**Logbook**

**Name: Diego D, Shravan S**

**Grade: 9**

**Project: Solar UAV, Code named: Solar Spear**

| Date | Notes: |
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| October 3, 2023 | Met with Ms. Bretner and had question approved.<br><br>Question: Can we create a highly maneuverable, off-the-grid, solar-efficient UAV?<br>Type of Project: Innovation |
| October 4, 2023 | Went through experimental/innovation/study rubric to understand components of project. |
| October 11, 2023 | Identified the problem and started researching potential aircraft capable of our goal. The first idea was to use the FT Kraken  , but then we decided not to continue the research of the design because the plane required 2 motors, was too big(wingspan of 70''), and was too slow to complete the high g maneuvers we would want the aircraft to perform. We switched to using the FT Spear  as our main design. |
| November 1st | Researched what electronics we need to successfully convert solar power into electricity usable by the RC electronics. |
| December 28th | Built a test foam glider to learn the building technique, as well as learned the importance of having a stable CG(center of gravity) |

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| **January 3rd** | **We built the plane out of foam board. This plane is called Prototype V1. Attached are some photos of that day.** |


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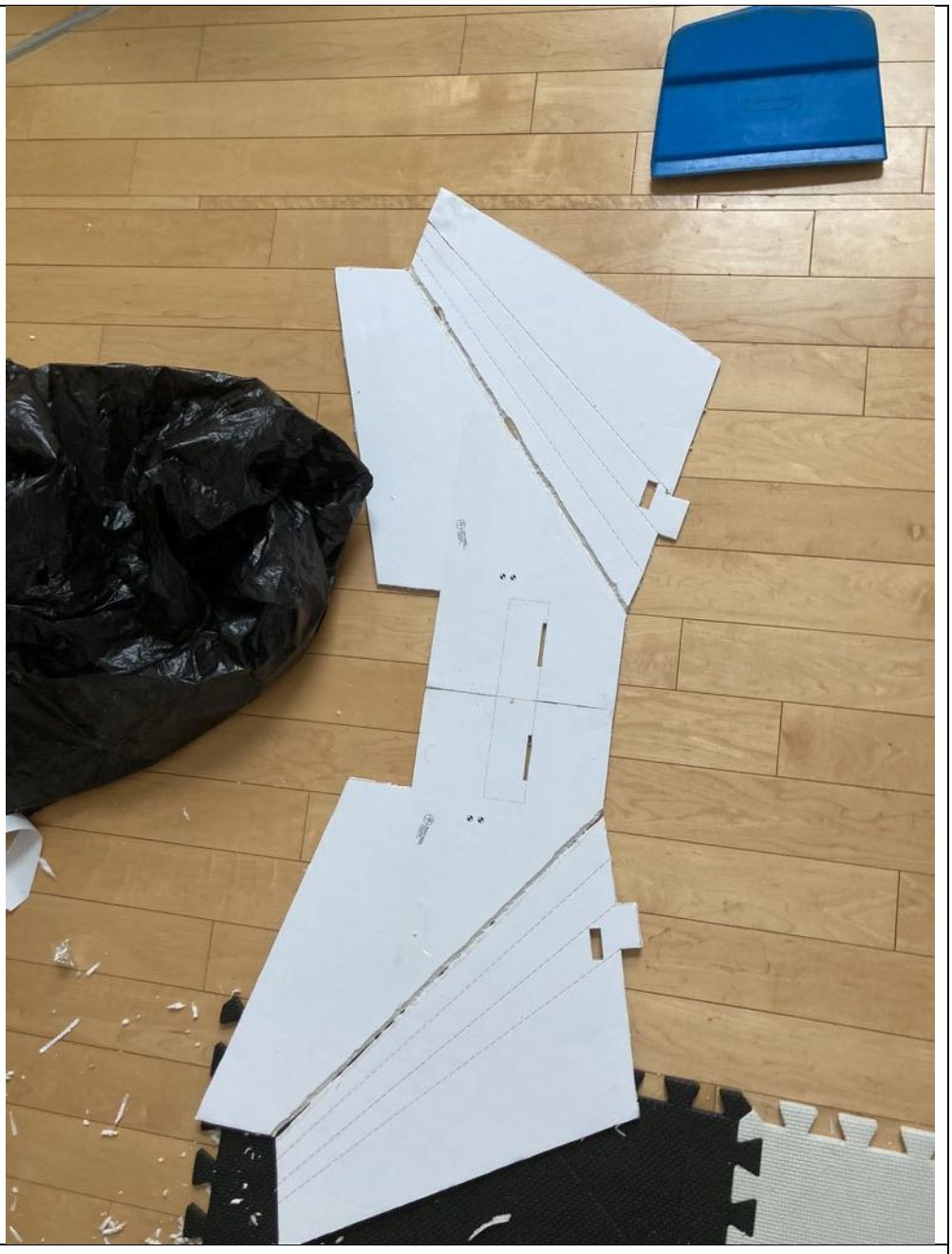
| |  |
| **Jan 25** | **We tested the range of our FPV camera. It came out to 300 meters, but that is when the battery died.** |
| **Jan 27** | **We put the electronics in, but the plane did not fly much. Most likely the reason is the way we launch the plane. The best attempt caused the plane to fly for 2 seconds before crashing into a snowbank.** |
| **Jan 29** | **On this day Diego found a better method to launch the plane, which is better, but more dangerous. It involves throwing the** |

