Memo

To: Professor Pisano

From: Team 9

Team: Aerobatic BlackBox

Date: 4/29/22

Subject: Customer Installation Report

1.0 Details of Customer Installation

- Dates: Apr 10, 2022
- Location: Mansfield Municipal Airport
- Members present: Pai Liu, Xinyu Liu, Darcy Meyer
- Customer present: Dr. Kenneth D. Sebesta
- Aircraft: Citabria 7ECA

2.0 Requirements

2.1 List of Requirements

Hardware

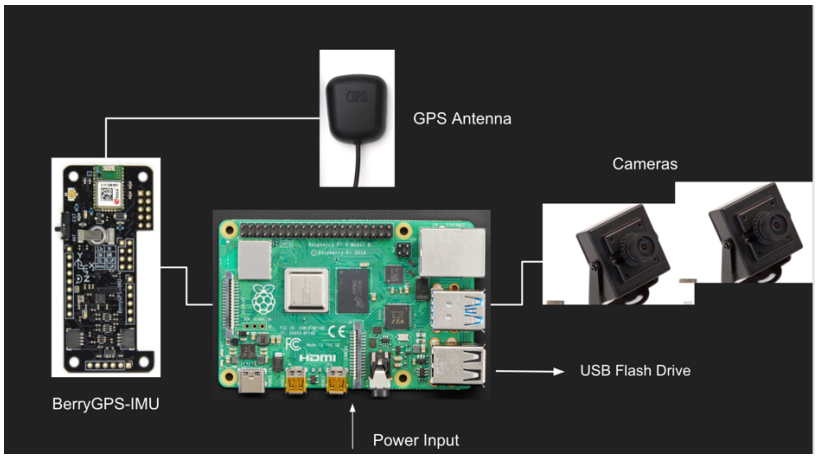
- GPS: Cold start under 5 mins, and hot start under 2 seconds.
- IMU: Successfully record the yaw, pitch, roll angle correctly.
- Dial Camera: Needs to be installed with a view of both the airspeed dial and tachometer.
- Pilot input Camera: Needs to be installed with a view of both the flight stick and the rudder cable.
- Touch Screen: needs to be installed in a place where the pilot can easily access it.

Software

- User Interface: UI should be displayed on the touch screen, and it should be able to start and stop the data recording program.
- Camera Calibration: This software should allow the image processing algorithm to be calibrated by the pilot.

