Autonomous Drone Pollination

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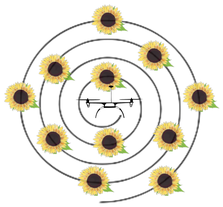
Problem Statement

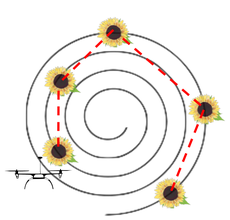
The declining bee population poses a threat to many aspects of life on earth as they are essential pollinators. Our team aims to supplement the declining bee population with drones capable of pollinating flowers autonomously. The goal of this project is to create a system capable of locating sunflowers within a region and transferring pollen between them.

Objectives



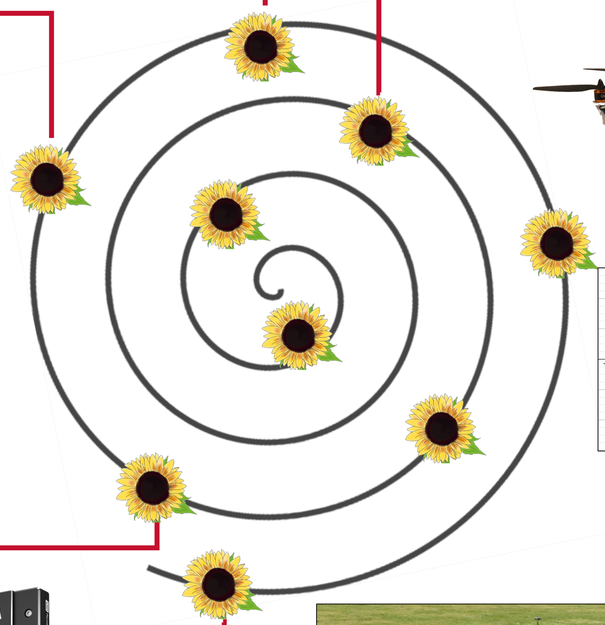
1. The system must be able to navigate a region near its starting location and search for flowers during flight.

2. The system must be able to locate and approach flowers.

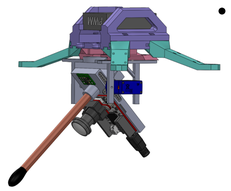


3. The system must have a method of sequencing between multiple target flowers in the same region.

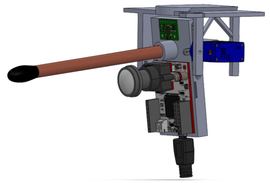
4. The system must have a method for collecting and depositing pollen.



Mechanical Approach



- Designed a compact, 3D printed, modular drone with the intention of limiting the downwash effect.



- Created a 3D printed end-effector powered by a servo
- Contains a makeup brush for pollen collection
- Contains an openMV camera for flower detection and tracking

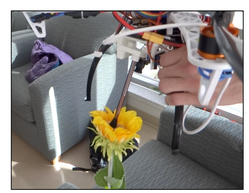
- Purchased a QwinOut drone for experimental evaluation
- Attached required components for successful flight
- Implemented the 3D printed end-effector for flower pollination

Testing and Evaluation

- Created search patterns with positional waypoint generations

- Logged positional and velocity set points versus the drone's performance

- Testing consisted of three flowers spaced randomly in a field
- The drone successfully searched the region and located flowers to pollinate.
- The drone successfully centered over the flower and lowered to attempt pollination



- Unit tests revealed the end-effector was capable of dynamically tracking a flower and properly aligning for pollination

System Approach

- Utilized a Raspberry Pi 3 as an on-board computer to facilitate all aspects of the drone.
- Runs ROS architecture and powers all sensors and servos

- Used an OpenMV Cam H7 for vision processing and flower detection.
- Performs color blob detection for yellow sunflowers

- Used a Pixhawk 4 for drone control and flight stabilization.
- Px4 receives mavlink messages from the Pi to control the drone.

Lessons Learned

- An important step for product development is to utilize products on the market as a proof of concept. Once a proof of concept has been established, a prototype to better fit your needs can be developed.
- Online communication can make group projects difficult as misunderstandings are common. Its important to be clear and ensure everyone is on the same page.
- Playing on team member's strengths and previous experience makes group projects easier to accomplish.