Hands-On Flight

Fall Design Review
Outline

- Purpose/ Functionality
- Team
- Block Diagram
- Parts
- Bill of Material
- Power Distribution
- Schematic
- PCB
- Software Development
- Conclusion
Purpose
Purpose

- Design a glove to improve intuitive interactions between humans and machines
  - Integrate smaller circuit design for compact product and ease of use
  - Add additional functionality through haptic feedback
  - Interface new sensors into drone flying experience
Team
Who is the Hands-On Flight Team?

- **Oscar Wang**
  - Project Leader, System Design
- **Juan Reyes**
  - Software Development, Peripheral Integration
- **Eduardo Olmos**
  - Software Development, Android Application
- **Alex Berlanga**
  - Hardware Development, PCB Design
- **Miguel Berlanga**
  - Hardware Development, PCB Design
Functionality
Functionality (sensors/ICs)

- Capture motion of the hand through Inertial Measurement Units and stretch sensors
- Transmit motion data to drone to control drone flight:
  - Throttle
  - Roll
  - Pitch
  - Yaw
- Provide haptic feedback to user for use of throttle and axial movements
Functionality (High Level)

Hand Control

Sends IMU and Stretch Sensor Data

Arveng Control App

Translates data received into controls for drone

DJI Drone
Block Diagram
Parts
Parts

- MPU 9250
  - SPI serial communication
  - Orientation calculations
Parts

- Haptic components
  - Vibrating Mini Motor Disc
  - DRV2605L
  - I2C serial communication
  - User feedback for limits of MPU 9250
Parts

- StrechFABRIC
  - Analog communication
  - Used to interact with drone
Parts

- nRF52840
  - Bluetooth 5 Technology
    - Supports long range
  - Supports SPI and I2C
Bill of Materials
## Bill of Materials

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**Total Cost:** $366.35
Power Distribution
Power Distribution

● MPU 9250
  ○ VDD supply voltage range 2.4 – 3.6 V
  ○ Gyroscope operating current: 3.2 mA
  ○ Accelerometer operating current: 450 uA
  ○ Magnetometer operating current: 280 uA

● Haptic components
  ○ Vibrating Mini Motor Disc
    ■ 3 V, 60 mA
  ○ DRV2605L
    ■ 3V, 500 uA
Power Distribution

- StretchFABRIC
  - uA per StretchFABRIC
- nRF52840
  - 12.9mA
- LDO Voltage Regulator 3.3V 2A
- 3.7 Lithium-Ion Battery Rechargeable 110 mAh
PCB

- 4-Layer Board
- Dimensions for casing: 2” x 1” x 0.5”
- One Power Place (3.3v)
- One Ground Plane
- 2 Planes for traces
Software Development
Software Development

- IMUs
  - Read quaternion values through SPI
  - Convert quaternions to yaw, pitch, and roll
- Stretch sensors
  - Measuring capacitance through analog
  - A pin and resistor will charge and discharge it
- Haptic motor
  - Read through I2C
  - Use haptic controller to create ramp and other types of vibrations
Software Development

- Data transmitted to phone app via BLE
- Telemetry is processed -> feature extrapolation
  - Control signals generation
  - Debouncing

- Integration with DJI Mobile SDK
  - Rich sensor data available up to 10Hz
  - Transmission to Drone via WiFi Direct
Conclusion
Conclusion

● What we’ve done:
  ○ Schematic is completed
  ○ Finalized BOM
  ○ Peripherals functionality is tested

● Plans for the future:
  ○ Finishing up the layout for PCB
  ○ Integration of MPU 9250 with nRF52840
  ○ Integration of DRV2605L with nRF52840
  ○ Developing a wireframe for software applications
## Conclusion

| Task Details | Start | End | Week Duration | Start Week | End Week | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Priority |
|--------------|-------|-----|---------------|------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|---------|----------|


## Conclusion

### Haptic Motor Vibrating Disc
- Hot glue gun haptic motor vibrating disc w/ driver: Week 1
- Play with 3 V - 5 V for vibration preference: Week 2
- Full accurate data from haptic driver/disc mechanism: Week 3

### nRF52840
- Choose configuration 1-6: Week 4
- Power configuration: Week 5
- Integrate IMU with SoC: Week 6
- Integrate haptic driver/disc mechanism with SoC: Week 7
- Integrate StretchFABRIC with SoC: Week 8

### Casing
- Measure the size of the case: Week 9
- Schematic for PCB: Week 10
- Layout for PCB: Week 11
A special thanks to:

- Yogananda Isukapalli, for keeping us on track and heading Capstone Program
- Brandon Pon, for TA Mentorship
- Carrie Segal, for TA Mentorship
- Aveng Technologies, for sponsoring and mentorship
Questions?