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DESIGN AND FABRICATION OF A AGRICULTURAL DRONE

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Abstract - *This paper says about Agricultural Drones. Nowadays the surroundings are improving and updating with number of Technologies. The same way our agricultural system has also developed like, we are using drones to develop the agricultural systems. The drone helps in different types of agricultural fields like sprinkling the pesticides, UREA and helps in monitoring the growth of the crop. If we spray pesticides manually it can affect the human who is spraying the pesticide. So, these Unmanned aerial vehicles – aircraft are used to spray pesticides and other liquids. Drones can survey large areas of land. The drones do it with less time compared to humans. But the equipment is difficult to handle for the labourers. So, we are working on drones that can help agriculture and make work easier for the farmers. UAV systems can provide real-time imagery and sensor data from the farm fields which takes more time and not accurate when we check manually on foot or by vehicle. Even though it was difficult to check by vehicle without damaging crops. Whereas with the use of drones no crop damage occurs and it will complete in less span of time.*

Keywords: Drone, UAV, Sprayer, Camera, Analysis, CFD.

1. INTRODUCTION

In India the major source of occupation is agriculture. About 60% of the occupation is done from agriculture. We need to improve the productivity of different types of crops by providing safe cultivation. And mainly the crops mustn't affect by any kind of pests or insects. So, we need to spray pesticides and different types of chemicals to keep crops safe. In manual, it takes a huge amount of time and energy of farmers for large areas of the field. Basically, it is harmful to farmers to spray pesticides and other chemicals with their hands. So we can use the technology and reduce the time and energy of the farmer by using UAV (Unmanned Aerial Vehicles) called Drones for the large areas of fields. The use of drones helps the farmers by doing a huge amount of works done by humans. They are safe to use and are more useful in agricultural fields. Using these devices in the field provides better cultivation, good crop health. There are many kinds of drones that are used in agriculture, we need to pick the drone which is useful to us. The Drones can spray pesticides and insecticides for large fields. This project aims to reduce the ill effects of pesticides or other chemicals on human beings. And also spraying the pesticides over large fields in a short span of time. The device we make is a combination of spraying mechanisms in a drone. This device uses to spray the fields that farmers cannot spray. We use drones to spray the pesticides. The control of drones is not much difficult to learn. The drone can be used anywhere in the fields even indoor or outdoor. This device contains a universal sprayer that sprays pesticides, the global nozzle can spray both pesticides and fertilizers. When the drone flies in the air it takes the images of the field from its elevation with the help of the controller who controls the drone through the remote. The images are taken from the sky-view show the problems on the field, infections of the crop like fungi, bacteria. UAVs are also used to count the number of crops on the field. UAVs improve crop productivity and tell how to maintain the crop healthy. Drones complete the work in less time, it also covers the huge amount of field within a short span of time. Drones also help in irrigation management with the help of thermal cameras equipped in it. The drone sprays at 40-60 faster than manual spraying. We need to use the drones precisely so that there would be no problem when we use drones.

Figure1: Agricultural Drone View

Nowadays the health of the crop is more important to the agricultural field. Suppose a crop is infected in the field, from that single infected crop many numbers of crops get infected, so the health of the crops is much important in the field. Various diseases in the crop get identified by the camera on the UAV. After monitoring the crops UAV sprays fertilizers or pesticides based on the damage that happened to the crop. The drones help the farmers in many ways by reducing the workload and time consumption. These UAVs having multispectral cameras and takes pictures of the field from different views. We can use high-resolution RGB cameras which can detect crop health problems. This project aims to increase productivity and improve crop health and saving the time of the farmer.

2. LITERATURE REVIEW

Prof. K. B. korlahalli and others had published a research paper named "An Automatically Controlled Drone based Aerial Pesticide Sprayer". In this paper, the authors said how to implement the drone. In this paper, the wireless drone is based on flight-controlled board, GPS sensor, BLDC, wireless transceivers, batteries. They used FCB to control the drone operations like moment, lighting, and other such operations. The published research paper is available in K. L. E Institute of Technology, Hubballi, Project reference no: 39S_BE_0564.

Prof. S. Meival M.E and others had published a paper named "Quad copter UAV based fertilizer and pesticide spraying system". In that paper, the authors had given how to implement the agriculture wonder drone. They gave detailed information about UAV Quad copter and sprayer module and spraying pesticides to the areas that cannot easily accessible by farmers. They also said about the multispectral cameras which are used to capture green fields by using remote sensing images and as well as the edges of the crop area. The published research paper is available at International Academic Research, Journal of Engineering Sciences, Volume 1, Issue 1, February 2016.

