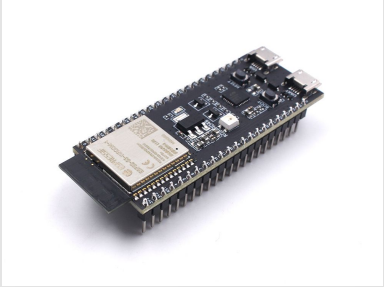
Automations for ABLE ALLIANCE

Jong Yoon Kim, Anirudh KS Gattu, Yu-Chen Lin

Motivation

- Electric wheelchairs are becoming more common
  - People with disabilities can move independently
- But means they are not being supervised
  - Alone in case of emergency
- Need a system to get immediate assistance
  - Wheelchair immobilized, crashed, collision, fall
  - Automatically contact emergency responders/caregiver
- Only 10% of individuals requiring assistive tech have them
  - $$$ & resources

Objectives



- Primary recipient of the implemented tech: ABLE Alliance @ GT
  - Can initiate change starting from our neighbors
- Research Question
  - ***How can we effectively integrate efficient and reliable sensor-based, low-power smart technology into wheelchair systems to enhance the safety and overall quality of life for individuals with mobility impairments?***
- ESP32 S3 = Bluetooth LE, 2.4 GHz WiFi, 512KB SRAM, 4MB, flash memory, 3 UART controllers

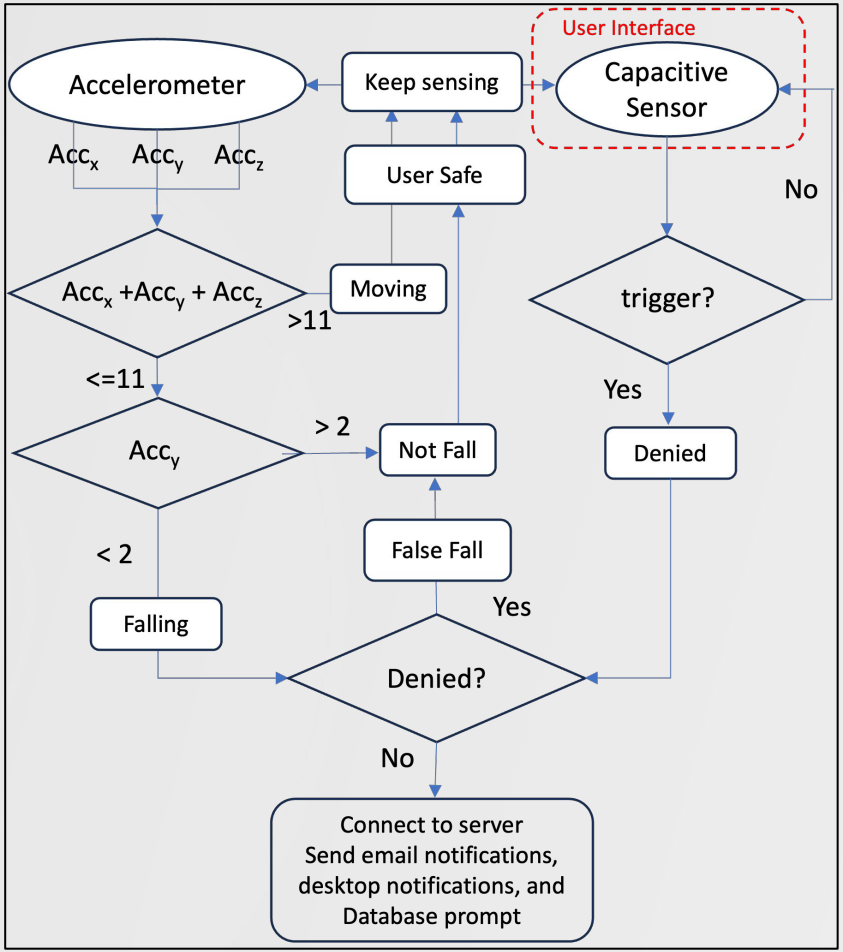
System Architecture

*Each subsystem within the setup can respond to distinct levels of emergency scenarios & are **complementary** to each other