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| | **plane by the back, (near the propeller) and powering up later. Also, Diego tested gliding capabilities off his roof. During testing, a nameless person failed to catch the plane, causing the nose to cave in. This was because we cut some supports for the nose, to fit the battery. Anyway, we started to build the plane again from scratch** |
| **Feb 1** | **After getting some laser-cut parts at school, we almost finished building the plane.** |
| **Feb 3** | **We started ripping the parts from the old plane to transfer to the new one. Also, we designed a foam base for the solar panels. We also soldered leads to the solar panels to fit this wiring diagram. Finally, we took a drone pilot license, and registered the drone to ensure safety, and legality.** |
| **Feb 4** | **Diego tested the solar panels with a flashlight. He got a little less voltage than expected, and a lot less current. This is fair, because this is not the sun. Also, Shravan designed several logos.** |
| **Feb 5** | **Diego had 3d printed a screw-based gantry for the FPV camera. It was very tight, and not the best of prints.** |
| **Feb 6** | **Diego had also 3D printed a plastic firewall and some plastic clips to keep the hatch shut. The holes in the firewall were not perfect and it was too big.** |
| **Feb 10** | **We put it for a test flight, combining everything we knew. It was fast and ascended very quickly. It was dark and one of the winglets broke, so we headed home.** |
| **Feb 15** | **We finished up the plane without any solar panels, so Diego could get a feel for how to fly the plane. Before test flight 1, Diego noticed the servos were not fully functional, which was because of the cold. To fix this, we 'limbered' up the servos by making it move to the ends of its movement. This day was filled with improvement after the crashes. The first change we made was reinforcing the nose with tape, to tension the nose, and to give it rigidity. We also learned that we need altitude to glide, after breaking yet another winglet by trying to glide it off a hill. We also learned that only one winglet is bad for** |

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| | **flying, as it becomes very unstable. We learned this the hard way after launching the plane with only one plane. Over this day, Diego got better flying the plane. We also learned how deflection affects flight performance. Also, we doubled up the winglets since they kept breaking. Finally, the Velcro mount for the battery broke and we ended up heading back** |
| **Feb 16** | **We mounted the solar panels, and tested them. But during testing, we realized that our setup would not work, because the different voltages in parallel would not be able to sufficiently power the UAV. Because of the limited time and cost, we had to make do and make something else. We ended up wiring 8 1.5 V panels in series and putting that in parallel with the 6V panels. We put it for a test flight, and Diego made an awesome landing that ended up breaking a prop. We fixed it and went for another flight, but something must have been wrong in the throw because the plane crashed, and the firewall broke. We fixed it up, but we did not fly again since it was dark.** |
| **Feb 17** | **Today we set it up as it would be, with solar panels and FPV cameras mounted. It flew well. However, Diego flew it into the sun, and it stalled, causing the plane to fall. Due to several factors such as inertia, too strong of a winglet, and repeated crashing caused the wings to snap off when it crashed. We couldn't repair it, so we made a new model that very day. We added carbon fiber spars for support and made it the best we could. The build quality was not the best, however. Also, some mistakes in the plans caused the plane to be a bit difficult to build. In the end, it came out okay. Differences in the design include a slightly smaller center pod, carbon fiber rods, and extra foam in the nose for strength. We finished building the plane, without solar panels. One more thing we bought was an XT60 y lead to make wiring clean, and a battery checker to properly check battery voltage. We also got some flight times** |
| **Feb 18** | **We got to work on transferring our information onto the trifold. We designed the layout and started posting papers on to the board.** |