Prof P. P. Mone and others had published a paper. It is named "Agriculture Drone for Spraying and Pesticides". In that paper, the authors gave the mechanism of the drone and how to implement the drone. They also said about how the drone sprays automatically. They also researched WHO and gave statements that most of the farmers were infected by the disease caused by pesticides and fertilizers. In that statement, around 3 million farmers were infected for the same reason each year. In that paper, the authors had said what precautions can a farmer take to avoid the harmful effects of pesticides and other chemicals. And they had used the PIC microcontroller for the control of the Quad copter. The published research paper is available in IJRTI, Volume 2, Issue 6, 2017.

Sheng Wen and others had a published research paper. The research paper named "Numerical analysis and validation of spray distributions disturbed by Quad rotor drone wake at different flight speeds". It says about how the drone can fly and its numerical analysis using the Lattice Boltzmann method which was used to simulate the downwash flow field of a Quad rotor drone. The published research paper is available at Computers and Electronics in Agriculture, Volume 166, November 2019, 105036.

3. OBJECTIVE OF THE PROJECT

- The purpose of this project is to increase the awareness of the usage of agricultural drone in India so that all the farmers will get to know about the drone and a lot of them comes forward and learns how to control the drone by the help of the remote. Then buys it and use the drone in fields.
- The drone which we control through the remote helps in sprinkling the water and spraying pesticides, spraying fertilizers, and other chemicals like UREA.
- It also takes pictures of the field from a certain height above the ground, with those images we can find which crop gets infected and which one is healthy.
- The device also senses the temperature and how much water is needed for the crop.
- The UAV is used to increase crop production in the field and helps to reduce the workload and time of the farmer.

4. DESIGN AND FABRICATION

The remote controls all the actions of the drone and helps to spray water and pesticides, and also helps to take pictures of the field in different views and helps to identify the infected plants. We need to design all the parts of the drone and assemble them.

Components Required:

- **Frame:** The frame is a structure that holds all the components together. It is the main important part of the drone. It should be strong and it should be lightweight. If the weight is heavy it can't fly so we need to use lightweight material to design the frame.

Figure2: Frame of agricultural drone.

- **Electronic speed controller:** These are simply called as ESCs. These are the devices that allow drone flight controllers to control and adjust the speed of the aircraft's motors. A signal from the flight changes ESC to increase or decrease the voltage to the motors as required. They change the speed of the propellers.

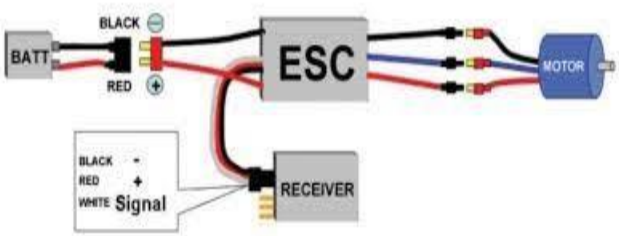

Figure3: Electronic Speed Controller.

- **Brushless DC Electric Motors:** These are commonly called BLDC motors. These are synchronous motors using the direct current to run. If the motor doesn't work, it will stop spinning and the propeller attached to it stops rotating and the drone will not fly. This is also one of the important parts of the drone.

Figure4: Brushless DC Motors.

- **Propellers:** These are the wings of the drone. These are the devices that transform rotary motion into linear thrust. The drone propellers when starts spinning they provide airlift by spinning and flight the drone. They create an airflow which forms a pressure difference between the top and bottom surfaces of a propeller.

Figure5: Propellers.

- **Fly Sky Transmitter and Receiver CT6B:** Fly sky CT6B is a 2.4 GHz channel Transmitter and the Receiver is a remote which controls drone by the remote.

Figure6: Fly Sky Transmitter and Receiver CT6B.

- **Battery and the Charger:** We all know about the battery and the charger. Without a battery, any electronic device won't work. So these are also an important part of drones.

Figure7: Battery and the Charger.

- **Camera:** It is the device which takes the pictures of the fields. And helps us to see where we need to spray pesticides and fertilizers on the field. It is a multispectral camera.

Figure8: Camera.

We need to assemble all the parts and make a drone that is controlled by the Transmitter and Receiver CT6B. After the assembly, we need to check how it works and know how to control the drone by the remote. When the drone flies it will sprinkle the water on the plants. It will complete within a short span of time. After that, we need to replace the water with the pesticide in the sprinkler tank. And again, flight the drone and sprays the pesticide in it to the crops to avoid pests and insects. It can also take pictures of the field with the use of a camera mounted on the drone. It will take the pictures from different views like Front-view, Top-view, Rear-view. Those pictures are helpful for the identification of the infected crops in the field. If we attach the infrared camera, we can see the thermal images of the field. With that infrared camera, we can predict the water stress in the crops, it can detect disease and pathogen detection in the crops.

