

**Automated vehicle Services for People with disabilities –  
Involved Responsive Engineering  
(ASPIRE Center)**

**Quarterly Progress Report #6**

<b>Grant Number:</b>	69A3552047140
<b>Topic:</b>	Implications of Accessible Automated Vehicles and Mobility Services for People with Disabilities
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<b>Partner Universities:</b>	Uniformed Services University of Health Sciences The Catholic University of America
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<b>Prepared for:</b>	University Transportation Centers Program, Office of the Assistant Secretary for Research & Technology, U.S Department of Transportation

## 1. Accomplishments

**Aim 1: Systematic Review:** We will conduct a comprehensive review of the literature to more clearly understand the current trends and implications for future travel related to accessible automated vehicles and services.

- **Specific Objectives and Major Activities:**

Nothing to report this quarter as we have successfully completed Aim 1 as mentioned in previous reports. Please refer to the below mentioned manuscript publication:

<https://doi.org/10.1016/j.neulet.2021.136103>

Dicianno, Brad E., Sivashankar Sivakanthan, S. Andrea Sundaram, Shantanu Satpute, Hailee Kulich, Elizabeth Powers, Nikitha Deepak, Rebecca Russell, Rosemarie Cooper, and Rory A. Cooper. "Systematic Review: Automated Vehicles and Services for People with Disabilities." *Neuroscience Letters* (2021): 136103.

**Aim 2: Understand the needs of Users and Providers:** We will conduct surveys, focus groups, and journey mapping of stakeholders, including individuals with disabilities, their travel companions and/or caregivers, designers, medical providers, and mobility service experts (e.g., vehicle manufacturers and modifiers, as well as adaptive driving training instructors). The survey will be refined using pilot surveys, focus groups and journey mapping and then distributed broadly to all key stakeholders.

- **Specific Objectives:**

1. Recruit and enroll research participants for Journey Mapping
2. Finalize script for AV focus group (designers, medical providers, and mobility service experts)
3. IRB Modification to include designers, medical providers, and mobility service experts in the AV Focus groups
4. Recruit and enroll research participants for AV Focus Group
5. Finalize survey questions and draft on REDCap
6. IRB protocol development for pilot/nationwide survey

- **Major Activities:**

***Journey Mapping***- One-on-one interviews were conducted via Zoom with individuals with disabilities and older adults to better understand their current transportation related experience. Participants were asked to share their decision-making processes and steps taken to use mobility services. All study procedures with respect to recruitment, enrollment, data analysis, reimbursement, etc. are being followed per approved IRB protocol.

An enrollment matrix was implemented to ensure good representation of individuals with varying disabilities who use personal and public transportation. To date, **18 participants** (8 female, 10 male) have been enrolled in the Journey Mapping study. In addition, participants filled out a sociodemographic survey that captured information related to age, gender, disability type, etc. Study participants belonged to the following disability categories (*as defined by American Community Survey (ACS)*):

- 1) Hearing difficulty, deaf or having serious difficulty hearing (DEAR).
- 2) Vision difficulty, blind or having serious difficulty seeing, even when wearing glasses (DEYE).

- 3) Cognitive difficulty. Because of a physical, mental, or emotional problem, having difficulty remembering, concentrating, or making decisions (DREM).
- 4) Ambulatory difficulty. Having serious difficulty walking or climbing stairs (DPHY).
- 5) Self-care difficulty. Having difficulty bathing or dressing (DDRS).
- 6) Independent living difficulty. Because of a physical, mental, or emotional problem, having difficulty doing errands alone such as visiting a doctor's office or shopping (DOUT).

Please note that a few participants fell under multiple categories. A sample size of 12-15 participants has been found to be adequate to achieve thematic saturation in qualitative research using interviewing techniques. We will aim to interview up to 20 participants for Journey Mapping. Currently, preliminary data analysis is on-going and will report more details in the next quarter.

**Focus Groups-** The purpose of the AV Focus Group research study is to better understand transportation experts, individual with disabilities, older adults, and their caregivers' views on automated vehicles (AV) and transportation systems such as self-driving cars, automated ridesharing (e.g., Ubers without drivers), etc.

This quarter, questions to be asked to the 'Transportation Provider, Expert or Designer' group were finalized. An IRB amendment was submitted to include this to the existing study protocol that was subsequently approved by the University of Pittsburgh, Institutional Review Board. The socio-demographics survey was also updated.

**Study title:** Automated vehicle Services for People with disabilities – Involved Responsive Engineering (ASPIRE Center): Journey Mapping- Focus Group

**IRB #:** MOD20090111-002

**Review Type:** Modification / Update

**Approval date:** 1/13/2022

We have initiated this phase of the study. Mock trials were conducted, and all necessary study logistics have been coordinated. The first focus group involving people with disabilities (N=5) was successfully completed. Multiple focus groups consisting of 4-6 individuals with disabilities/older adults, their travel partners/caregivers and transportation providers/experts/designers will be facilitated by trained study team members to obtain perceptions around Automated Vehicle (AV) transportation & systems. Recruitment efforts are on-going.

Individuals who participated in the Journey Mapping will be encouraged to participate in the AV focus groups. Interview guides will be used to maintain consistency in the questions being asked for each group. These discussions will be recorded, transcribed, and responses categorized to extract common themes.

