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exoSTANCE

Exoskeleton Segway -- Redefining the Limits of Mobility

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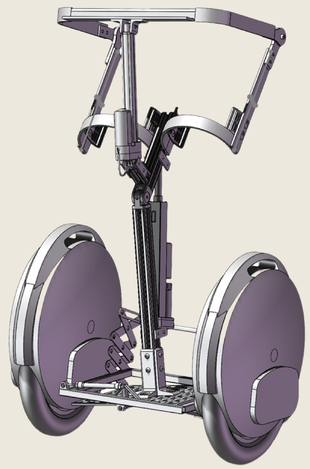
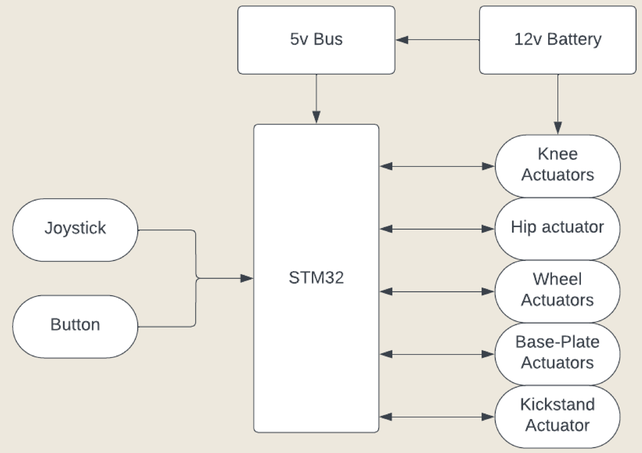
Project

- Currently, physical disabilities limit users to one option for transportation.
  - Wheelchairs themselves are difficult to navigate many situations.
  - Exoskeletons are expensive and impractical. It wears on the hardware.

- The ExoStance's light frame, and small footprint provides an efficient alternative method of transportation to people with disabilities.
  - Standing up in motion.
  - Access to a vehicle without expensive modifications.
  - Affordable overall frame.

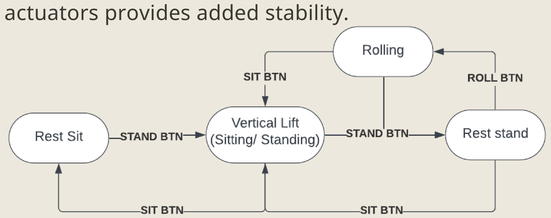
System





Methods

- This project utilizes two existing electric unicycles, secured to either side of the frame.
- Mechanical team designed a custom frame that houses electrical components and battery between the users' legs. The frame can be easily disassembled.
- Electronics in the frame are powered by a 12V battery that provides power to the motor drivers and actuators, and DC/DC converter that provides 5V to an STM32 microcontroller.
- User controls movement with a joystick and four buttons.
- External interrupts read actuator positions into a model to control:
  - Actuators at the hip and the knee allow the user to sit and stand.
  - Actuators on the wheels for turn assist.
  - Actuators on the side of the base control balance on uneven ground.
  - Kickstand controlled by actuators provides added stability.



Conclusion

- **Project Successes**
  - Users are able to drive the ExoStance freely.
  - User control of position and driving mode.
  - Precise Actuator control for user safety.

- **Future Development**
  - This was a proof of concept that will be iterated to bring to market.
  - More research on reading speed from the wheels for safety limitations.
  - Next year the engineers will refine the control loop and implement wireless user interface.
  - Next year's team will be urged to implement tilt sensing in control loops.

- **Lessons Learned**
  - Interpretation of sensor data
  - Power Distribution and Management
  - Control loops with analog input and pulse-width modulation.