IJIREEICE
ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 8.021 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 12, Issue 6, June 2024
DOI: 10.17148/IJIREEICE.2024.12601

Smarter Drone for Fertilizer Spraying

Burle Gunvant Pandurang[1], Adhav Shubham Sunil[2], Babar Swaraj Siddheshwar[3]

Prof. C. E. Kolambe[4]

Student, of Mechanical Engineering, Anantrao Pawar College of Engineering and Research, Pune Maharashtra, India.

Professor, Dept. of Mechanical Engineering, Anantrao Pawar College of Engineering and Research, Pune Maharashtra, India.

Abstract: The adoption of hexacopter drones for fertilizer spraying in agriculture signifies a major leap forward in precision farming techniques. These drones, with their distinctive six-rotor setup, offer enhanced stability and greater payload capacity, essential for the precise and efficient application of fertilizers. This study explores the use of hexacopter drones outfitted with advanced GPS and sensor systems to deliver fertilizers accurately, thus optimizing usage and minimizing environmental harm. Hexacopters' ability to traverse difficult terrains and swiftly cover extensive fields results in considerable labor and time savings compared to traditional methods. However, the widespread use of this technology faces obstacles such as high initial investment costs, regulatory compliance issues, and the need for specialized training. This paper provides a detailed analysis of the technical specifications, benefits, challenges, and future prospects of using hexacopter drones for fertilizer spraying, highlighting their potential to improve agricultural productivity and sustainability.

I. INTRODUCTION

The infusion of drone technology into agriculture has inaugurated a new epoch of precision farming, with hexacopter drones emerging as revolutionary implements for fertilizer application. Renowned for their six-rotor configuration, hexacopters exhibit unparalleled stability and payload capacity, fundamental for the meticulous dissemination of fertilizers across vast agricultural expanses. Enhanced with cutting-edge GPS and sensor systems, these drones facilitate targeted application, orchestrating the optimization of fertilizer utilization while concurrently mitigating environmental impact. Moreover, their adept maneuverability across diverse terrains and swift coverage of extensive fields herald a paradigmatic transformation in agricultural efficiency. Notwithstanding their auspicious advantages, the ubiquitous integration of hexacopter drones confronts impediments such as initial capital outlay and regulatory intricacies.

In the 21st century of Morden technology and technological advancement we have reach the moon and trying to farm on the mars and space. We have certainly reached the skies but we could not reach to the places in our grasp and one of them is today’s agricultural sector. With increasing in population with estimation of becoming 9 billion by 2040 we sure are lacking in the Morden agriculture in many ways to feed the bellies of coming generation we need to take the precaution and all necessary measure now and on global scale for more mature farming and providing all of the people of the agriculture a helping hand of technology. Even in this technologically advance era 70% farmers all across the world are using conventional method of agriculture where hard labour is getting on their nerve and there is a big gap between demand and supply and not enough food to feed 7 billion and soon, we are touching 9 billion so we need to take all the globalization in technology and help the farmers to increase their productivity and mineralise their effort by the proportion of production. Let alone in India 85% of farmers are not familiar with words like technology and by taking that in consideration it is our duty to educate them in regarding to that and so we can resolve our research around them and still can make them took after technology for their beneficiary purpose, as it is their rights to be part of this technological revolution.

II. LITERATURE SURVEY

Dr. K. Gayathri Devi, N.Sowmiya, Dr.K.Yasoda, Dr.K.Muthulakshmi, Mr.B.Kishore

In this paper we can find spraying the pesticides and fertilizer in the agricultural field on different crops using Unmanned Aerial Vehicle (UAV) in different quad copter and it also aids to develop the precision agriculture technique in monitoring different crops using camera mounted UAV. Overall performance of this method will increase by using quad copter which will spray the pesticides and monitoring the crop. This method will reduce the number of pesticides and fertilizer used in agricultural field and also increase crop yield.

