Studying the Effect of Drones on STEM Education

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Problem

There is a narrow range of educational robotics opportunities in secondary schools; therefore, students lack options to engage in STEM that appeal to their interests.

Hypothesis

Project-based learning related to building, programming and using autonomous drones provides an engaging and exciting vehicle to increase interest in STEM, especially for students from underrepresented groups, by enhancing students self-efficacy, attitudes, content knowledge, and skills of science practices.

Approach

Leverage the existing educational resources for the Introduction to Robotics course taught at Brown University to develop a standards-aligned robotics curriculum using drones for secondary school students.

Existing Education Platform

Course Outcomes: students build, program, and fly their own drones.

Learning Materials: textbook, assignments, projects, and instructional edX videos

Platform: A Raspberry Pi Drone
Hardware Features:
- Compute: Raspberry Pi, Python, ROS
- Sensors: IMU, Infrared, Camera

Software Features:.
- Velocity and Position estimates using optical flow and computer vision
- PID control
- UKF state estimation
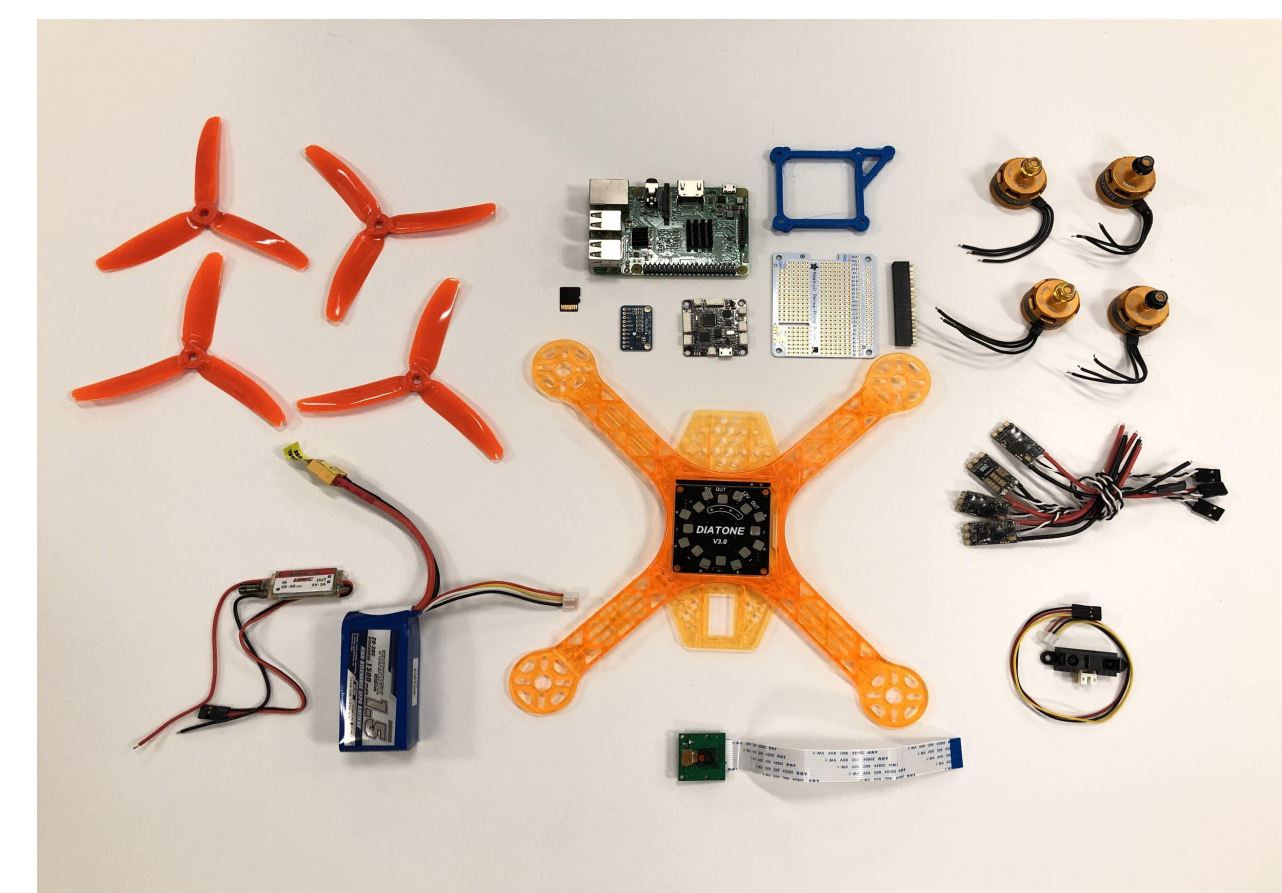- Localization and SLAM

The Drone

Fig. 1: Hardware components that students are provided

Fig. 2: Completed drone build

Broad Impact

The program will provide an education intervention for schools in Rhode Island and elsewhere at no cost to the schools or students. 300 drone kits will be distributed to approximately 20 schools. The designated instructor for each school will receive 1 week of paid professional development experience. Long-term impact on students' interest in STEM will be evaluated.

Future Education Initiative

Fall 2020 Roll out plan: Provide materials and training for twenty schools to participate in the education program train in the form most effective for their students: i.e. after school, as an elective, or another.

Modules:
- Building the drone
- Electronics: soldering, multimeter
- PID Control
- Sensors and Actuators
- State Estimation
- Programming: Linux, Shell, Python, ROS
- Safety, Ethics, History, and Societal Relevance