SCC-IRG Track 1: Advancing Human-Centered Sociotechnical Research for Enabling Independent Mobility in People with Physical Disabilities

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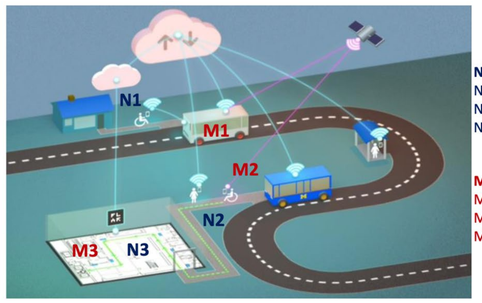
Project Challenge



NAVIGATION TASKS:
N1: House to transportation pickup point
N2: Drop off point to entry of building
N3: Entry of building to desired room

MANEUVERING TASKS:
M1: Board, maneuver and park inside vehicle
M2: De-board vehicle and localize at drop off point
M3: Maneuver and park inside desired room

Navigation and Maneuvering Tasks Encountered by Persons with Disabilities in End-to-End Mobility Scenario

Intellectual Merit

- Explore how human factors, and social-psychological factors can synergistically inform the design and adoption of end to end mobility system for wheelchair users.
- Address the identified knowledge gaps of the highly fragmented navigation and maneuvering in wheelchair design.

Broader Impact

- Greatly improve the quality of life and independence for persons with disabilities.
- Reduce the social isolation often experienced by individuals due to mobility limitations.

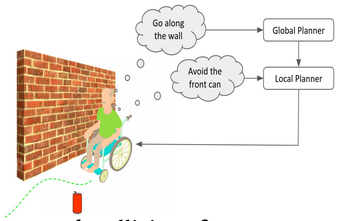
Future Goals

- Advance learning-based techniques for spatial and user preference mapping.
- Optimize wheelchair maneuverability in tight spaces and seamless transitions between outdoors and indoors.

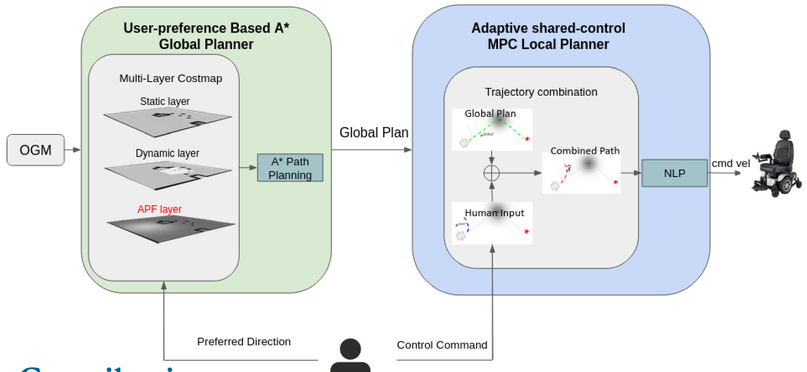
Shared-Autonomy Based Wheelchair Navigation System

Motivation

- Shared control based navigation plays an important role in gaining trust during the robot navigation.



- The development of adaptive, efficient and collision-free navigation systems is the cornerstone of intelligent wheelchair.



Contribution

- A novel shared control navigation framework taking user preferences that can achieve a desirable involvement.
- The preliminary results reveal superior efficiency compared and adherence to user-desired paths compared to other methods.
- A novel simulation and wheelchair platform is proposed.

Future work

- Develop a large language model (LLM-based global indoor tour planner to allow user to interact with the wheelchair.
- Combine the share control with socially-aware navigation system to achieve a better performance in dynamic environment

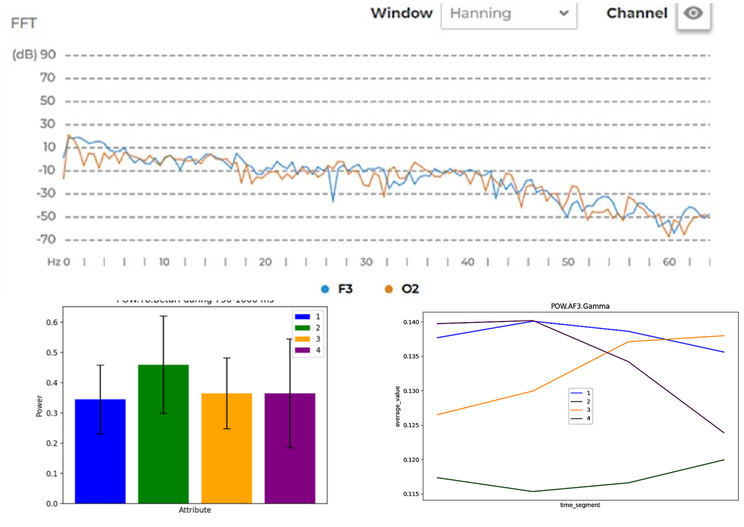
Automatic Annotation for Urban Accessibility

Motivation

- Many urban regions remain unannotated, making it challenging for persons with physical disabilities who often struggle with extended travel times and significant inconvenience for independent mobility.
- Annotating urban landscapes allows users and decision makers to identify areas that are inaccessible or require maintenance.

Contribution

- A brain-computer interface method that allows individuals to contribute to identifying inaccessible attributes in cityscapes during their daily travel.
- Transform conventional annotation efforts on crowdsourcing platforms.
- Proof-of-Concept with simulated neurophysiological data



Future work

- These identified predictive cognition dynamics can be used as a proxy to develop the proposed BCI application.
- Connect with existing navigation services and city infrastructure maintenance platforms to render accessible path planning.