Praveen Kumar Reddy Maddikunta, Saqib Hakak, Mamoun Alazab, Sweta Bhattacharya, Thippa Reddy Gadekallu, Wazir Zada Khan, and Quoc-Viet Pham. In this publication we analyse the requirement and challenges

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 8.021 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 12, Issue 6, June 2024
DOI: 10.17148/IJIREEICE.2024.12601

we face while application of the UAV in smart agriculture. The architecture, adaption and usage of UAVs in smart agriculture have been explored and presented. Potential case studies involving Bluetooth Smart-enabled sensors and UAVs in smart agriculture have been discussed. Bluetooth Smart technology can be replaced with any other technology for implementation purposes. The motivation of using Bluetooth Smart in case-studies is the lowcost and ease of access via smart phones. We have also explored various types of agricultural sensors such as location-based sensors, optical sensors, temperature-based sensors, etc, and identified several applications of UAVs in smart agriculture.

R. B. Kalamkar, M. C. Ahire, P. A. Ghadge, S. A. Dhenge and M. S. Anarase (Department of Extension Education, MPKV, Rahuri, India CAAST-CSAWM, MPKV, Rahuri, India). In this paper we understand Drones are helpful for farming management in terms of observing, measuring, and taking action based on real-time crop and livestock data. It erases the need for guesswork in modern farming and instead gives farmers the ability to maximize their yields and run more efficient organizations, all while enhancing crop production.

Shaik Himam Saheb & Dr. G. Satish Babu (ICFAI University)
AGRICULTURE ROBOT which is architecture based on unmanned aerial vehicle (UAVs) and a Seeding System that can be employed to implement a control loop for agricultural applications where AGRICULTURE ROBOT is responsible for seed sowing. Here by we can reduce the human efforts not much but some amount. This will be helpful in performing the seeding task done in agricultural fields in less time. This will reduce the labour cost also and perform the work very accurate. This is completely operated by the radio transmitter and receiver within the range of signal. If we are getting far away within the signal range then the AGRICULTURE ROBOT will not work properly. This system may be further developed in many ways, by replacing the seeding system with other equipment's or systems like if cutter is placed then it will be used for cutting crops, if sprayer module is attached to drone then it will be used as pesticide spraying drone, and also if provided with high equipment's and cost then it also performs scanning of plants, security causes, inspecting crop details with specified seeds, fertilizers, pesticides as per soil condition suggested from scientists of agriculture on crops. The process of application is controlled by means of the feedback from the wireless sensors network developed a ground level on the crop field.

III. METHODOLOGY

- **Drone Selection and Configuration:** Choose a drone model based on factors such as payload capacity and flight endurance, then configure it with necessary components like GPS and sensors to suit the specific agricultural application.
- **Flight Planning and Navigation:** Utilize software to plan precise flight paths, accounting for factors like terrain and crop layout, ensuring the drone navigates efficiently and safely during operations.
- **Fertilizer Application Procedure**: Implement a systematic process for loading and dispensing fertilizers from the drone, ensuring even distribution over the agricultural area to optimize crop health and yield.
- **Performance Evaluation:** Regularly assess the drone's performance, including flight stability, payload handling, and data accuracy, to identify areas for improvement and ensure optimal functionality throughout agricultural operations.

3.1 Working Principal:

Working principle of drone: (sprinkling pesticide) A Drone, or UAV (Unmanned Aerial Vehicle), is a type of aircraft that can operate autonomously along a predefined route using autopilot systems and GPS coordinates. These devices also come with conventional radio controls, allowing for manual piloting when necessary. While the term UAV can sometimes refer to the entire system, including ground control stations and video systems, it is most commonly associated with model airplanes and helicopters featuring both fixed and rotary wings.
Drones, particularly quadcopters, feature four fixed and vertically oriented propellers. Each propeller operates at a variable and independent speed, enabling the drone to perform a full range of movements. The process of controlling these movements involves several key components:

1. **Transmitter and Receiver:** The transmitter sends signals which are received by the drone's receiver.
2. **Flight Controller:** The receiver forwards these signals to the flight controller, which processes them using accelerometer and gyroscope sensors.
3. **Electronic Speed Controllers (ESCs):** The processed signals are then sent to the ESCs, which regulate the amount of current delivered to the motors.
4. **Motors and Propellers:** The motors, mechanically connected to the propellers, receive the specified current and rotate to generate thrust, allowing the drone to manoeuvre.

ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 8.021 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 12, Issue 6, June 2024
DOI: 10.17148/IJIREEICE.2024.12601

Sprinkling Pesticide Mechanism:

For pesticide application, the drone is equipped with a specialized system that includes a storage tank, a pump, and a nozzle. Here's how it works:

1. **Power Source:** The pump is powered by a Li-Po (Lithium-Polymer) battery.
2. **Pressurization and Flow Control:** The pump pressurizes the liquid pesticide in the storage tank, pushing it through the pipeline to the nozzle. The flow rate of the pump can be adjusted by varying the input current, which is controlled from the transmitter.
3. **Spraying Mechanism:** The pressurized liquid exits through the nozzle, where it is sprayed over the target area.

3.2 CAD Design And Actual Model:

IV. CALCULATIONS

Battery Calculations

Specifications of battry:11.1 V
4200 mAh
45 c •

Continuous Discharge Current(A):

$$Capacity(mAh) \times c\ rating \times \frac{1}{1000}$$

$$\therefore A = 4200mAh \times 45 \times \frac{1}{1000} = 189A$$

Power consumption by each motor

Motor = 920 kV

Battery voltage = 11.1 V ESC = 40 A

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 6, June 2024
DOI: 10.17148/IJIREEICE.2024.12601

Formula

$$P_{motor} = V \times I_{motor}$$
$$I_{motor} = \frac{P_{motor}}{V}$$

So, power consumption by each motor is 40 A

$$I_{motor} = \frac{40\ A}{11.1\ V} \approx 3.60\ A$$

Let's find power consumed by each motor

$$P_{motor} = 11.1\ V \times 3.60\ A \approx 39.96\ W$$
$$A = \frac{W}{V}$$
$$A = \frac{39.96\ W}{11.1\ V} \approx 3.6\ A$$

2. Total power consumed by all motors

$$P_{motor} = 6 \times 39.96\ W = 239.76\ W$$

3. Total power consumption by ESCs

6 ESCs

40 A for each ESCs

$$P_{ESC} = 6 \times 39.96\ A \times 11.1\ V$$
$$= 2664\ W$$

4. Total power consumption

The sum of power consumed by motors and ESCs

$$\therefore P_{motor} + P_{ESC}$$
$$239.76\ W + 2664\ W$$
$$= 2903.76\ W$$

2903.76 Watts to amperes at 11.1 volts

$$A = \frac{W}{V}$$
$$A = \frac{2903.76}{11.1} \approx 261.87\ A$$

Total Power consumption is 261.87 Amps

5. Spraying system adding 20 A

261.87 A + 20 A

=281.87 Amps

6. Total thrust

Motor thrust = 920 kV

Total thrust = thrust per motor × number of motors

= 900 gm × 6

∴Total thrust = 5400 gm

7. Motor rpm

Voltage(V)	Max. rpm	Mid. rpm	Min. rpm
11.1	10212	7188	3067

DOI: 10.17148/IJIREEICE.2024.12601

Assuming for 10 V

Maximum rpm kV × Voltage

920 × 10

= 9200 rpm

Medium rpm (75% of max.)

920 × 0.75

=6900 rpm

Minimum rpm (35% of max)

920 × 0.35

= 3220 rpm

8. Fly time

Calculating estimated flight time

$$Flight\ Time = \frac{Energy\ Capacity}{Energy\ Consumption}$$

$$= \frac{46.62\ Wh}{287.07\ Wh} = 0.62h$$

Flight Time = 0.62 × 60 minutes

= 9.72 minutes

V. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

In the end as we have adapted this technology as our own and we use it as it's a daily part of our life, we need to stretch our techno arms to the ruler side of our country where our farmer brother and sisters are still very much apart from it and aware them and provide them with technology for their daily hood of agriculture. Because soon in near future we as an earth will reach 9-billion and that many mouths needed to be feed and only person who can do that is those farmers and helping them now will eventually help us and making field or sector of agriculture atomize will evidently solve many problems on many levels of the society.