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| **Mar 1** | **After being selected, we started researching how to make a better plane, as our previous one was inefficient, with a charge time of 11 hours. We found solar cells that will decrease the theoretical charge time to 22 minutes. That's a 96 percent decrease. Also, the way we were charging the batteries was unsafe, so we also needed a BMS, or battery management system. Also, we needed to build a new airframe that fit the solar panels, as these are 12.5 cm^2. Taking inspiration from rctestflight, we decided to build a kf airfoil.** |
| **Mar 10** | **We got to work build the plane, but we encountered several hurdles. For one, the wings were very large, and connecting them was an issue. We fixed both issues by cutting material from the wings and glueing them together. In the end, we had the wings joined, and the center pod halfway done. The elevons and motor must be placed soon. We also took iteration 3 for the last flight, hoping to get drone footage. The weather was unfavorable, and the plane crashed on takeoff, and the firewall broke. Research on BMS happened, and we decided on buying some from amazon.** |
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# SCIENCE FAIR LOGBOOKS

Every science fair project **must include a logbook**, also sometimes called a research notebook, which is a complete, permanent record of how you did your experiment/research project; it shows what you did and thought every step along the way.

**LOGBOOK POINTERS:**

- write your logbook in a notebook
- make an entry every time you work on your project
- date each entry
- make your notes in point form
- don't worry about neatness; you do not need to re-copy your logbook to make it look "tidy"
- organize your logbook into sections such as: schedule, daily notes and ideas, background research, contacts and references, experimental procedure/method, data collection sheets, observations/results in tables and graphs, conclusions
- Write everything down, even if it seems insignificant at the time; the information may be useful later on
- Make sure that you describe things in enough detail that you and anyone else reading your logbook in the future will be able to understand your thoughts and repeat the entire experiment exactly like you did it in the first place, just using your logbook.
- You must create your logbook as you go; it is unacceptable to create your logbook on the computer after you have finished your project
- NOTE: The text that appears on your backboard/tri-fold is just a summary of what you write in your logbook; there is much more information in your logbook than what appears on your backboard/tri-fold.

**LOGBOOK CONTENT:**

- **Timetable :** Come up with a timetable for doing each of the steps of your project and try to stick to it
- **Choose a Topic**: make a list of topics that interest you, things that you are really curious about and that you want to find answers to; explain how you came up with your topic, why you decided to do it.
- **Background Research**: Record your background research about your topic from books, magazines, TV programs, the Internet (with supervision), people and companies. Keep a record about where you gathered your information for your bibliography/list of references and acknowledgements.
- **Testable Question/Purpose:** Based on your background research, write down your testable question/purpose

- **Hypothesis**: write down what you think the results of your experiment will be based on the research that you've done
- **Materials:** List everything that you will need to do your experiment, such as equipment, ingredients, quantities of ingredients, measuring tools etc. Be very specific – give lots of details
- **Procedure**: List the steps you will go through to do your experiment. If you make any changes to the procedure after you start your experiment, describe them in your logbook with an explanation about why you made the change(s) and if the change(s) will affect the results collected prior to the change.
- **Variables**: list the controlled variables, the manipulated variable, and the responding variable
- **Data:** record all of your measurements/raw data that you collected on data sheets in your logbook
- **Results:** record your collected data in charts, tables, graphs, pictures and use these to help you explain what happened in your testing; describe any problems you might have had while you were testing , any changes that you had to make to your original plans, and whether those changes would affect the results collected before you made the changes
- **Conclusions:** write down your conclusions, whether or not your hypothesis was correct and why. It is OK if your results do not support your hypothesis - the information you collected still supports science.
- **Recommendations/Applications**: Make recommendations for improving your project, for further study, and applications I can make from my research