Development of Drone-Mounted Dispersal System

Saad Ali Hassan (Mechatronics)
https://www.linkedin.com/in/saadalihassan/

Supervisor:
Loulin Huang

Reinhart Bate (Mechanical)
https://www.linkedin.com/in/reinhart-b/

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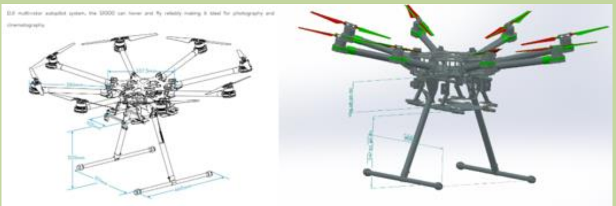
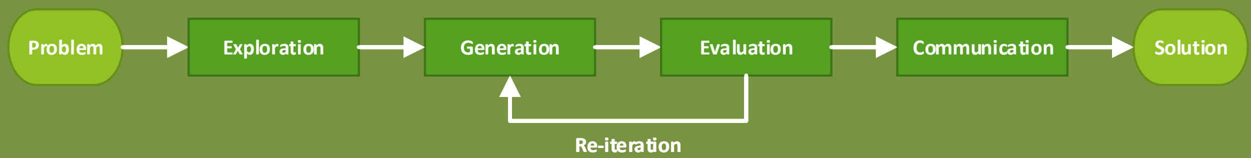
1. Introduction

Current methods for dispersing payloads are time and labour intensive. If the Department of Conservation is to meet their vision by 2050, alternative methods must be explored. 'Environment & Conservation Technologies', ECT, have tasked AUT students to produce a novel method of aerially dispersing the payload using a drone. The payload is soft and prone to breaking, therefore directly applying existing solutions which use hard products is not suitable. Research on existing drone methods was conducted to clarify the goal and establish specifications.



2. Design Process



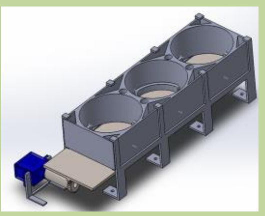
Conceptual and detail design was conducted to develop and prototype a dispersal mechanism. The mechanism most suited to this application was found to involve a rack and pinion system.

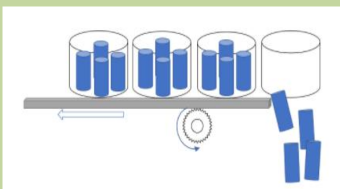
Specifications were established and agreed to by the students and ECT.

Key specifications include:

- Must have functionality to disperse 4x payload on command
- Reloading should be quick and convenient, the drone should spend no longer than 1 minute on the ground in-between flights
- Payload capacity is to be maximised, dispersal system weight is to be minimised
- Design should be scalable for higher capacity drones
- The total mass of the fully laden system must be less than 9kg

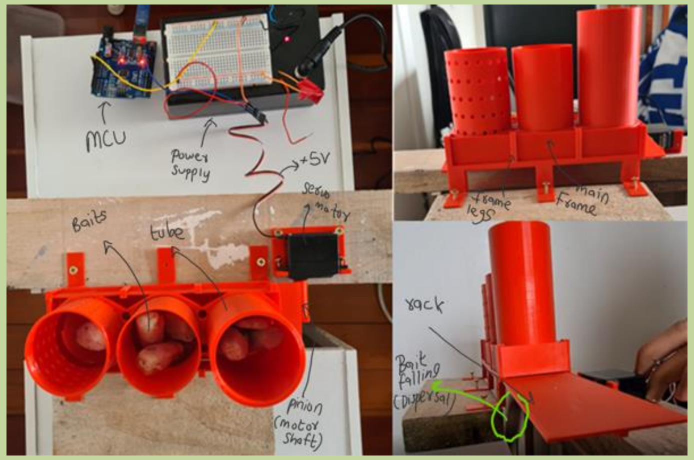
Selected Concept:





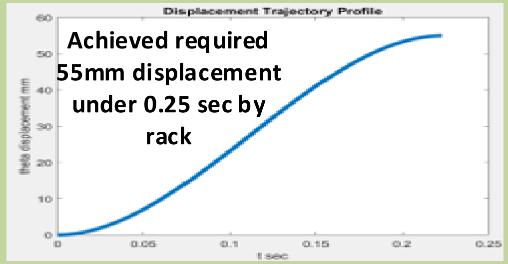
3. Prototyping and Testing

3D Printing:
Due to lockdown, the most convenient and efficient way to manufacture the prototype was to 3D print.

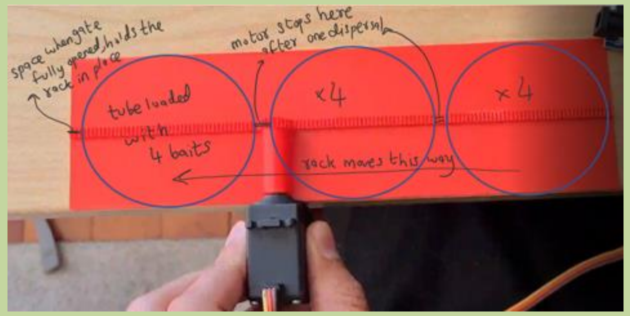


Component Breakdown:
1.Main Frame (Tube holder)
2.3x Tubes of various designs
3.2x Frame legs
4.2x Planks of wood
5.Arduino UNO
6.Power Supply
7.Stepper Motor

Displacement Trajectory Analysis of single dispersal:



Working:
To achieve controlled dispersal functionality without making the system complex, the stepper motor was programmed using Arduino. The program takes the user command of 'disperse' and then motor steps the calculated rotational displacement that gets converted to linear displacement by the rack. As the rack moves away the payload falls under gravity.



4. Detail Design

Cartridges are 5 tubes long, containing 20 units of payload each. They are removable, to reduce reloading time and have groove cut-outs for weight reduction. PLA was the chosen material for this stage of design for its 3D-printability, stiffness/weight ratio, durability to fresh/salty water, and UV resistance.
They are fixed to an aluminium sub-frame. This sub-frame also supports the sliding gate and motor housing. The aluminium 'U-frame' component connects the sub-frame to the drone's mounting slots. A topological study was undertaken to reduce the mass while maintaining adequate strength, 43% mass reduction was achieved.

The goal of this section was to create a prototype which was ready for manufacture and flight testing. This system can carry 40 unit of payload, servicing 10 dispersal points (6400 sqm), and has a fully laden mass of 1.6 kg. Higher capacities can be achieved by arranging multiple systems in parallel.

5. Conclusions and Recommendations

- The design specifications have been met and verified by hand calculations and simulations.
- Considerations have been made regarding dimensions and materials to address potential manufacturing issues.
- Once the 40-Unit system is verified by flight testing, increasing payload capacity is simply to add more units in parallel and small design changes the chassis.
- The methods used to reduce the mass of the system were successful. The focus is now on increasing payload capacity, rather than decreasing system weight. The current design only allows for lateral expansion.

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