**Simulation Modeling of Recreational-Use Battery Consumption Tracking for the DJI Tello Quadcopter**

Green Computing Course Project Proposal

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1. **Abstract**

Drones are an increasingly large market in the United States. Their popularity has seen rapid growth in many industries, particularly in recreation. The National Conference of State Legislatures reported an astonishing 1.1 million registered recreational drones in March of 2023 [2]. However, this only includes drones required to be registered with the FAA and excludes a lot of smaller drones such as the DJI Ryze Tech Tello Quadcopter, which has been selected for this proposal. Such drones often come cheaper and require less advanced piloting skills. Coupled with the popular DJI technology, drones like the Tello have become increasingly popular for a younger, more inexperienced populace. As drones such as the Tello become increasingly prevalent, the need for efficient battery consumption tracking systems becomes paramount. This proposal explores an innovative approach of tracking battery and energy consumption of the Tello drone in simulation flights. It will underscore the critical role of these metrics in maximizing flight performance and operational capabilities, aiming to give new drone operators the option to use their drones more effectively and efficiently. The goal is to provide a package that can be integrated into a variety of drone flight systems to allow for energy and battery tracking for optimal energy efficiency should the user wish to do so.

1. **Introduction**

Efficient battery and energy tracking in drones play a pivotal role in optimizing flight performance, ensuring regulatory compliance, and enhancing operational efficiency. This proposal brings to light a solution that signifies the importance of monitoring battery consumption during various drone maneuvers, utilizing battery consumption data to demonstrate the impact of different flight scenarios on energy usage. With the right information provided to a drone operator, flight paths and maneuvers could be taken to increase the operability of the system. Research conducted by the United Kingdom Department of Research and Innovation demonstrated the impact that effective energy efficient usage of drones can have. They found that through proper measures, not only would drones be more sustainable, but they had the capacity to reduce the cost of maintenance by around 30% [3]. Such numbers emphasize the practicality of such a solution, and with a implementation, operators would gain more than they lose. Previous works have used many approaches for calculating drone energy consumption, but few allowed for user interaction. By introducing a solution where users can fly their drones with minimal interference from the energy tracking module, but still gain the necessary information for positive feedback, we open the door to a greener future for recreational drones.

1. **Related work**

Efficient battery and energy tracking in drones have been recognized as critical for optimizing flight performance, ensuring regulatory compliance, and enhancing operational efficiency [4, 1]. Prior research has explored various approaches to drone energy consumption tracking. A study published in ScienceDirect by A. Rodriquez et al. (2022) investigates the impact of drone flight data on energy use and greenhouse gas emissions. The authors explore the potential of drones for last-mile delivery and compare their energy consumption to conventional methods. Their findings suggest that drones can be significantly more energy-efficient, particularly for small packages. However, the environmental impact is also dependent on the source of electricity used for charging [4]. They further propose the development of an interactive UI for users hoping to fly their drones more greenly. However, unlike their approach, our research will utilize a more popular DJI Tello drone as the base for energy efficiency calculations and develop an interactive module that simulates real flights. Another study, published in MDPI by Gora et al. (2020), focuses on creating an energy consumption model for Unmanned Aerial Vehicles (UAVs). The authors emphasize the importance of minimizing energy consumption to reduce maintenance costs. They propose using machine learning algorithms to develop the model and compare different ML approaches. Their findings demonstrate that while some algorithms perform better than others, all can be effective in creating an energy consumption model, particularly notable as their approach does not necessitate specific knowledge about the UAV being used [1]. Unlike this work, we propose a more user-friendly approach that allows users to decide for themselves what they want for their systems while utilizing the information provided to them via our system. These studies highlight the growing interest in optimizing drone energy efficiency and the potential benefits of implementing such solutions. While your proposed system focuses on simulation flights, it aligns with this broader effort towards improved drone energy management.

1. **research design**
   1. **Research Methodology**

This project will be following the provided methodology in developing our solution:

1. Testing with the DJI Ryze Tech Tello Quadcopter, various drone movements will be tracked for their battery consumption using the open-source Python Tello library.
2. Battery consumption tracking for each drone task will be utilized in determining overall battery consumption.
3. A Tello Drone Simulator will be developed to approximate drone battery usage over various flight paths.
4. Real-time messages will be incorporated to notify users of energy consumption based on the specific drone actions.
5. Final energy consumption and approximate energy consumption will be displayed for drone operator. This will be key for future flights as users can utilize this information to optimize their flights.
   1. **Expected Research Outcomes**

Below are the expected results of this research project:

1. A battery consumption tracking program will be developed to track real-time drone data for the project.
2. A Tello Drone Simulator will be created that allows users to test fly a Tello drone. This simulator will allow for all the basic drone movements and provide maps of drone pathing after the flight is complete.
3. An interactive algorithm will be developed to allow users to use the simulator to fly a simulation drone and visualize battery consumption. Messages will be shared indicating high or low energy loss from the drone. Simulation drone flights will either be terminated by the user or be shut down upon the battery hitting zero percent.
4. A final battery consumption report will be shared with the user, including all drone movements and final battery usage and energy consumption of the flight.
5. **references**
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