International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Design and Fabrication of Fish Feeding Drone

Muruganantham S[1], Dinesh S[2], Kathershaw M[2], Lokesh Kumar K[2], William Richard K[2]

[1]Assistant Professor, [2]UG Students - Final Year, Department of Mechanical Engineering, Nandha Engineering College, Erode 638 052, Tamilnadu, India

Abstract

Drones have revolutionized many industries. Drones have been used for military purposes for decades and are now integral to commercial enterprises, leading to disruption in industries such as construction and agriculture. Notably, they have become essential in achieving sustainable agriculture, and are tasked with crop spraying and mapping to reduce the overuse of pesticides and fertilizers. Therefore, from these uses of drones we prefer the drone for the application for feeding to the fish farm. The conventional methods of supplying feed to fish farm are ineffective. It is better to find new an automatic feeder using drone saving pellets from crushing and cohesion without hitting pellets during feeding at a predetermined interval of time and an accurate amount of food with a larger surface area covered by pellets. Developing-country fish farmers use manual feeding to be more cost-effective than with costly mechanized feeding, The dispensed feed operated by a motor located underneath the pellet hopper and the feed material was discharged into the fish farm through a gate in the bottom of the feeder. Furthermore, the feeder used very little electricity and saving time, cost, labor, energy, and pellets.

Keywords: Design, fabrication, fish feeding drone.

1. Introduction

Drones are eyes in the sky for fish feeding. Now the fish feeding is very interesting thought for preparing it. The use of drone is to reduce the human work, which saves energy and time and it is easy to operate. Developing fish country farmers use manual feeding to be more cost effective. We use the feed carrier under the drone for spreading the feed. And, the feed carrier contains open close type valve under drone feed carrier and it is operated by remote controller. In this process does not need more employs. And it is easily operated by a single man. BLDC motor is used to help the drone for flying and it is fixed to the wings for flying. We do not want to roam around the pond shore for feeding, we can stand at the place and can operate controller to feed around the pond. By this we can save energy and not much peoples are required for this process by this it is cost wise very help process. Further imagine that you are raising it, those gentle fish that are favorites of many ponds and aquariums.

2. Review of Literature

The extensive literature survey will help to understand the concept, the theorems and the different factors that influence the drone's performance. Before starting our work, we had viewed many research papers which indicates that for rescue-based drone installation is a crafty and a skillful task many factors associated with it such as power consumption time required, maintenance cost, number of units produced per drone etc.

Ali Magdi Sayed Soliman, Suleyman Cinar Cagan et.al, [1] his study aims to encourage the idea of utilizing unmanned aerial vehicles in the fire- fighting application. The main advantage of UAVs is their ability to work at rugged places and dangerous environment like fixed-wing vehicles, rotary-wing vehicles typically have a feature of flying slowly or hovering, taking off or landing vertically. For doing a task of dropping fire- extinguishing balls, rotary-wing UAVs are the proper vehicles to be used.

Abdel Ilah N. Alshbatat Raj et.al, [2] the system is structured with five units: Hexacopter unmanned aerial vehicle (UAV), landmine detector, hands free flight controller, emergency flight controller, and the main onboard flight controller. Drone is equipped with a landmine detector, emergency flight controller, and the main on-board flight controller.

Abdel ilahalshbatat et.al, [3] the system was implemented and tested using Arduino Nano board. The board was programmed and interfaced with the original circuitry kit. Experimental results have shown that the proposed control strategy provides an efficient collision avoidance scheme for an unknown environment.

Agoston Restas et al, [4] this paper focuses mainly on operational and tactical drone application in disaster management. Drone can be used for fire detection, intervention monitoring and for post-fire monitoring for special rescue teams, the drone application can help much in a rapid location selection, where enough place remained to survive for victims during earthquake.

Aníbal Olleron. Luís Merino et.al, [5] summarizes different control techniques including both control architectures and control methods. Computer vision for aerial robotics is briefly considered.