5. RESULTS AND DISCUSSION

We have designed the drone with a sprinkler and camera mounted on it. We have also done CFD analysis for this design.

CFD analysis: CFD analysis mean Computational Fluid Dynamics. It is a branch of fluid dynamics that uses data structures and numerical analysis. Computers will perform these calculations that required to simulate the free-stream flow of the fluid. CFD is applied to many research and problems including aerodynamics, aerospace, weather simulation analysis. This analysis is based on conversation equations which include continuity equations, Navier-Stokes equation, and Bernoulli's equation. For solving these equations, we use the final volume method(CFD). This analysis follows a procedure.

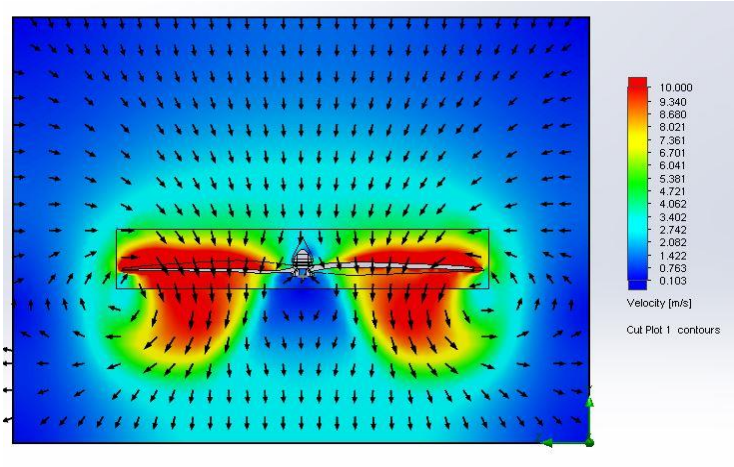

Figure9: CFD Analysis.

- **Pre-processing:** The user input importing the geometry of the drone, establishing the boundary and loading conditions. In CFD we need fluid properties with the boundary conditions. And next the numerical solution involves the process of discretization that means dividing the drone into smaller tiny cells and a numerical method calculates the solution based on the mathematical model. The mathematical model uses Hooke's law and Strain-Displacement relations. By using those two methods it forms a matrix and then solved.
- **Processing/solving:** This is the second step of CFD analysis. The analysis calculates the solution based on the user input for a mathematical model. In this, the solver solves a mathematical model instead of the physical model. So we need to do analysis in a better way to obtain a perfect solution. In CFD we use cell centre values and nodes to find the solution for a separate cell and it is connected with other cells.

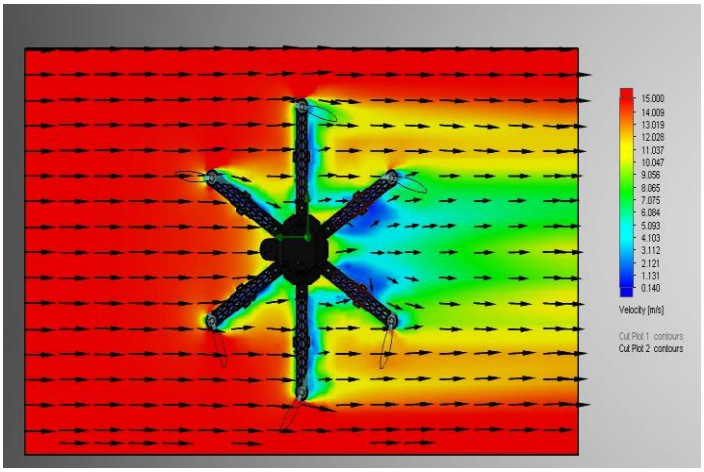

Figure10: As shown in the above figure the velocity changes from part to part.

- **Post-processing/validation:** This is the third step of CFD analysis. This involves the selection of variables that are required for the solution. We can get the solution by various methods like numerical value, graphical form, and other methods. This post-processing is also used in the validation of the solution. Errors, assumptions, and approximations used by the model are used to enhance the solution. When the solution has an error in the experimented result, the solution is repeated by changing the boundary values and improving the model. The experimental results are validated in this step of analysis.

