***Team Agreement***

**EC463/EC464 - Senior Design**

**Fall 2021 – Spring 2022**

We, the members of team number 9, called Team 9: Aerobatic Black Box, have entered into a project titled Aerobatic Black Box for the customer, Kenn Sebesta as part of Senior Design Project, ENG EC463/EC464.

The general objective of our project is:

Creating a system installed in a plane that records the pilot's inputs and the state of the plane over time, and saves the data for later analysis and visualization, to be used for more accurate judging of aerobatic flights and general telemetry and logging.

We expect that our major project deliverables will include the following:

Hardware: 1, a Raspberry Pi 4 for data processing and storage; 2, an IMU sensor to get the data of the plane’s state; 3, a GPS sensor to get the position of the plane; 4, a camera to record the airspeed and pilot’s inputs.

Software: 1, a .fdr file that can be used in X-Plane 11 simulator; 2, the image processing algorithm that can analyze the airspeed and pilot’s input.

GENERAL CRITERIA FOR SUCCESS

We understand that evaluation of our work in Senior Design will depend on several factors. First is our team's success at meeting our proposed objectives, as described by our specifications, and providing our deliverables in working fashion, with the required documentation, by the course deadlines. Second is our demonstration of individual proficiency at design and at keeping adequate engineering records of our work. Third is our individual and collective team skill in listening, helping others to reach their goals, and negotiating technical and team problems. Finally, we understand the department policy for reimbursement of expenditures made in executing our project and agree that anything spent about the amount reimbursed by the department will be equally shared among all team members.

INDIVIDUAL LEADERSHIP

We understand that Senior Design teams shall be organized to give each member clear responsibility for one or more design areas. Several people may collaborate on a problem, but only one person should be the designated 'leader' for a design area. Each of us should be the leader of at least one design area so that we can clearly demonstrate our individual proficiency in design and in keeping professional engineering records (in our logbooks).

RESOLVING TEAM CONFLICTS

We understand that we need to work to resolve interpersonal and technical disputes within our team, in a professional and respectful manner. This will sometimes involve compromise, and we agree to be open to reasoned technical arguments about our individual areas and the team's collective efforts. We will seek faculty or mentor help when problems appear serious and are not resolved quickly by our efforts.

NON-PERFORMANCE OF DUTIES BY A TEAM MEMBER

We understand that each of us must pursue our design and team tasks in a professional and timely fashion to ensure our team's success. Should a team member fail to show diligence and concern for the team, a meeting of the team and the course faculty will be held to assess the situation and recommend specific short-term performance goals for the team member, and possibly the whole team. If these goals are not met, the course faculty may decide to remove the offending team member from the team. The student will then have to complete the course reporting directly to the faculty as a team of one. This is a serious step and suggests a significant failure on the part of the individual, and possibly the whole team. It should not be considered except as a last resort.

QUESTIONS

We understand that students and teams are welcome to approach the course faculty about this agreement at any time.

INDIVIDUAL TEAM MEMBER RESPONSIBILITIES

The remaining pages list our team members and our individual 'leader' responsibilities.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: (printed) Xinyu Liu

Team Number 9 Team Name: Team 9: Aerobatic Black Box

I have read this entire document, including my teammates’ descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature Xinyu Liu

Date: 1/12/2021

The following paragraph(s) describes the technical problem(s) for which I hold leadership responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

My technical responsibility is the software of GPS/INS, Camera and IMU of the project. The responsibility includes getting the roll/pitch/yaw and Altitude data from the IMU sensor; getting the position, speed and Altitude data of the plant from the GPS sensor; recording the image of the pilot’s inputs from the Camera. The technical problems I faced is that it is hard to find the GPS signals indoors, and when the plane is up-side-down, the GPS signal will be impacted by the ground. I plan to use several GPS sensors to solve this problem. Besides, for the IMU part, the frequency is different for each data output. I need to change the output rate of the data so they will be produced at the same time. For the Camera part, the shaking of the plane gauge will affect the quality of the image for the pilot’s input. I plan to use an algorithm to reduce the effect of the shaking.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: (printed) Darcy Meyer