Bas Vergouw, Huub Nagel, Geert Bondt and Bart Custers et.al, [6] the different types of drones can be differentiated in terms of the type (fixed wing multirotor, etc.), the degree of autonomy, the size and weight, and the power source. These specifications are important, for example for the drone's cruising range, the maximum flight duration, and the loading capacity. In order to perform a flight, drones have a need for (a certain amount of) wireless communication with a pilot on the ground. In addition, in most cases there is a need for communication with a payload, like a camera or a sensor.

Burchan Aydin, Emre Selvi, Jian Tao and Michael J. Starek et.al, [7] this paper examines the potential use of fire extinguishing balls as part of a proposed system, where drone and remote-sensing technologies are utilized cooperatively as a supplement to traditional firefighting methods. Scouting unmanned aircraft system (UAS) to detect spot fires and monitor the risk of wildfire approaching a building, Fire-fighting UAS autonomously traveling to the waypoints to drop fire extinguishing balls.

Casbeer.D. W; Beard. R. W; McLain.T. W et.al, [8] since a forest fire is typically inaccessible by ground vehicles due to mountainous terrain. Effective UAV path planning algorithm utilizing infrared images that are collected on-board in real- time. A new cooperative control mission concept is introduced where multiple low- altitude, short-endurance (LASE) UAVs are used for fire monitoring.

Craig B. Clements, Shiyuan Zhong et.al, [9] first comprehensive set of in situ measurements of turbulence and dynamics in an experimental wildland grass fire should help improve fire models.

Chi Yuan, Youmin Zhang, Zhixiang Liu et.al, [10] this paper presents a systematic overview of current progress in forest fire fighting technology. First, a brief review of the development and system architecture of UAV systems for forest fire monitoring, detection, and fighting is provided. Next, technologies related to UAV forest fire monitoring, detection, and fighting are briefly reviewed, including those associated with fire detection, diagnosis.

Connie Phan, Hugh H.T. Liu et.al, [11] a top-level mobile mission controller provides effective mission planning and system-level decision making such that mission completion time and resource expenditure are optimized. This paper discusses the potential application of the proposed hierarchical vehicle platform to high-risk missions, specifically in the context of wildfire fighting.

Fu-Hsuan Wen et.al, [12] this research presents an analysis and management strategy for hovering hexacopter with one or more failing motors. Of late, multirotor drones have become particularly popular, and all drones have been increasing in popularity. Unlike a fixed-wing drone, failure of motors in a multirotor craft may cause safety problems.

M. Hassanalian, M. Abdelkefi et.al, [13] in this review paper, they identify a novel classification of flying drones that ranges from unmanned air vehicles to smart dusts at both ends of this spectrum, with their new defined applications. Design and fabrication challenges of micro drones, existing methods for increasing their endurance, and various navigation and control approaches are discussed in details.

Huy X. Pham; Hung M. La et.al, [14] using Unmanned Aerial Vehicles (UAV) to cover wildfire is promising because it can replace humans for fire tracking, reducing hazards and saving operation costs.in this paper we propose a distributed control framework designed for a team of UAVs that can closely monitor a wild fire in open space, and precisely track its development.

Hugo Rodrigue, Seunghyun Cho et.al, [15] this work introduces a novel concept for a twist morphing wing segment where only a segment of the wing is actuated which causes a rotation of the tip of the wing while the base segment fixed. This structure was implemented in a UAV-sized wing and was tested both in still-air conditions and in an open-type wind tunnel to determine the actual impact of this mode of actuation.

James F. Campbell et.al, [16] home delivery by drones as an alternative or complement to traditional delivery by trucks is attracting considerable attention from major retailers and service providers (Amazon, UPS, Google, DHL, Wallmart, etc.), as well as several startups. While drone delivery may offer considerable economic savings.

Juan Jesús Roldán-Gómez, Eduardo González-Gironda, Antonio Barrientos et.al, [17] extinguishing operations are dangerous because any accident can cause injuries or even deaths among the professionals. The survey considers two detection systems: one with drones and another with fixed cameras. The survey asks about the application of drones to monitor the evolution of fires.

Luigi Di Puglia Pugliesea et.al, [18] parcels delivery is the most expensive phase of the distribution logistics. Everyday several vehicles, usually internal combustion engine vehicles, must serve a high number of customers spatially distributed in an urban area.