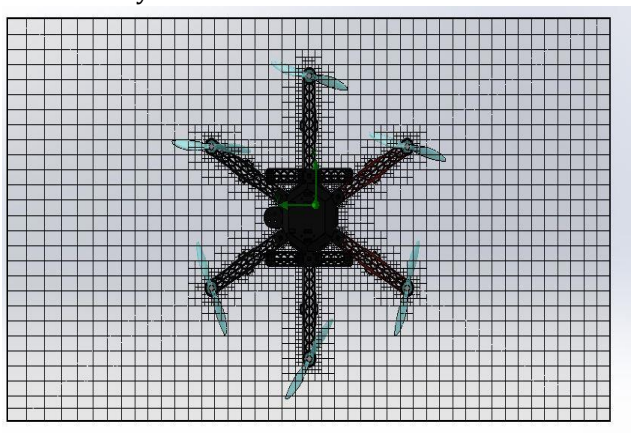

Figure11: The design of the drone.

6. CONCLUSION

The drone contextual investigation shows that in getting the air to noticeable quality novel ways as an object of agrarian imaginaries, concern, and practice, sprayer drones produce an intrinsically pioneering method of identifying with the air, getting it, moving toward it, and of acting in and through it. These drones made spraying faster than humans and it also gives the images captured of the field from the top. So we can easily spray the pesticides in the field knowing the dimensions of our fields. And it is better than humans in terms of fast and energy and everything. This can be used in every agricultural field in India. We need to develop these kinds of technologies so that every farmer should know about this and he wants to use and develop his field and protect his life from the damage caused by the pesticides and other chemicals. Not every farmer knows how to use it, so we need to help farmers how to use this device. He learns and he can use it in his / her fields. If we have an infrared camera and GPS sensor attached to it, we can easily get thermal images of the field and knows how to improve crop production. With the GPS sensor in it, we can easily monitor the drone and get sprayed each and every portion of the field, and locate the drone. These kinds of drones are very useful to the farmer in every aspect. But the major disadvantage is to learn how to control the drone. In India most of the humans whose occupation is agriculture are illiterate. So it is very difficult for them to learn how to control the drone. So this is the major disadvantage of the drone. If they learn to control the drone, they can easily spray pesticide in their respective fields. There is a vital role in the future if we use these drones carefully. If we use these regularly it gets updated from time to time and every updated drone gets better than the previous one. Developments and modifications are done to each and every new update. In other countries like the USA, Japan, Germany, and many other countries are developed in agriculture and they are using these kinds of drones. Like the same way our India also need to develop and use the drones in the major occupation like agriculture. By the use of these drones in agriculture all the production of the crop increases in each and every kind of crop. And the safety of the crop increases, better cultivation to the field, and many other problems get reduced by using these drones.

7. REFERENCES

[1] Misbah Rehman.Z, B Kavya, Divya Mehta, Priya Ranjan Kumar and G.R Sunil Kumar, "Quadcopter for pesticide spraying", International Journal of Scientific & Engineering Research, vol. 7, no. 5.

[2] C. A. Rokhmana, "The potential of UAV-based remote sensing for supporting precision agriculture in Indonesia", Procedia Environmental Sciences, vol. 24, pp. 245-253, 2015.

[3] ''Remote Sensing Applications: Society and Environment'' by Patricia K. Freeman. Volume 2, December 2015, Pages 35-43.

[4] S Ayyappan, Pitam Chandra & S K Tandon, Agricultural Transformation through Public Private Partnership, ICAR, New Delhi. https://icar.gov.in/files/Public-Private Partnership.pdf.

[5] D. Yallappa, M. Veerangouda, D. Maski, V. Palled and M. Bheemanna (2017) Development and evaluation of drone mounted sprayer for pesticide applications to crops. IEEE Global Humanitarian Technology Conference (GHTC), San Jose, CA, 2017, pp. 1-7.

[6] Drone for GIS, [online] Available: https://www.gislounge.com/use-drones-gis/ .

[7] Future farming, [online] Available: http://www.fao.org/e-agriculture/news/exploring-agricultural-drones- future-farming-precision-agriculture-mapping-and-spraying.

[8] "Field evaluation of spray drift and environmental impact using an agricultural unmanned aerial vehicle (UAV) sprayer" named research paper published by Guobin Wang and others. Volume 737, 1 October 2020, 139793.

[9] The research paper entitled "Entrepreneurs of the air: Sprayer drones as mediators of volumetric agriculture". Volume 84, May 2021, Pages 55-62.

[10] "Assessment of spray deposition, drift, and mass balance from unmanned aerial vehicle sprayer using an artificial vineyard" named research paper published by Changling Wang tells you about the drone mass balance and spraying of pesticide. Volume 777, 10 July 2020, 146181. about the drone mass balance and spraying of pesticide. Volume 777, 2020, 146181.