Ethical and Environmental Analysis

Year: \_2019\_ Semester: \_Spring\_ Team: \_\_17\_\_ Project: \_Face Tracking Drone\_\_\_\_\_\_

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Assignment Evaluation:

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| --- | --- | --- | --- | --- |
| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Environmental Impact** | 4.5 | x6 | 27 |  |
| **Ethical Challenges** | 4.25 | x6 | 25.5 |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 4.5 | x2 | 9 |  |
| **Formatting and Citations** | 5 | x1 | 5 |  |
| **Figures and Graphs** | 5 | x2 | 10 |  |
| **Technical Writing Style** | 4.5 | x3 | 13.5 |  |
| **Total Score** | 90 | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

Comments:

1. Environmental Impact Analysis

Our project comprise of a drone frame, 4 ESC modules, 4 motors, a gimbal frame, 3 gimbal motors, a camera, 2 GPS modules, a flight control, a VTX transmitter, a PCB mounted on the drone, a PCB case on the drone, a PCB for ground station and a PCB case for the ground station.

As lots of the components are involved with electrical function, they will be the main cause of all the environmental concerns over the three stages of our products’ life cycle.

**1.1 Stage of Manufacture**

During the manufacturing process, the main environmental problems are caused by the PCB and plastic components. Wastes are coming from multiple steps of PCB production, including cleaning and surface preparation; catalyst application and electroless plating; pattern printing and masking [1]. During the process mentioned above, lots of chemical in the disposed solutions are contains etching ingredients and acids which are hard to treat with. Thus, the production process must be performed under extra care to ensure that the negative effect on the environment is minimized.

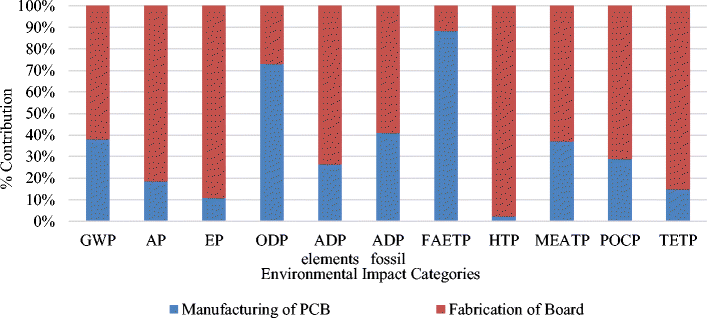


Figure1. The Contribution of manufacturing of PCB on a various environmental impact

The frame of our drone and gimbal are made from glass fiber and polyamide. The production of glass fiber needs to be handled with extra attention because it is found that breathing glass fiber dust can cause irritation of nose and throat. In addition, eyes will become red with exposing the fiberglass. Momentous stomach irritation will also happen if the worker accidentally swallowed glass fiber. During the manufacturing process of polyamide, nitrous oxides is usually released to the atmosphere because the industry has no use of it as a byproduct [2]. However, it has a high global warming potential that is 310 times that of carbon dioxide [3].

**1.2 Stage of Nominal use**

During nominal use of our product, improper use of the battery is one of the main causes of the danger. Since we are using the Lipo battery for the main power source of the product. It is important that the Lipo battery is charged in the correct way. As is known, if a high voltage is applied across the cells when charging, the battery cells will swell and explode if they are not disconnected in time [4]. To minimize the possible dangers caused when using the battery, it is important that the user knows the correct way to use the battery. Otherwise, the explosion of the battery might cause major injuries to the user. We will include this in our user manual to ensure that users are aware of this.

**1.3 Stage of Disposal**

Although glass fiber is recyclable, the recycling process is costly and is not friendly to the environment [5]. Additional discussion may be necessary for recycling the glass fiber part of the frame. Polyamide itself is recycled from waste material [6]. It may look like that it is a fairly environment-friendly ingredient, however, it has an extremely low decay rate. Incinerating it also produce harmful products [2].

The battery is extremely toxic for soil, so it is necessary to dispose of the battery in a proper way. It is recommended to collect the used or damaged batteries and send them to the battery recycling centers or any other facility that has a specialized recycling department. The battery contains lead and other heavy metal will cause serious environmental impact.

All the electronic circuits could be recycled, and it is a waste that they end up in a landfill. It is recommended to visit a recycling center since it is easy to find one. Usually, the electronic wastes contain lead, mercury, cadmium and can be harmful if released into the environment. Reusing and recycling raw materials from e-waste can conserve natural resources [7].

1. Ethical Challenges

We have made a lot of effort to make sure our product is safe to use. We incorporated two control modes for the drone. When the auto-tracking mode fails, the control source falls back to the radio controller. Users need to make sure the radio is turned to landing mode before they enable the face tracking feature. In the future, we will develop some validation algorithm to enforce this step. Meanwhile, we will include this in the user manual so that users are aware of this requirement. When the flight control is in landing mode and face-tracking is disable, the drone can land safely no matter what.

In addition, we have chosen the face-tracking algorithm carefully in a way that the feedback rate is high enough so that there will not be any delay in the drone’s behavior. Of course, the trade-off of this decision is the accuracy of the face-tracking result.

It is totally fine when the drone is used properly by following safety rules, but however, there are some points need to be made considering preservations and flying rules which we will include in our user manual.

The drone is powered by a Lipo battery and there is no battery protection within this device. That means the battery could be overdrawn or be damaged by other physical damages such as penetration. All Lipo batteries will be damaged if the energy is overdrawn. So, when this product is not used for a long period, users should not keep the battery in a low energy state which may cause battery damaged. The battery should be detached when not in use and kept away from any ignition sources. Users also need to keep the product in dry places in case the circuits get damaged.

The drone may contain lots of small pieces components and it contains sharp objects, it is extremely recommended for adults and any children below fourteen should be accompanied by adults when flying this drone. Keep the drone away from babies in case they swallow any tiny components.

As an aircraft product, it is necessary to consider some extreme cases like losing control of aircraft or powering off accidentally. It is possible for our drone to become a danger to the user or people around. Therefore, it is necessary to make rules for users to obey [8]:

* Fly only for fun or recreation.
* Follow the safety guidelines of a model aircraft community-based organization.
* Fly at or below 400 feet when in uncontrolled airspace.
* Fly within visual line-of-sight, meaning you as the drone operator use your own eyes and needed contacts or glasses, to ensure you can see your drone at all times.
* Never fly near other aircraft.
* Never fly over groups of people, public events, or stadiums full of people.
* Never fly near or over emergency response efforts.

3.0 Sources Cited

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