Lauren Bowers Reddy, Daniel DeLaurentis et.al, [19] although providing significant benefits compared with manned aircraft or ground systems, unmanned aircraft also introduce costs and risks. This investigation, an opinion survey was administered to assess participants knowledge, attitude, and practices about unmanned aircraft.

Laszlo.B.; Agoston.R.; Xu. Q et.al, [20] research used their own experiences in this field, practical experiments, economic analysis, and expert estimation. Result and discussion.

3. Problem Identification

- Manual feeding requires more amount of energy for fish farming
- Pellets spreading accuracy ratio is poor.
- Manual feeding takes more time.
- Requires a greater number of manual workers.

4. Objectives

The objective of the proposed system is to develop a fish feeding drone which performs operations like (surveillance, feed carrying and dropping mechanism, spraying mechanism.).

- Spraying the feed to the fish like ponds and farms etc.
- To reduce the risk of manual workers.
- To reduce the other expenses by using drone.

5. Methodology

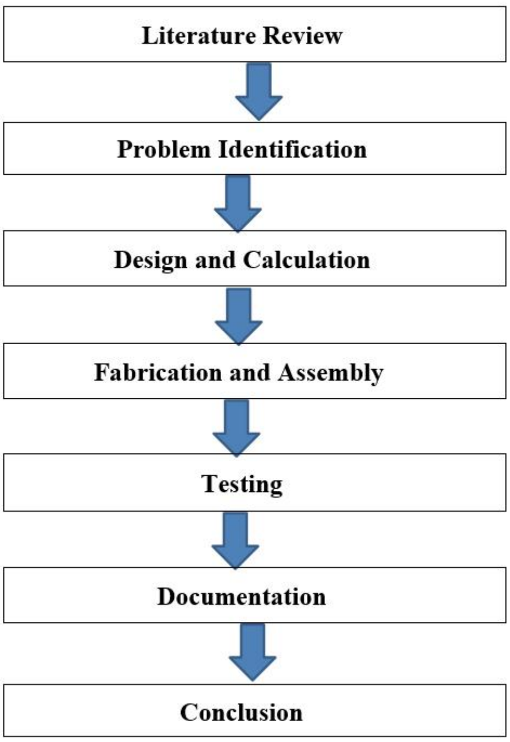

Figure 1 Work flow

6. Design Calculations

In order to accomplish the necessary functions that the hexacopter will execute, three main designs were chosen. These designs involve the hexacopter's main components that will be optimized, which are the release mechanism and camera. The release mechanism designs were designed for the hexacopter to drop a chemical fire extinguishing grenade onto a selected location to extinguish firesor for testing and research motives. Additionally, a camera is to be installed on top of the hexacopter that will be utilized for recording, photographing, and inspecting purposes. The camera will be predominantly used to inspect bridges, buildings, and other structures that engineers evaluate. These two key characteristics of the hexacopter are the focal points to the designs demonstrated in the subsequent sections.