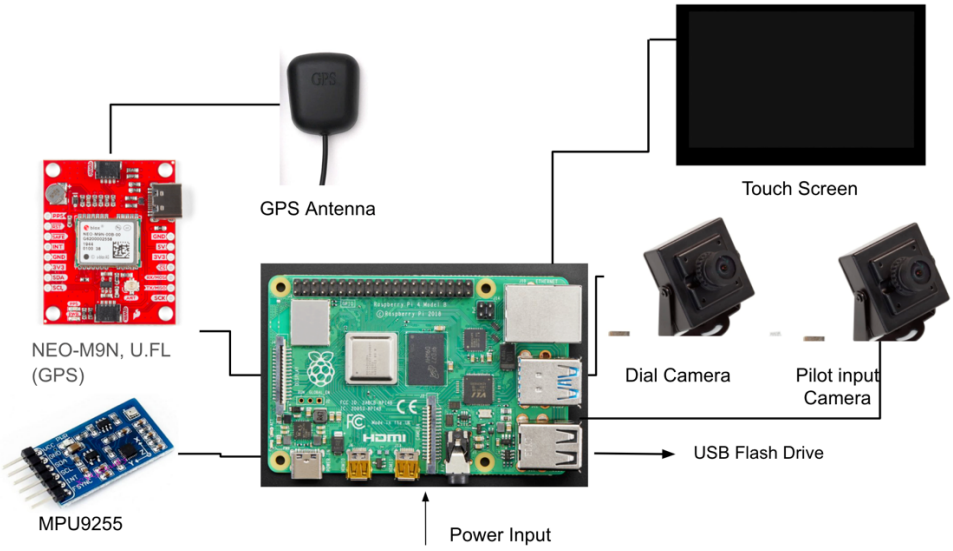
2.2 Original Product

The original product used the BerryGPS-IMU for the GPS module and IMU module. However, during the customer installation and on plane testing, we found that the GPS module needed more than 20 min to get a location fix from a cold start, which did not meet our requirements. Additionally, the IMU readings from the BerryGPS-IMU were different from what we expected based on its orientation, which did not meet our requirements. As a result, after our second prototype testing, we changed our GPS module and IMU module from the BerryGPS-IMU to the ublox-M9N (GPS) and the MPU9255 (IMU). Our other hardware met our requirements. The image below is the original product overview.



2.3 Final Product

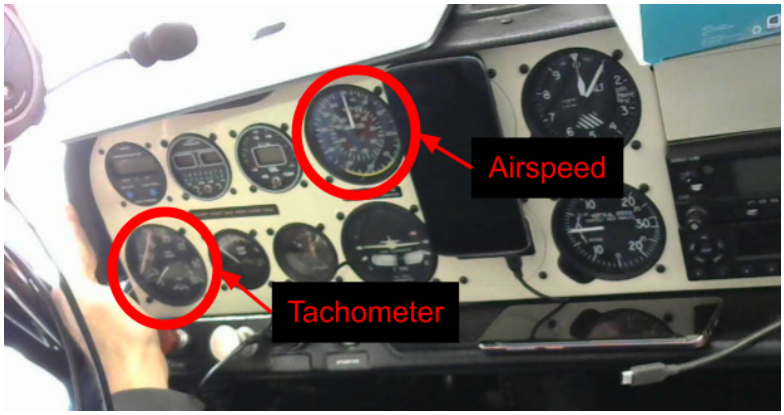
The final product contains the new hardware such as ublox-M9N and MPU9255. The new GPS during the test was able to get a location fix under 1 min from a cold start and under 1 second from a hot start. This performance meets our requirements. The new MPU also outputs the expected data. The image below is our final product overview.



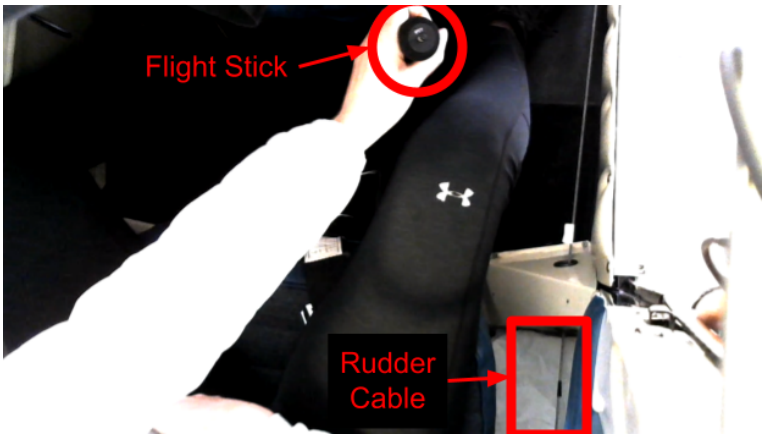
2.4 Product Installation

During the installation, we first selected the upper left corner of the aircraft cabin as the installation location for our Black Box body. The photo below is the upper left corner of the cabin:

Second, we selected the top bar of the aircraft for installing the dial camera, and the photo below shows the camera's view from the top bar. This view includes both the airspeed and tachometer.



Finally, we selected the top roof in the back seat to install the pilot input camera, and the photo below shows the camera's view from the roof. This view includes both the flight stick and rudder cable.



3.0 Testing & Future Plans

3.1 Testing

During the testing, we found two issues. The first was with the filter for the IMU data: during the zero gravity test, the 3D image of the plane lost its orientation, and started spinning. The second problem was that our cameras did not have the ability to automatically adjust their exposure, which caused the images to be over exposed during high brightness conditions. The other hardware and software worked as we expected.

3.2 Future Plans

The overall installation is successfully done. In the future we will update the data filter for the AHRS system, and change the camera settings to automatically adjust for exposure.