*System naming conventions inspired from GT Stamps

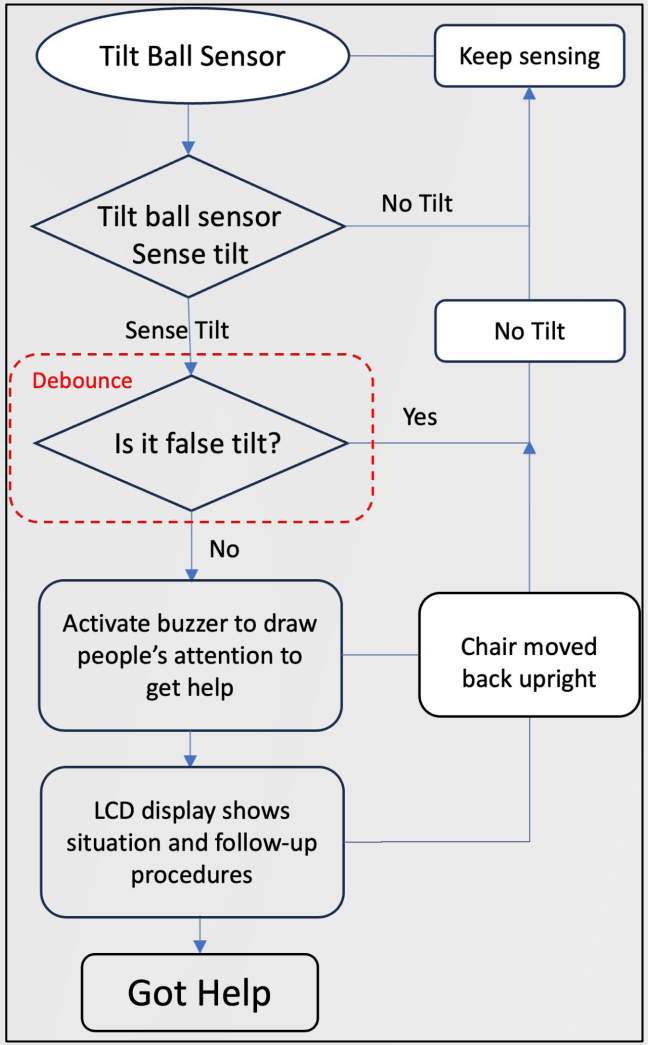
Gold Care Team

- Core of System
- MPU6050 & LEDS
  - 6-axis acc/gyro
- Server Provisioning: emergency server dispatch
  - Desktop Notification Prompt
  - SMTP email to responders/caregiver
    - Patient details & coordinates
  - Private Database Repo: Crash Policy
    - EHR
- Midas False Positive
  - Capacitive DENY sensor