Team Number 9 Team Name: Team 9: Aerobatic Black Box

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Team Member Signature Darcy Meyer

Date: 1/12/2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

I will hold technical responsibility for the image processing software that reads the airspeed dial and rudder cable positions, and for the algorithm that interpolates between sensor readings. The image processing software responsibility includes writing code to collect a stream of images from the camera, calculate the value of the airspeed dial or the position of the rudder cable in the image, and store the calculated value to include in the .FDR file. This will also include writing code for calibration of the initial positions of the airspeed dial and rudder cables in the images. The interpolation algorithm responsibility includes writing code to convert a stream of sparse data readings about the position and orientation of the aircraft into a smooth and dense stream of data that can be inserted into the .FDR file. This will require approximating the data in between the given sensor readings, and some de-noising of the data.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: (printed) Pai Liu

Team Number: 9 Team Name: Team 9: Aerobatic Black Box

I have read this entire document, including my teammates’ descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature Pai Liu

Date: December 1st, 2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

I hold the technical responsibility for hardware research that decides to choose which hardware the project will use, the hardware includes the Processing Unit, Camera, IMU, and GPS, For circuit soldering, I soldered the part together to raspberry Pi and test out hardware. For example, I learned and solder GPS to Raspberry Pi. Before testing, I set up each sensor with the code the manufacture provided, if the code is not suitable for our project, I write our code, for instance, the pressure sensor gives us a different unit, I wrote an algorithm to change the unit that we can use. Furthermore, I test each hardware by comparing the data from the sensor with actual data. Finally, I have the responsibility on extract all the data from the sensor to a .txt file. These files will later be used on .FDR file. The technology problem we are facing is the GPS will take a long searching time when it is placed indoor.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: (printed) Wenjun Ma

Team Number 9 Team Name: Team 9: Aerobatic Black Box

I have read this entire document, including my teammates’ descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature Wenjun Ma

Date: 1/12/2021

The following paragraph(s) describes the technical problem(s) for which I hold leader responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)

My Technical responsibility is both implementing the code for output data for IMU and GPS and checking the general hardware part. For IMU and GPS parts, my responsibility is mainly to modify the given codes and add the desired output data format into the different separated output files. Furthermore, due to the situation that the parts are compiling with different machine languages, my responsibility also includes combining the two output files in a way to get the desired and matched one output file that could be read and processed by Xplane, which is used for replay the flight. For the hardware part, my responsibility is to check the applicability of each part in the system. To make sure each part could work well in the system, I also need to solder the circuit, sort out and adjust the best output frequency that each part of the system could achieve, and figure out the best position to mount the camera module that would best enhance the performance of the system.

TEAM MEMBER ADDENDUM (submit one for each team member):

Team Member Name: (printed) Radhey K. Patel

Team Number: 9 Team Name: Team 9: Aerobatic Black Box

I have read this entire document, including my teammates’ descriptions of their 'leader' roles. I understand the document and agree with the descriptions of roles.

Team Member Signature Radhey Patel

Date: December 1st, 2021

The following paragraph(s) describes the technical problem(s) for which I hold leadership responsibility. (Please give technical details if possible. Broad topical claims will be difficult to assess.)   
\* The responsibility of my leadership is co-presenting the testing systems procedure specific to the visualization simulation through X Plane 11 and aggregate data formatting compatible with Xplane and in compliance with the NTSB fdr file guidelines. In addition to that, I am currently mapping out the team schedule and project timeline over the gantt chart. I, also, presented for the Shark Tank Event alongside my team and implemented feedback on the design. I’m working on a mathematical model underlying the GPS/INS and IMU for the project. The technical problems I faced included converting GPS signals to exact coordinates as well as converting it to +/-0-180 deg system, generating barometric readings from the sensor to measure altitude and am currently in the process to calibrate data lags by predicting the GPS signal based on the INS. Besides, for the IMU part, the frequency is different for each data output- providing a time synchronized log available to be encoded into the fdr file is part of my purview. For the Camera input, the shaking of the plane gauge will affect the quality of the image for the pilot’s input. I plan to implement a trial over a car’s speedometer on the ground before flight training.