University of Portland — Shiley School of Engineering

Transnavigators: Voice Controlled Wheelchair

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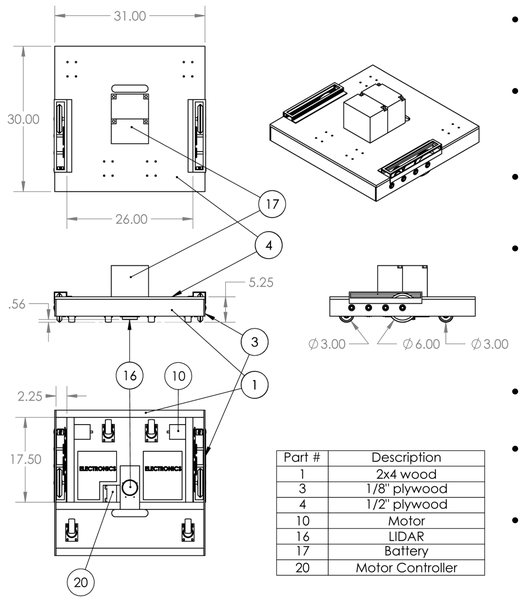
Project Summary

The Transnavigators' Voice Controlled Wheelchair will increase people's independence by autonomously navigating them to their destination using voice commands. This platform will allow users to convert their existing wheelchair into an autonomous wheelchair. It is controlled by voice commands and can find the user or navigate to a destination. One possible application is for patients in a hospital setting. In situations where their wheelchair is far away, patients can simply ask Alexa, and a wheelchair will automatically navigate itself to their position. In addition, after they get on their wheelchair, the patient can use directional and destination commands to navigate to a desired location.

Background

- Nurses typically move wheelchairs in hospitals and homes
- MIT's autonomous wheelchair (2016) – Hospital testing [1]
- WHILL NEXT (2017) – Airport testing [2]
- Autonomous car R&D applies to all autonomous vehicles
- LIDAR - obstacle detection becoming cheaper
- Ultra-wideband indoor positioning systems [3]

Chassis Design



Part #	Description
1	2x4 wood
3	1/8" plywood
4	1/2" plywood
10	Motor
16	LIDAR
17	Battery
20	Motor Controller

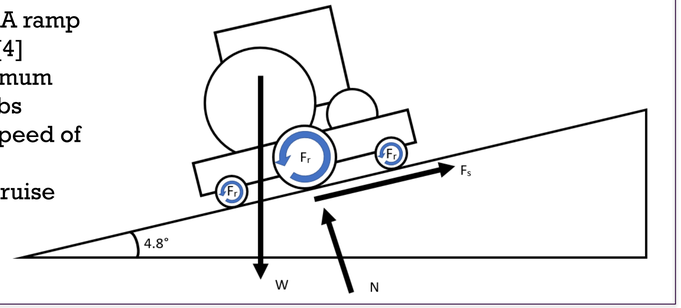
- Two driven wheels in center
- Four 360° swivel casters in corners
- Mount LIDAR and electronics under platform
- Mount wheelchair and batteries on top
- Major dimensions determined from ADA specifications for doorways and adult wheelchairs
- Doorway minimum width = 32"
- Adult wheelchair width = 26"
- Clearance below platform for ramps, LIDAR, and irregularities in surface

References

[1] Teo, Pauline (2017). Featured video: A self-driving wheelchair. Retrieved from http://news.mit.edu/2017/featured-video-self-driving-wheelchair-0726.
[2] Panasonic Corporation (2017). Public Testing of Information Universal Design begins at Haneda Airport. Retrieved from http://news.panasonic.com/global/press/data/2017/08/en170808-6/en170808-6.html.
[3] DecaWave (2015). ScenSor DW1000. Retrieved from https://www.decawave.com/products/dw1000
[4] Department of Justice (2010). 2010 ADA Standards for Accessible Design. Retrieved from https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

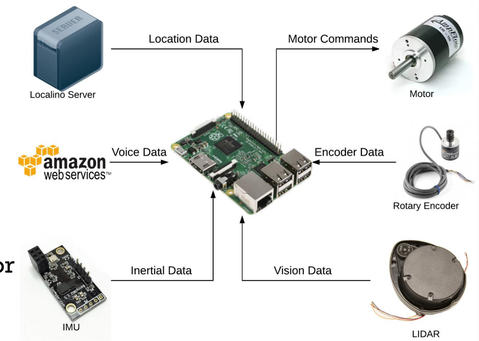
Drive Train

- Maximum ADA ramp slope of 4.8° [4]
- Desired maximum carry of 300 lbs
- Desired top speed of 4 mph
- 166 Watts to cruise

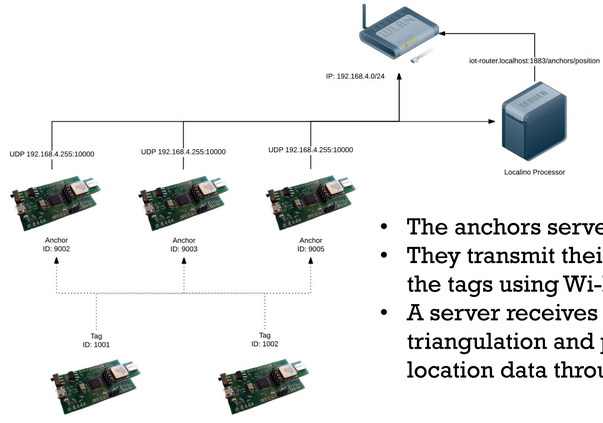


Data Flow

- AWS – voice commands
- Localino – absolute position
- LIDAR – obstacle avoidance
- IMU - orientation
- Raspberry Pi - process data & controls motor
- Motor - feedback loop for speed control



Positioning System



- The anchors serve as landmarks
- They transmit their distance to the tags using Wi-Fi
- A server receives the data for triangulation and publishes location data through MQTT

Voice Recognition System

- User says a command to Echo
- Alexa interprets and transforms the command into JSON
- Lambda updates IoT's device shadow
- Raspberry Pi receives IoT's MQTT message