trip

To the right: example of rider UI



## Day in the Life: Service Provider



- ▶ Service providers given 360 view of surrounding environment
- ▶ System status indicates AVs confidence to maneuver through environment
- ▶ Service providers work from a remote location and view a system status for all autonomous vehicles currently dispatched on rides with ride sharing companies.



## HAZARD ZONE DETECTION

Machine learning helps perform comparative analysis that calculates hazard zone percentage to determine whether vehicle may be in danger

i.e. construction zone or dirt roads

To the right: example of service provider UI showing different cars that have increasing hazard zone percentages over time





## AV & SERVICE PROVIDER COLLABORATION

### Upcoming Obstacle Detected

System has detected potential paths for bypass.

#### Route History

Left turn on Scholars Dr S onto Scholars Ln  
3000 feet

Make a U-Turn on Scholars Ln  
3000 feet

Turn right on Scholars Dr S  
2500 feet



#### System Generated Alternate Routes

1. Drive past road lines on shoulder to bypass obstacle.  
Approximate time estimate: ~12 minutes

Modify

Select Path



2. Perform U-Turn when conditions are safe and drive alternate route.  
Approximate time estimate: ~10 minutes

Modify

Select Path



#### Manual Override Option

Set Restrictions

Set Destination

Set Path/Trajectory

Front Perspective



Blind Spot Front Left Perspective



Back Perspective



Blind Spot Front Right Perspective





## AV & SERVICE PROVIDER COLLABORATION (CLOSEUP)

### Upcoming Obstacle Detected

System has detected potential paths for bypass.

Manual Override Option 

Set Restrictions

Set Parameters

Set Path Trajectory

Front Perspective



Blind Spot Front Left Perspective



Back Perspective



Blind Spot Front Right Perspective



## Closeup of Manual Override

Setting paths, boundaries, and restrictions for the AV to safely follow

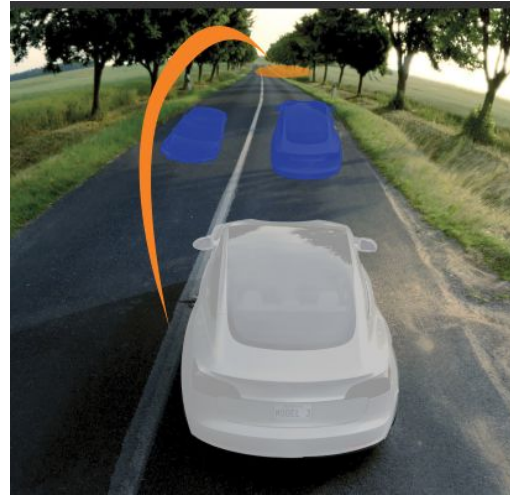


## MANUAL OVERRIDE MODE - FAQ



### Why not create a driving simulator?

1. Requires precise calibration
2. Capture-to-Display Latency
3. Different model cars handle uniquely



### Why trajectory arrows?

1. Reduce takeover responsibilities
2. UI is uniform for all cars
3. Increased depth perception



# 4.

## Testing and Feedback





## Testing and Feedback

### Testing Rider UX

AV gives audio notifications to alert “blind” passenger of its arrival

Approximately 5 minute trip with construction zone detected

### Findings for Rider Experience

Riders were comfortable and relaxed

Communication mostly helpful but one rider described it as “extra”

Problems:

- Blindfolded passengers had difficulty finding vehicle
- Riders were not rushed which could explain why they were relaxed

# Testing and Feedback

## Testing Service Provider UX

Tested to see if service providers could provide smart choice in short amount of time

Easiest way we could think of to test UI

Problems:

- Could make quick and safe decisions but difficult to place stickers in the correct spot as video moves



