Clay-Wolkin Fellowship 2018-2019: Augmented Reality for Pilots

**Project Goal:**

To design and build a system to provide AHRS (Altitude and Heading Reference System), GPS, and ADSB (Automatic Dependent Surveillance Broadcast) information on AR goggles with head-tracking capability. The system will extract relevant data from plane instrumentation, which will be displayed along with graphical representations of aircraft, runways, and other important features. Aim to provide a low-cost open-source system driven from a laptop or mobile device ready for testing in a real airplane.

**Project Requirements:**

1. Preliminary Feature List:
   1. AR goggles will display:
      1. Current location (latitude / longitude / altitude)
      2. Current heading
      3. Graphical representations of surrounding aircraft and runways
   2. Aircraft and runway representations overlaid on real-world relative positions
      1. Requires accurate (±0.1**°**-1**°**) head-tracking relative to surroundings
   3. Location / heading / ADSB data taken from onboard flight computer
2. Budget, Size, and IP Requirements:
   1. Headset control and flight computer interface should remain portable and low-power
   2. Maximum budget for development:
   3. Maximum budget for final unit:
   4. All design data should remain open-source

**Preliminary Timeline:**

|  |  |
| --- | --- |
| 9/10 – 9/15 | Headset and sensor interface research. Create preliminary part order and obtain price quotes |
| 9/16 – 9/22 | Order parts and start development on headset tracking and graphics |
| 9/23 – 9/29 | Continued work on headset tracking and graphics |
| 9/30 – 10/6 | Complete basic plane / runway headset visualization |
| 10/7 – 10/13 | Begin integration with plane instrumentation |
| 10/14 - ?/? | Complete integration with plane instrumentation |

**Required Equipment:**

1. AR headset and tracking system
   1. Features:
      1. External video input to goggles
      2. Power / data tethering over cable
      3. At least (±0.1**°**-1**°**) head-tracking precision
      4. Preferable: absolute (non-IMU) head-tracking system
   2. Current candidates:
      1. Epson Moviero BT-35E ($999): IMU tracking
      2. Epson Movieto BT-300 ($800): IMU tracking, requires wireless link
      3. Dreamworld Dreamglass ($400): IMU tracking, poor support
   3. External tracking:
      1. Bosch BNO055: Integrated 9-axis IMU / sensor fusion, accurate ±1**°**
2. Flight computer interface
   1. Converting ARINC429 (standard avionics interface) data to usable interface
   2. USB adapters require Windows API, high prince ($1000)
   3. Design PCB for ARINC429 – SPI interface ($20-$100 IC)
3. Flight computer interface alternatives
   1. Gather data independently of plane avionics
   2. Sensor fusion between GPS, IMU
   3. Collect ADS-B data with USB RTL-SDR (FlightAware)
4. Interface and graphics computer
   1. Contingent on headset choice and graphics requirements
   2. Ideally Linux platform
   3. Raspberry Pi- easy access to SPI / I2C