Individual Report (EN617)

Group-14
Shivam Yadav
150100086

Title:

Drone based package delivery system, optimal path planning and cost estimation

Objective:

A Drone has to deliver a package from a depot or warehouse to the predetermined destinations or consumers. The main objective of this project is to provide path planning that aims to minimize the delivery cost and reduce the total energy consumption.

My work

- Drone modeling and characterization
  - Thrust to weight ratio (TWR) is generally 1.5 to 2. It indicates how much thrust is needed to lift the drone with the given weight. Total mass of drone is mass of battery, payload and frame and motors
  - Motors are chosen so as they can together provide the required thrust and propellers to use is specified by the motor manufacturer for optimum working
  - Power consumption of the drone is calculated from the thrust and velocity of the drone
  - Battery capacity (kWh) required is obtained from power consumption and time of flight of the drone
  - Battery charge (in mAh) required is calculated by time of flight, power consumption, percentage battery discharge and voltage of battery. The battery voltage is fixed once motors are finalized
  - Cost of charging the battery and maintenance is the running cost for the drone
- Selection of motors, propellers and number of rotors

  Selected Motor: Model 2826 1000KV 3KG Thrust Brushless Motor

  Specifications: Maximum thrust of 3KG on 4Cell Battery. Specially designed for RC Planes of medium to larger models. These motor can turn propeller of size 10 to 14. Diameter is 28cm and can length is 26cm.Recommended plane size around 3KG. Weight is 175gms and recommended battery 3 and 4 cell. For best performance 4 cell is recommended.

  Maximum AMP is 50A. So recommended ESC is 60A

  Other Recommended motors

1. Coolplay syms x5c-1 x5c x5
2. Hobby-mate quad-copter kit motor
3. Parrot AR Drone 2.0 motor
4. Hobby-power A2212 brushless motor

- Flying power consumption and cost estimation for drone

  Mathematics and calculation of power consumption is done.

  The cost is estimated from the charging of battery and number of electricity units required to charge it.

  $M_t = M_b + M_f + M_p$ // Total mass of drone
  $T = 1.5 * M_t$ // Thrust in kg
  $P = T * v * 9.8/eff, \quad TOF = d/v$ // Time of flight, v:speed of drone
  $C(kWh) = P(kW) * TOF(h)$ // Battery capacity
  $C(mAh) = P(W) * 1000 * TOF(hr)/V(14.8V for 4S)$ // Battery charge
  $M_b = 0.0005 * C(mAh)^n$ // Battery mass based on battery rating, n=0.8182

  The mass of battery is iteratively calculated from Battery-weight vs capacity correlation

- Battery selection, battery weight-capacity correlation and battery cost

  4S or 4 cell LiPo 14.8V battery

  Battery-weight vs. capacity correlation: Y(kg)=0.0005*C(mAh)^0.8182

  Battery cost vs. capacity correlation: Y(Rs) = 0.8662*C(mAh)+373.56

- Involved in decision making in the problem formulation and algorithm selection for the problem

  The problem formulation involves the extent of the project as there are many possibilities with so it needs to be well defined. The algorithm selected is easy to implement and fast for small data set

Learning from the project

- Drone modeling and factors influencing its characteristics
- Data mapping and fitting for different data
- Familiarized about techniques for optimal path planning
- Market surveying for products
- Working in team and coordinating