# Testing and Feedback

## Service Provider Ratio

Honda service help line took 7 minutes to answer one of us

Same person answered the five of us successively

Pointed out that SP ratio should be 1:1



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**5.**

**Feasibility**

## Implementation of Existing Technology

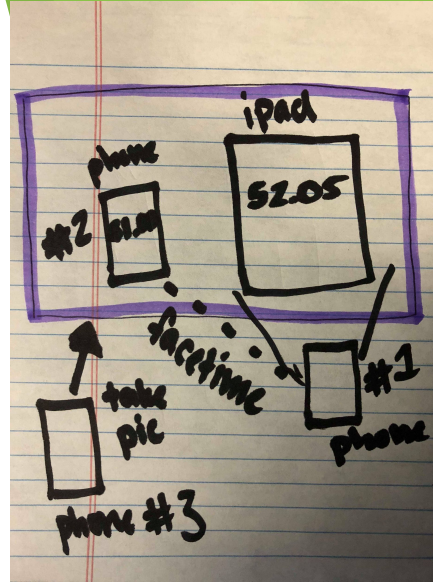
The technology needed to implement AV onDemand already exists

- Capture-to-Display technology
  - ◆ Satellite data transfer
- Machine learning and big data acquisition
- Lidar detectors

# Capture-to-Display Latency

Time it takes to compress, decompress, then display video to remote location

- Empirical testing with skype shows a CTD of 200ms delay
- Skype states their latency can reach a minimum of 150ms
- Car can travel up to 5.5ft in 25mph zone



# Understanding Big Data

Uber and Lyft test AVs in urban environments to identify where they fail

Data storage can be called upon in real time to verify if an AV is in a predetermined hazard zone





A thick, solid red diagonal stripe runs from the top right corner towards the bottom left, dividing the white background.

6.

Impact

## Mobility for Individuals with Disabilities



AV onDemand eliminates passenger takeover responsibilities required in level 3 to 4 AVs, increasing mobility for the physically, cognitively, and visually disabled.

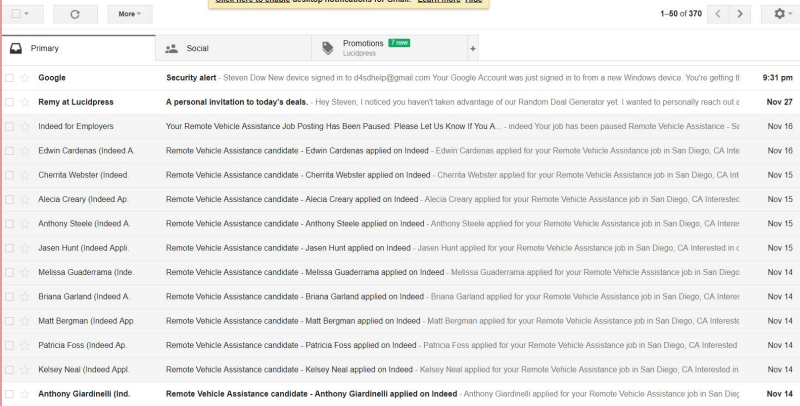
## Enhanced Rider Freedom

AV onDemand's service extends to all ride-share customers who don't want to worry about rider responsibility.

## New Employment Opportunities

AV onDemand creates a new job market for professional drivers who would be displaced by AVs.

Individuals with disabilities who demonstrate the capacity to perform service provider duties may also be employed.



The screenshot shows an email inbox interface. At the top, there's a search bar and navigation icons. Below the search bar, there are tabs for 'Primary', 'Social', and 'Promotions'. The 'Primary' tab is selected. The inbox list shows several emails, all from 'Indeed' regarding job applications for 'Remote Vehicle Assistance'. The emails are listed in a table-like format with columns for sender, subject, and date.