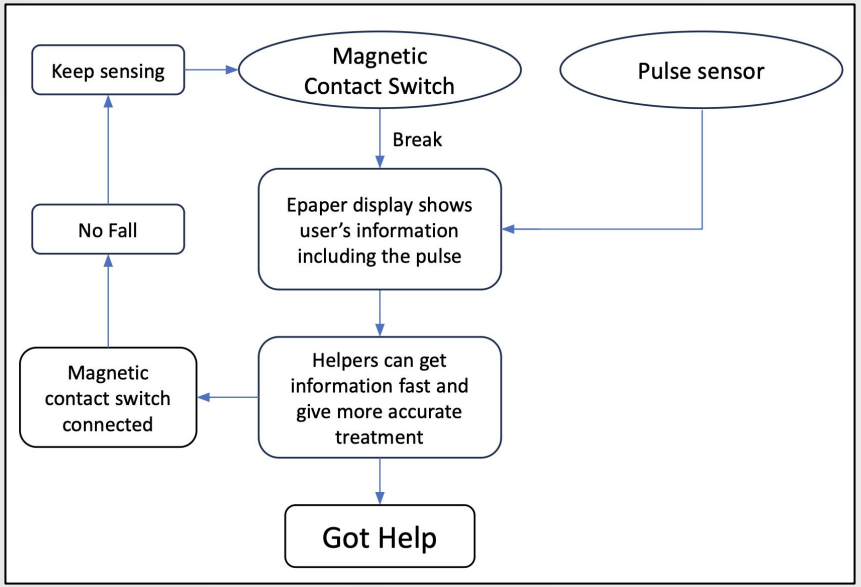
Silver Care Team

- Tilt (not caught by Gold) = still severe threat
- CMT-1285C-035 (buzzer)
  - NO Fall = Skyward posture
  - FALL = parallel 2 ground
- LCD1602
  - Help Instructions
- False Buzzing
  - Debounce Technique to Filter



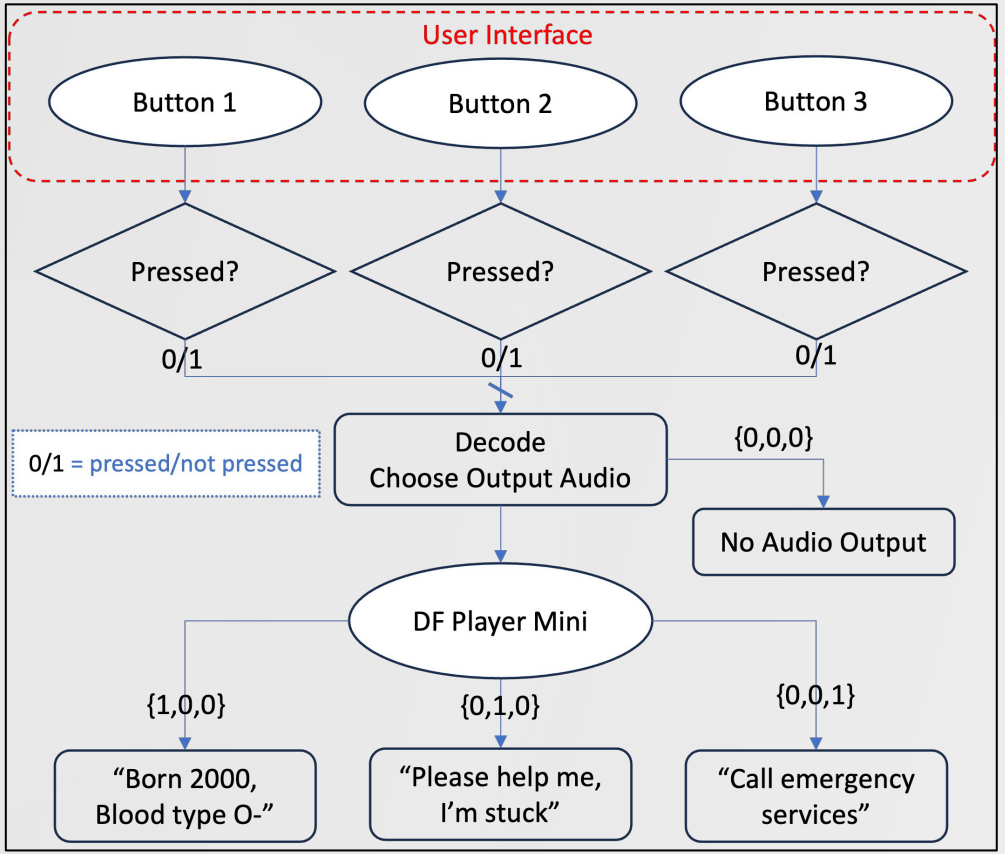
Bronze Care Team

- Threatening impact
  - Sensitive patient
  - Hard collison, crash, havoc
- 8601 NO/NC Magnetic Contact Switch
  - collision -> split
  - disengage electrical circuit
- Pulse Sensor
  - On-the-spot’ pulse collection & diagnosis
- 4.3-inch e-Paper UART
  - Vitals info
  - Name, DoB, Blood Type, Condition
  - Ink-based Persistive Display