5.2 Future Scope

In distant future we can improvise our self and this making automation agriculture a habitual practice where 90 % agricultural sector is under the wings of atomisation where majority of people are getting their cultivation, irrigation and harvesting done with various technology and this will sure be the win for all. Just like the automation in agriculture we can impose vertical farming in the inhabitant area where we as a human being can't survive and that space of the mother earth is just being there as a waste and as we pick thegrasp of tech we can sure say that such area can be used for vertical farming and indoor farming some companies are doing this on commercial scale and lots and lots of people are doing research on global level and we sure can seein the future we have achieve such a great things with technology.

REFERENCES

[1]. Naji, Ibrahim, "The Drones' Impact On Precision Agriculture" (2019). Open Access Theses & Dissertations. 2880.

[2]. Kalamkar, R. B., M. C. Ahire, P. A. Ghadge, S. A. Dhenge and Anarase, M. S. 2020. Drone and its Applications in Agriculture. Int.J.Curr.Microbiol.App.Sci. 9(06): 3022-3026.

[3]. Shaik Himam Saheb & Dr. G. Satish Babu, Design and Analysis of Light Weight Agriculture Robot, ICFAI University, Volume 17 Issue 6 Version 1.0 Year 2017

[4]. Praveen Kumar Reddy Maddikunta, Saqib Hakak, Mamoun Alazab, Sweta Bhattacharya, Thippa Reddy Gadekallu, Wazir Zada Khan, and Quoc-Viet Pham, 1. School of Information Technology, Vellore Institute of Technology, Vellore, India, 2. Faculty of Computer Science, University of New Brunswick, Fredericton, Canada 3. College of Engineering, IT and Environment, Charles Darwin University, Casuarina, Australia 4. Faculty of CS & IT, Jazan University, Saudi Arabia

[5]. S., R. Swarnkar, S. Bhukya and Namwade, G. 2019. Application of Drone in Agriculture. Int.J.Curr.Microbiol.App.Sci. 8(01): 2500-2505.

ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⪤ Peer-reviewed & Refereed journal ⪤ Vol. 12, Issue 6, June 2024

DOI: 10.17148/IJIREEICE.2024.12601

[6]. Pathak H, Kumar GAK, Mohapatra SD, Gaikwad BB and Rane J, (2020), Use of Drones in Agriculture: Potentials, Problems and Policy Needs, Publication no. 300, ICAR-NIASM, pp 13+iv. [7] Vijay Rana1 and Mahima. 2020. Impact of Drone Technology in Agriculture. Int.J.Curr.Microbiol.App.Sci. 9(01): 1613-1619

[7]. Karan Kumar Shaw1 , Vimalkumar R. 2 1,2UG Students, Batch-2021, Department of Aerospace Engineering, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu District, Tamil Nadu-603203, Design and Development of a Drone for Spraying Pesticides, Fertilizers and Disinfectants India., ISSN: 2278-0181 Vol. 9 Issue 05,May-2020

[8]. S.R.Kurkute1, B. D. Deore2, Payal Kasar3, Megha Bhamare4, Mayuri Sahane5, 1, 2 Assistant Professor, Department of E&TC, SIEM, Nashik, India, Drones for Smart Agriculture: A Technical Report, 3, 4, 5 Student, Department of E&TC, SIEM, Nashik, India, ISSN: 2321-9653, Volume 6 Issue IV, April 2018.

[9]. Assist. Prof. Aydoğan Y.1 Faculty of Agriculture, Adnan Menderes University1 , Turkey, DRONE TECHNOLOGY IN AGRICULTURAL MECHANIZATION, WEB ISSN 2534-8450; PRINT ISSN 0861-9638