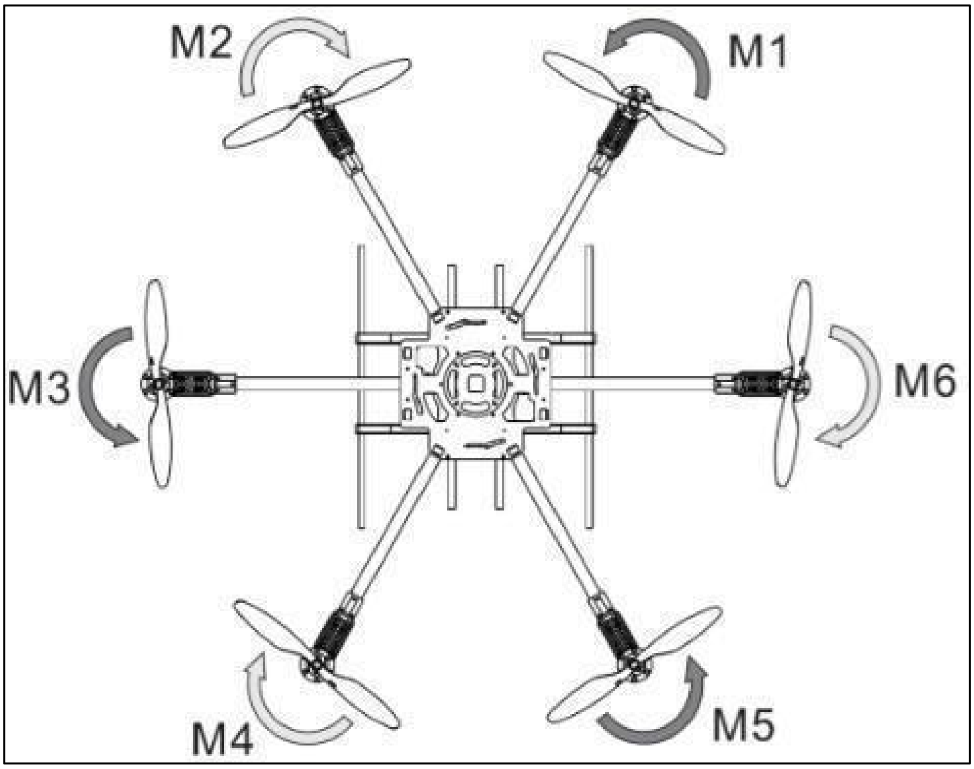

Figure 2. Design of a hexacopter

6.1 Force Analysis

The most important aspect of this quadcopter is its ability to fly. For it to fly properly, a simple force analysis along the vertical direction is taken in order to determine the minimum radius of a propeller needed to allow the quadcopter to fly.

$\sum Fy = 6T - W = 0$

Where T is the thrust supplied by each individual motor and W is the overall weight of the hexacopter.

T = 0.25 W = 0.25*48.93 = 12.23 N
Force = 6T – W = 24.45 kg-m/sec^2

6.2 Battery run time

We use the formula to calculate the run time of the drone.
Run Time = (10 × battery capacity in amp hours) / (appliance load in watts).
= (10 × 4500) / (8.325) = 15 -20 mins (appx).

6.3 Drone Fly distance

This drone has FSCT6B 6 channel receiver, Fly Sky FS-CT6B 6-Channel and 2.4 Ghz transmitter. So, this ranges from 500 m to 1000 m in the air. This may vary when the load is applied

Fly Distance = maximum 1000 m and minimum 500 m.

6.4 Drone angle

This is a hexacopter, so angle is more important. Hexacopter has six frames and 6 propellers.

- Number of Axis = 6
- Wheel base = 500 mm
- symmetrical Propeller =10 × 4.7 in, 8 × 4.5 in
- Take off weight = 1200 -2400 g
- Frame angle = Each 60 degree

7. Conclusions

Overall, this project boosted multiple aspects of engineering knowledge to complete. Basic design considerations were used when designing the structural framework of the hexacopter to ensure no net moments, torques, or forces aside from the thrust force were to be felt on the hexacopter. Keeping this in mind, a very balanced and symmetrical design came into focus with most of the components for the hexacopter located in a centralized position among the plates of the hexacopter with the motors and propellers attached to the end of each evenly spaced arm. It was also noted in aviation knowledge, that residual torques incurred from the motors and propellers would need to be dealt with, so opposing rotational patterns were designed to be placed adjacent to one another. A series of calculations were performed to aid in the choosing process for the correct size of propellers. Knowing the weight of the hexacopter, a minimum thrust force can be determined which will then aid in selecting a specific size of propeller depending on the motors used. Most of the complex design process came into play during the design of the release mechanism for the fish feed carrier. It was decided that a four hold and drop mechanism would be the most effective and stable design for the release mechanism and that this release mechanism would be placed in a central location along the underside of the hexacopter's central plates. It was concluded that the material is far more resilient than needed, but due to ease of manufacturing and low cost, PLA plastic was chosen as the final material of manufacture.

References

1. Ali Magdi Sayed Soliman, Suleyman Cinar Cagan & Berat Baris Buldum., The design of a rotary-wing unmanned aerial vehicles–payload drop mechanism for fire-fighting services using fire-extinguishing balls., SN Applied sciences, Article number: 1259 (2019)

2. Abdel Ilah N. Alshbatat Raj, Heuristic Optimization Technique to Locate and Avoid Buried Landmines: Drone-based Approach, Information Technology and Computer Science,2018.

