DART: Drone Assisted Replication Training

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Goals

- **Create a reliable, cost-effective system for training novice drone pilots through an experienced instructor**
  - System relies on **replication training** and a set of **live feedback** mechanisms
  - Facilitate learning for students through two modes:
    - **Trace:** servos on joysticks mimic instructor's path in real-time or from recorded flight
    - **Comparison:** student controls joysticks to mimic instructor's recorded flight
  - Offer varying difficulty levels to cater to individual skill levels
  - Enable **real-time** feedback for students during flight replication
  - Integrate **feedback** through:
    - Audio cues
    - Haptic feedback

Motivations and Methodology

- **Motivations**
  - Drone industry revenue projected to reach **$4.7B by 2028**
    - Pressing need for an optimal training method to meet the growing demand for skilled pilots
  - **VR simulator** training offers a safer alternative, but it's effectiveness and accuracy compared to practical training needs improvement
- **Methodology**
  - Read and write voltages from main transmitter using Pi
    - DAC and ADC set-up for **WRITE/READ** modes
  - Wireless bi-directional communication between Pi and Arduino
  - Adding **vertical** servo-joystick **motion** in training transmitter
  - Adding **horizontal** servo-joystick **motion** in training transmitter
  - **Playing recorded voltages** from Pi to Arduino to control joysticks
  - **Tracing live voltages** from Pi to Arduino to control joysticks
  - Live comparison of Student transmitter inputs vs recorded flight
    - **Haptic feedback** and **audio feedback** during the live comparison mode

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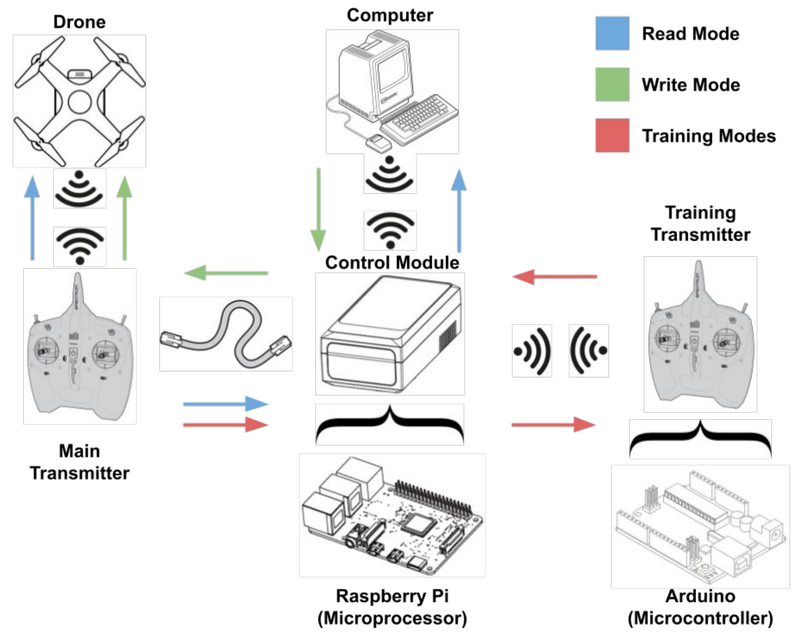
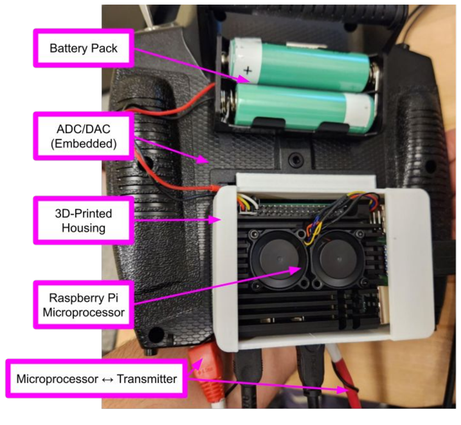
System Overview

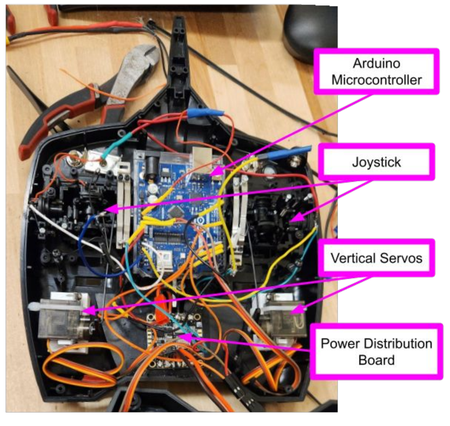
- **Hardware**
  - **Control Module:** Interface between both transmitters and the computer
  - **Main Transmitter:** Controls the drone and receives inputs/sends outputs to the control module
  - **Training Transmitter:** Receives inputs from the control module to enact both training modes
- **Software**
  - **Read/Write Mode:** Record and playback joystick inputs for controls optimization
  - **Trace Training:** Internal servos move joysticks to follow a live/recorded flight path
  - **Comparison Training:** Auditory and haptic feedback for a live/recorded flight path

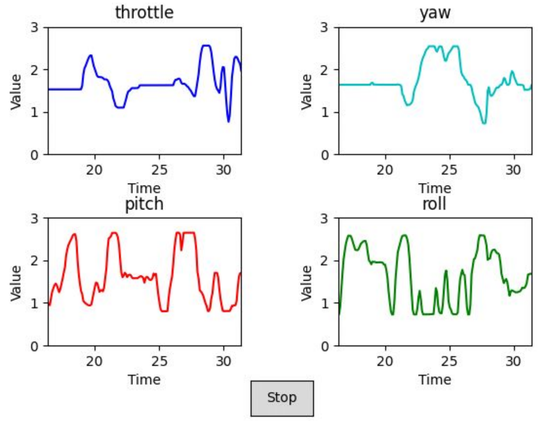


Results

- Switch to change between the **read/write modes** successfully added to main transmitter
  - Raspberry Pi added to back of transmitter with 3D-printed case
- **Servo-controlled joysticks** and two haptic motors successfully added to the training transmitter
- **MQTT server** allows communication between Pi and Arduino with **minimal latency**
- Main transmitter can accurately **replay flight path** to drone and training transmitter
- Training transmitter successfully imitates inputs made by instructor transmitter in **trace mode**
- **Haptic** feedback from motors for throttle/pitch and **sound** feedback from **Android app** for roll/yaw works in **comparison mode** on training transmitter







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