User Interface

- Custom Speaking System
  - Speech-impaired patient
  - Shocking situation
- DFPlayer + LM386
  - Plays MP3 audio
  - Internal audio amplifier
- Serial communication (TX & RX)
- 3 pre-defined speech
  - Concise & Informative

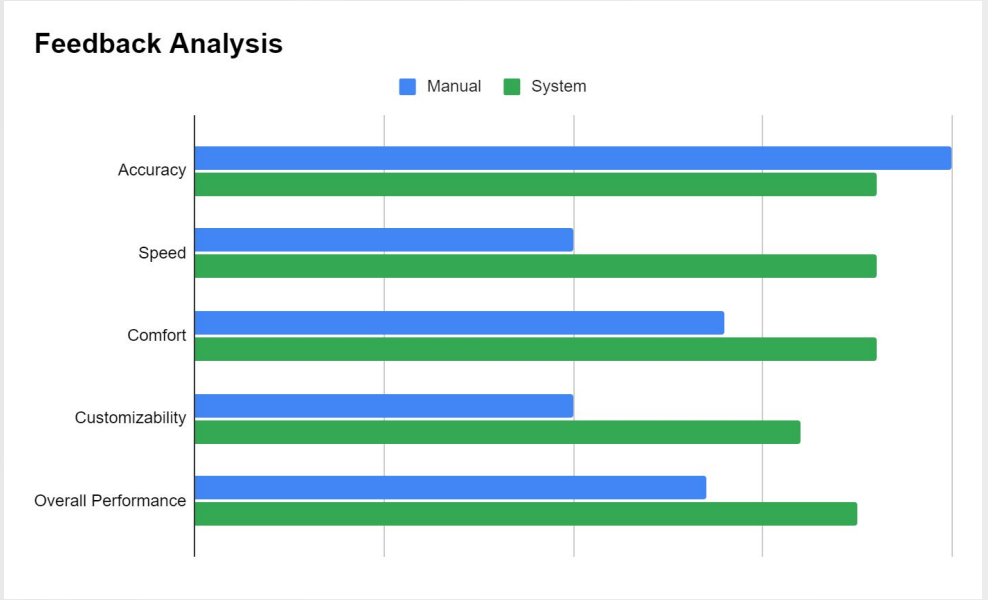


Changes to OG Plan

- False Detection Challenges
  - Added more complementary systems + sensors
- GUI Application for iPhone
  - In hindsight, NO b/c additional maintenance burden
- Faster to get help from nearby
  - Added an emergency call-out system w/ integrated speakers
  - Added a display system to convey vital patient info