Sender	Subject	Date
Google	Security alert - Steven Dow New device signed in to d4sdhelp@gmail.com Your Google Account was just signed in to from a new Windows device. You're getting if	9:31 pm
Remy at Lucidpress	A personal invitation to today's deals. - Hey Steven, I noticed you haven't taken advantage of our Random Deal Generator yet. I wanted to personally reach out &	Nov 27
Indeed for Employers	Your Remote Vehicle Assistance Job Posting Has Been Paused. Please Let Us Know if You A... indeed Your job has been paused Remote Vehicle Assistance - Si	Nov 15
Edwin Cardenas (Indeed A	Remote Vehicle Assistance candidate - Edwin Cardenas applied on Indeed - Edwin Cardenas applied for your Remote Vehicle Assistance job in San Diego, CA Inte	Nov 15
Cherrita Webster (Indeed	Remote Vehicle Assistance candidate - Cherrita Webster applied on Indeed - Cherrita Webster applied for your Remote Vehicle Assistance job in San Diego, CA Int	Nov 15
Alicia Creary (Indeed Ap	Remote Vehicle Assistance candidate - Alicia Creary applied on Indeed - Alicia Creary applied for your Remote Vehicle Assistance job in San Diego, CA Interestec	Nov 15
Anthony Steele (Indeed A	Remote Vehicle Assistance candidate - Anthony Steele applied on Indeed - Anthony Steele applied for your Remote Vehicle Assistance job in San Diego, CA Interne	Nov 15
Jasen Hunt (Indeed Appl	Remote Vehicle Assistance candidate - Jasen Hunt applied on Indeed - Jasen Hunt applied for your Remote Vehicle Assistance job in San Diego, CA Interested in c	Nov 15
Melissa Guaderrama (Inde	Remote Vehicle Assistance candidate - Melissa Guaderrama applied on Indeed - Melissa Guaderrama applied for your Remote Vehicle Assistance job in San Diego	Nov 14
Briana Garland (Indeed A	Remote Vehicle Assistance candidate - Briana Garland applied on Indeed - Briana Garland applied for your Remote Vehicle Assistance job in San Diego, CA Interne	Nov 14
Matt Bergman (Indeed Ap	Remote Vehicle Assistance candidate - Matt Bergman applied on Indeed - Matt Bergman applied for your Remote Vehicle Assistance job in San Diego, CA Interest	Nov 14
Patricia Foss (Indeed Ap	Remote Vehicle Assistance candidate - Patricia Foss applied on Indeed - Patricia Foss applied for your Remote Vehicle Assistance job in San Diego, CA Interestec	Nov 14
Kelsey Neal (Indeed Appl	Remote Vehicle Assistance candidate - Kelsey Neal applied on Indeed - Kelsey Neal applied for your Remote Vehicle Assistance job in San Diego, CA Interested in	Nov 14
Anthony Giardinelli (Ind	Remote Vehicle Assistance candidate - Anthony Giardinelli applied on Indeed - Anthony Giardinelli applied for your Remote Vehicle Assistance job in San Die	Nov 14

We put a fake service provider job listing on Indeed.com and received over 300 applications!

A thick yellow diagonal stripe runs from the top right corner towards the bottom left, separating the white background from a solid yellow area on the right.

**7.**

**Future Steps**

## Developing a Robust Service Provider UI

### What we have:

Alex on roof with phones taped together

Snapchat stickers to indicate boundaries and paths

2D arrow projectiles



## Developing a Robust Service Provider UI

### What we want:

Camera with 360 view

Drag and drop indicators onto real time video for manual takeover

- 3D arrow projectiles

Computer program that allows the Service Provider to actually control the car

Calculate the perfect ratio of service providers to AVs

### How to do:

Access to an AV

Computer programmers and mechanics

Gather data for hazard percentages

More time

More testing

\$\$\$



Thank you!!

References:

<http://www.ti.com/lit/wp/spry301/spry301.pdf> Calculating Latency

U.S. Census Bureau, American Community Survey

Bureau of Transportation Statistics, “Transportation Difficulties Keep Over Half a Million Disabled at Home,” April 2003.