**Survey development-** A draft of the 'Voice of the Consumer' and 'Voice of the Provider' survey questions were finalized after review from the advisory board members. These questions were designed mainly based on literature review however as we complete focus groups, we expect updates/modification to these national survey-based questions. Currently, we are building the survey using REDCap.

Voice of Consumer: Individuals with disabilities/older adults, travel partners like caregivers or spouse  
Voice of Provider: Transportation Provider, Expert or Designer

IRB related to the survey is currently under development and will be submitted for review this quarter.

**Study title:** Automated vehicle Services for People with disabilities – Involved Responsive Engineering (ASPIRE Center): Voice of Consumer-Provider survey

**IRB #:** STUDY20120052

**Review Type:** Pending  
**Approval date:** Pending

**Aim 3: Data synthesis, extrapolation, analysis and modeling:** We will synthesize the data obtained to understand the current and future needs of potential stakeholders of accessible automated transportation and services. This will involve presenting summary survey findings, extrapolating findings to the greater population of potential automated vehicle users, combining our data with publicly available datasets to understand factors that influence travel, displaying clusters of users based on their characteristics and needs, and ideation and development of solid models that illustrate key features and parameters for implementing automated vehicles and mobility services.

- **Major Activities:**

Transcripts from Zoom recordings of ‘Journey Mapping’ interviews are currently being de-identified for data analysis purposes to extract common themes.

*New sub-project: Wheelchair Accessible Autonomous Vehicle Concept*

Dr. Grindle is putting together a team to work on integrating design of powered wheelchair and EV van to communicate, coordinate, and be more compatible. We have hired and onboarded two post-docs to assist with this project.

Our partners at the School of Architecture & Planning at CUA and Center for Rehabilitation Sciences Research at USUHS have established a team to implement three phases of research activities to accomplish stated project goals. These teams will utilize architects and designers with skills in digital media to:

Phase I – develop infographics that depict to users with disabilities and stakeholders within transportation services, the existing barriers, and challenges, as well as unknown and unexplored issues/factors that need to be elucidated to enhance transportation services for individuals with disabilities, that were uncovered during the systematic review of the literature (Diciano et al.).

Phase II – develop infographics to better portray the information gathered through the Focus Groups and survey studies. These infographics will emphasize the depiction of “journey mapping” across the transportation continuum (e.g., from home to the store, throughout community, leisure travel, etc.).

Phase III – the teams will work in a trans-disciplinary fashion with engineers, transportation stakeholders, and users across the spectrum of disabilities, to develop design concepts and plans for self-driving vehicles, that accommodate persons with disabilities throughout the challenges and barriers that were previously identified during phase I and phase II.

## **2. Changes/Problems**

### **a. Actual Problems or delays and actions to resolve them**

The initial proposed work with CUA had to be delayed in executing the activities within the grant because of COVID-19 restrictions. A contractual/award agreement has now been established between U. Pitt and Catholic University. Budget, budget justification, and statement of work have also been adjusted to reflect the updated period of performance, as outlined by the no-cost extension.

### **b. Anticipated Problems/Issues**

Nothing to Report.

### 3. Collaborations

The ASPIRE Center continues to attract more organizations to engage and partner. We have now included Braun Mobility as a partner in our UTC. This quarter, we have continued to engage advisory board members in project activities such as reviewing survey questions, recruitment strategies, etc. In addition, we worked with Toyota Mobility Foundation (TMF) on the data analysis of 'Journey Mapping' study. Another DoT-ASPIRE Center Advisory Board meeting has been scheduled and we will continue to hold these bi-monthly meetings.

Over the quarter, Dr. Cooper and team have presented in the below events:

- ADED Conference "Accessible Autonomous Vehicles", Columbus, Ohio, January 16, 2022
- National Mobility Equipment Dealers Association (NMEDA) Conference [Keynote "Rolling Disruptors" panel](#), Columbus, Ohio, January 15, 2022

### 4. Education and Workforce Development

In this quarter, we hired and onboarded two post docs into our team. We continue to engage PhD students in activities such as data analysis, designing focus group and survey questions for Aim 2. In addition, we will have interns and co-ops working on project activities.

The CUA team is currently developing the curriculum and proposed course credit hours for graduate and undergraduate students to expand their knowledge of digital media, autonomous/self-driving vehicles, and transportation infrastructure to apply this towards each phase of the project. These students and their faculty mentors will not only promote further inquiry and discovery within the field but help disseminate to the stakeholders and general public the existing challenges and barriers, as well as possible solutions to expand safe and effective transportation options for individuals across the spectrum of disabilities. Moreover, students will be taught how to work within trans-disciplinary teams (designers, healthcare providers, architects, engineers, caregivers, transportation officials, industry, etc.) to create solutions that not only alleviate barriers to transportation for individuals with disabilities but enhance the transportation options for all.

### 5. Performance metrics

Peer-Reviewed Journal Publication:

1. Sivakanthan S, Castagno J, Candiotti JL, Zhou J, Sundaram SA, Atkins EM, Cooper RA. [Automated curb recognition and negotiation for robotic wheelchairs](#). **Sensors**. 2021 Jan;21(23):7810.

Media:

**Here and Now, WBUR/National Public Radio**

- [Behind the effort to make sidewalks accessible](#)

**UTC Spotlight Newsletter**

- [Quarterly Issue 1, January 2022](#)

For more information, please refer to the ASPIRE Center website:

[Tier 1 University Transportation Center \(UTC\) grant | Human Engineering Research Laboratories | University of Pittsburgh](#)