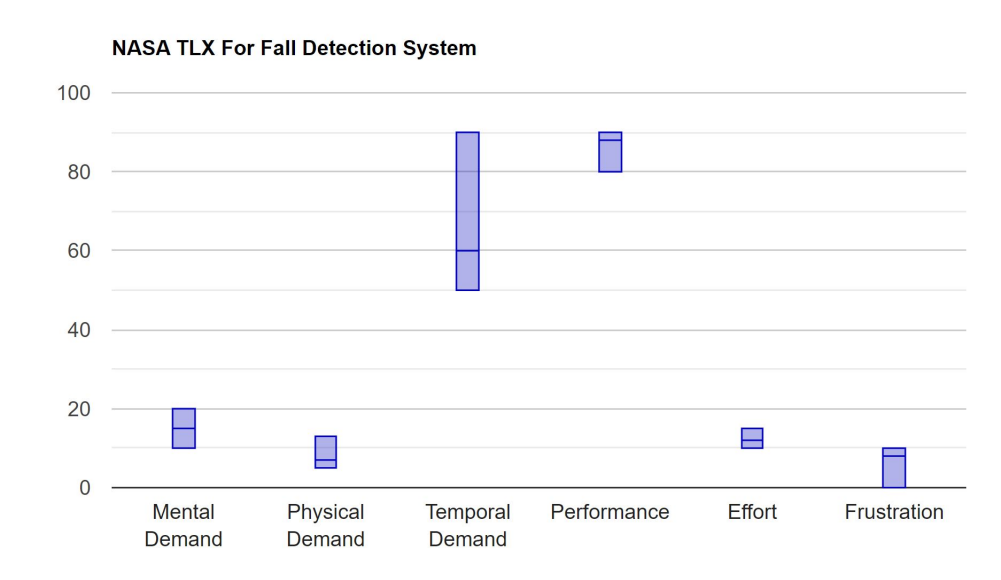
Results: Feedback Analysis

- Received feedback from ABLE Alliance (& Trey):
  - our system vs manual setup
- Asked to complete tasks:
  - Calling Emergency Contact
  - Providing Personal Information
  - Calling out for help
- Our system was behind in accuracy
  - But not by much
- Our system was better in:
  - Speed, Comfort, Customizability
  - Overall Performance



Results: NASA TLX

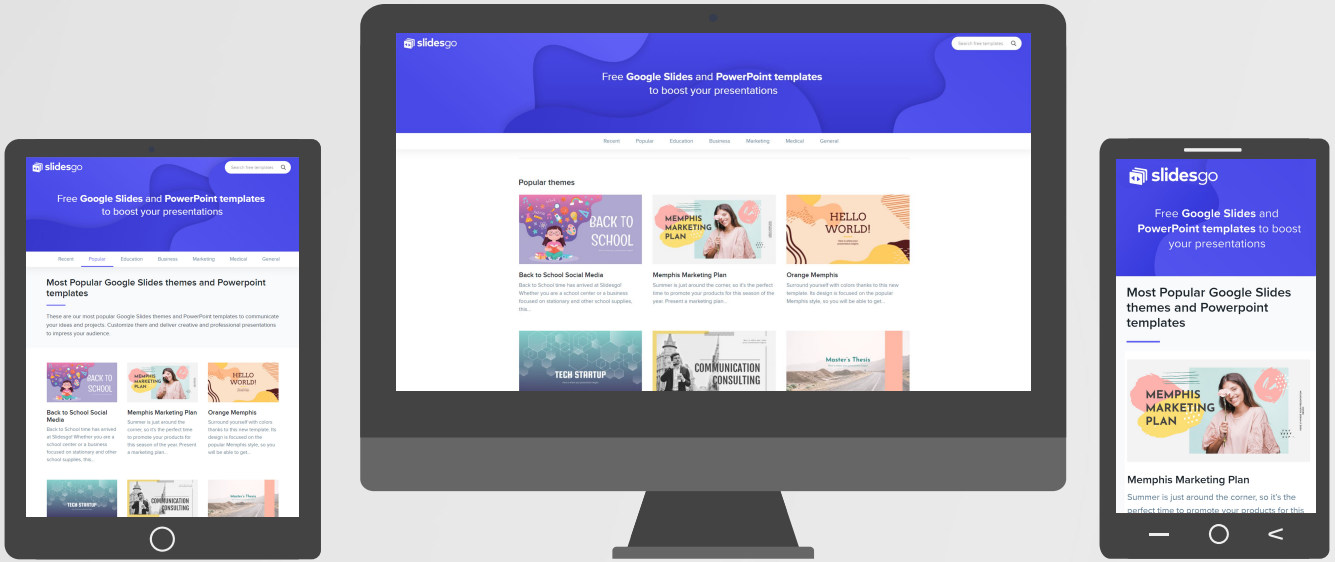
- Conduct a Nasa TLX to ensure the user's workload is low
- Low in:
  - Mental Demand
  - Physical Demand
  - Effort
  - Frustration
- High in:
  - Performance
  - Temporal Demand
    - Means the users were in rush



Reflection / Future

- Overall, system works GREAT
  - ***surpassed*** the initial benchmarks
  - Accurate, fast, and easy to use
  - Much better than manual
  - Users were gratified w/ the prototype
- Wires everywhere & Power
  - Wires discreet by proper PCB & case
  - Interconnect ESP32 S3s (WIFIClient library)
  - Solar-Power
- ML autonomous interactive speech

Club Contact on GroupMe app. Also yet to come



Can be accessed on ios, android, or computer

THANKS