The Team

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System Design
Purpose

Problem Statement

Our Solution
Problem
Solution

Design a glove to improve intuitive interactions between humans and machines

- Haptic feedback
- User friendly sensors
- Form fitting circuit design
Functionality

Sensors and IC Usage
System Overview
Sensors and IC Usage

- Capture motion of the hand through Inertial Measurement Units and stretch sensors
- Transmit motion data to drone:
  - Throttle
  - Roll
  - Pitch
  - Yaw
- Haptic feedback for axial movements
System Overview

Hand Control
Sends IMU and Stretch Sensor Data
Arveng Control App
Translates data received into controls for drone
DJI Drone
Parts

Micro-controller
IMU
Haptic driver
Stretch sensor
Micro-controller (nRF52840)

- I2C & SPI
- Analog GPIOs
- Integrated Bluetooth 5
IMU (MPU-9250)

- SPI
- Orientation calculations
- Gyro + Accelerometer + Compass
Haptic driver (DRV2605L)

- I2C
- Vibrating motor disc
- User feedback
Stretch sensors

- Analog output
- Stretching changes capacitance
- Functional control of drone
Software

Signal Block Diagram
IMU
Stretch sensor
Haptic driver
Signal Block Diagram

Microcontroller:
- ADC
- Data Packeting
- Yaw Pitch Roll
- Quaternion
- Mag
- Accel
- Stretch Sensors
- Gyro
- Haptic Driver

Android Application:
- BLE
- Control Algorithm

Drone:
- Wifi Direct
- DJI Flight Controller
IMUs

- Read quaternion values

\[ q_0 = q_w = \cos(\alpha/2) \]
\[ q_1 = q_x = \sin(\alpha/2)\cos(\beta_z) \]
\[ q_2 = q_y = \sin(\alpha/2)\cos(\beta_y) \]
\[ q_2 = q_z = \sin(\alpha/2)\cos(\beta_z) \]

- Convert quaternions to yaw, pitch, and roll

\[ \text{yaw} = \text{atan2}(2(q_0q_1 + q_2q_3), 1 - 2(q_1^2 + q_2^2)) \]
\[ \text{pitch} = \text{asin}(2(q_0q_2 - q_3q_1)) \]
\[ \text{roll} = \text{atan2}(2(q_0q_3 + q_1q_2), 1 - 2(q_2^2 + q_3^2)) \]
Stretch sensors
- Measuring capacitance via RC charge timing
- One charge pin in series with resistor and stretch sensor
- Controls drone throttle

Haptic driver
- Selecting waveform
- Soft and stronger buzzes
Power Requirements

● Voltage Requirements: 1.7 v to 3.3 v operation
● IMU: 2.4 v - 3.6 v, Operating current 3.5 mA
● Haptic driver: 2 v - 5.2 v, Operating current ~2.4 mA
● Stretch sensors: 3 v - 5 v, Operating current ~1 uA
● 3.7 v 2000 mAh Lithium polymer battery
Schematic: Full Block Diagram
Our PCB
Conclusion

The Hands-On Flight Glove
Arveng App
From Hands-Off to Hands-On Flight Demo
The Hands-On Flight Glove
Arveng App
From Hands-Off to Hands-On Flight

Download App
Arveng Drone Glove application available on the Google Play Store

Glove Connect
Connect glove to smartphone through Bluetooth

Drone Connect
Connect drone to smartphone through WiFi

Calibration
Capture the glove and drone’s positional space

Tutorial
Explore how the drone understands the glove

Flight
Select GO FLY and have fun!
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Questions?