3. Abdel ilahalshbatat, Abdel-hamid soliman, Anwar al-assaf, Fuzzy-based obstacle avoidance system for quadrotor unmanned aerial vehicle, International Journal of Soft Computing and Artificial Intelligence, vol 5, 2017.

4. Agoston Restas., Drone Applications for Supporting Disaster Management, World Journal of Engineering and Technology, vol 3,.2015.

5. Aníbal Olleron, Luís Merino., Control and perception techniques for aerial robotic, Annual Reviews in Control, Volume 28, Issue 2, 2004.

6. Bas Vergouw, Huub Nagel, Geert Bondt and Bart Custers Drone Technology: Types, Payloads, Applications, Frequency Spectrum Issues and Future Developments., The Future of Drone Use 1st (online), 2016.

7. Burchan Aydin, Emre Selvi, Jian Tao, Michael J Starek, (2019) "Use of Fire-Extinguishing Balls for a Conceptual System of Drone-Assisted Wildfire Fighting".

8. Casbeer.D.W; Beard .R.W; McLain.T.W ; Li.S.M ; Mehra, R.K., Forest fire monitoring with multiple small UAVs., In Proceedings of the IEEE American Control Conference, 2005.

9. Craig B. Clements, Shiyuan Zhong, Scott Goodrick, Ju Li, Brian E. Potter, Xindi Bian, Warren E. Heilman, Joseph J. Charney, Ryan Perna, Meongdo Jang, Daegyun Lee, Monica Patel, Susan Street, and Glenn Aumann., Observing the dynamics of wildland grass fires: Fire Flux—A field validation experiment., Bulletin of the American Meteorological Society, vol 9, 2007.

10. Connie Phan, Hugh H.T. Liu, A cooperative UAV/UGV platform for wildfire detection and fighting, Asia Simulation Conference - 7th International Conference on System Simulation and Scientific Computing., 2008.

11. Claesson, D. Fredman, L. Svensson, M. Ringh, J. Hollenberg, P. Nordberg, M. Rosenqvist,T. Djarv, S. Österberg, J. Lennartsson & Y. Ban., Unmanned aerial vehicles (drones) in out-of-hospital-cardiac-arres., Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, Article number: 124, 2016

12. Fu-Hsuan Wen, Fu-Yuen Hsiao and Jaw-Kuen Shiau, Analysis and Management of Motor Failures of Hexacopter in Hover, Department of Aerospace Engineering, 2021.

13. M.Hassanalian, M. Abdelkefi, Design and fabrication challenges of micro drones, Annual Reviews in Control, 2019.

14. Huy X. Pham; Hung M. La; David Feil-Seifer; Matthew Deans, A distributed control framework for a team of unmanned aerial vehicles for dynamic wildfire tracking, 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2017.

15. Hugo Rodrigue, Seunghyun Cho, Min-Woo Han, Binayak Bhandari, Jae-Eul Shim & Sung-HooAhn., Effect of twist morphing wing segment on aerodynamic performance of UAV., Journal of Mechanical Science and Technology, 2016.

16. James F. Campbell, Donald C. Sweeney II, Juan Zhang, Strategic Design for Delivery with Trucks and Drones, College of Business Administration,2017.

17. Juan Jesús Roldán-Gómez, Eduardo González-Gironda, Antonio Barrientos., Applying Drone Swarms to Improve Firefighters' Efficiency and Safety., A Survey on Robotic Technologies for Forest Firefighting, vol 11, 2021.

18. Luigi Di Puglia Pugliesea, Francesca Guerrieroa, Giusy M, Using drones for parcels delivery process, International Conference on Industry 4.0, and Smart Manufacturing.

19. Lauren Bowers Reddy, Daniel DeLaurentis, Opinion Survey to Reduce Uncertainty in Public and Stakeholder Perception of Unmanned Aircraft, TRB Graduate Research Award Program on Public-Sector Aviation Issues, 2016.

20. Laszlo.B.; Agoston.R.; Xu. Q, Conceptual Approach of Measuring the Professional and Economic Effectiveness of Drone Applications Supporting Forest fire Management, Procedia Engineering, Volume 211, 2018.