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Investigations Of Drones For Pesticide Spraying In Agriculture

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Abstract: In India, about 58 percent of rural population directly depend on agriculture as a means of livelihood. But the untimely climatic conditions due to floods, droughts, famines, global warming, etc cause an imbalance in the production, especially during the important seasons of rabi and kharif. Apart from that, even after following regular procedure to irrigate the fields in a proper manner, there comes problem with plant eating insects, which affect the plant life and its product. So, it makes necessary for farmers to keep away insects by making use of pesticides. But anything in excess or important usage will hamper the plant growth. Hence, the modern solution of such a problem is, doing the same task using drones. Hence, in this paper, we would present survey on different types of drones used for pesticide spraying purpose in agriculture and compare the works of different individuals regarding the same. We also include an idea on how to solve the problem by developing a drone.

Index Terms: agriculture, drone, irrigate, pesticides

1. INTRODUCTION

Over the past few years we have seen a massive growth in the manufacture and sales of remote control airborne vehicles known as drones. When we hear the word *drone*, we probably think of something either very useful or very scary. But could they have aesthetic value? The aim is to push the boundary of what can be achieved with the autonomous flight. Drone is a word we see pretty often in today's pop culture, but drones are extremely divisor species. The word *drone* today is associated with the technologies of tomorrow, even though it seems likely that the word was coined in the early days of aviation, in reference to remote control target drone. With increasing occurrences of tragic events in recent times, the development of drones in agriculture field to be utilized in search and fertilizer operations have become more relevant. The resulting UAV was a major milestone for drone photography
and consumer drones in general. The Quadcopter is a simple format with very few moving parts and has rapidly become a

favorite vehicle for remote control enthusiasts and is widely being used. The rapid advances in computing power, the efficiency of the core-less of brushless motors, smaller microprocessors the development pf batteries and gyroscopic and accelerometer technology has all led to a proliferation of quadcopter designs. Agriculture is an important sector of the Indian economy.

One of the most common forms of pesticide application is found especially in conventional agriculture moving parts. The project aim is to remove the backpack and foot spraying techniques, eliminate the human efforts, to decrease labor costs by advancing the spraying

method and constant flow of droplets and using best resources for charging the batteries. Our drone obeys the spraying parameters and modes we have set for it, its tough for pilot to keep consistent flight height over uneven fields, affecting spraying results so with the help of proximity it can adjust its sights according to the terrain, ensuring spraying accuracy. So the drone can keep spraying speeds constant even with changing flight speed. Now spraying work can be done in just couple of minutes and its spray even reaches lower parts of plants and underneath leaves. We designed for farmers and built for the fields.

2. CLASSIFICATION

According to researchers of National Institute of Technology, Rourkela, drones are classified as: quadcopter, hexacopter, octacopter, fixed-wing rotor and heli-rotor respectively[1]. In each of the category, an agriculture drone with the functionality of spraying is available.
An example for quadcopter, developed by researchers at Tiruppur, has a camera, drone and sprayer, with a minimum spraying speed of 2 m/s and maximum speed of 3 m/s respectively[2]. Apart from spraying, it can monitor the crops through images captured via a camera equipped.

Fig 1. Quadcopter

An example for octocopter viable for agriculture use is, Agras MG-1S, based on equipment from the famous drone technology provider DJI, China. It has 6 propellers, and can take off with a load of 13.8 kg and 23.8 kg overall, with the pesticide payload of around 10 kg. Hence, the expected flight time is around 10 minutes to 22 minutes respectively.

Fig 2. Octacopter

An example for hexacopter with spraying functionality is developed in china[3]. It has the features of obstacle avoidance, six spraying nozzles and a 15 kg payload, capable of

providing a flight time of around 22 minutes upon usage of 16000 mAh battery. y.

Fig. 3. Hexacopter

Now, based on the above mentioned features, a comparison table can be plotted as follows for better glance:

Table 1. Detailed comparison between different pesticide spraying drones in agriculture.

	Quadcopter Agriculture Sprayer	**Hexacopter Agriculture Sprayer**	**Octacopter Agriculture Sprayer**
Weight	8.5 Kg	16 Kg	13.8 Kg – 22.8 Kg
Battery capacity	44.4 V / 10 Ah	16000 mAh	22000mAh
Payload	22 Kg	15 Kg	10 Kg
Sprayer tank capacity	10 litre	15 litre	10 litre
Propeller type	fixed	fixed	foldable

3. APPLICATIONS

A. Soil and Field Analysis

Drones are the great start of crop cycle[4]. Number We have the different types soil and field analysis[5][6]. Upon analysing the soil, we can print 3D map also for the seed patterning to the field after that drone driven it provides the data for irrigation.

Another method in soil and field analysis for drone mapping in agriculture, ability to count plants instead of someone manual count plant it takes time consuming for that using the drone it automated. Option and drone goes to the entire field and counts the number of plants in the field it gives the result with in a hour.

Not only that different ways to analyse the field include: Crop detect parasites and fungi, Analyse stand establishment, Generate variable rate for nitrogen and pesticides, Assess and cleans damage after a storm, Assess slop and drainage after the harvest.

Fig.4. Soil and Field Analysis

A. Planting

Now a days drones are used for tree planting also[5].
UAV's are now
being developed specially planting trees easier and faster. easier and faster.
First step is that, the area is whither suitable for growing area or not and what type of spices plant we can plant in to that field .this done by the mapping and data gathering drones
.using the 3d map specific area it gathers the information all the way and sends to the UAV's.
But humans it takes the more time but drones goes to anywhere .even tough area it goes and it measure the area
After that the data gathered and goes in to the algorithm shows the where to plant the plants and which type of spices plant into the field
After that the information gathered with map
containing information so drone tells the where the unwanted plants is their then area cleared unwanted plants and drone will plant the seed plants in the seed pods where location identified identified
After that the information gathered with map containing information so drone tells the where the unwanted plants is their then area cleared unwanted plants and drone will plant the seed plants in the seed pods where location identified. Using drones for tree planting it do the work very fast more than 10 times but man goes to the field and he need to dig the whole field. .

Fig. 5. Drone used for planting purpose

B. Crop spraying

Crop spraying is the process of spraying insects, pesticides, fungicides, and also used for other treatment onto the crop[5][7][6]. It used to cover the large amount of land from crops for to protect the insects some dangerous pests. So to do this duty need a more laborious, crop

spraying utilize the many hash chemicals that dangerous to the human health, some chemicals realizes the gases type so inhaling the gas that will effect to the lungs, respiratory system not only this some gases effects the body shorter time some gases effects longer time for that alternatively using the drone technology for much safer using the light detection , grounding lasers, gps detection , high cameras helps the farmer via this type of precision so doing like this it is five times faster than labour

working crop spraying. Crop spraying is using with drone technology saves the time and protects the human from the dangerous chemicals and it capture the inflected area with the help of camera that helps to the farmer.

Fig. 6. Crop spraying using drone

C. *Geo-fencing*

These drones are also used for geo fencing and also so many crops are getting damaged because of the animals attacking this geo fencing is used to fend off these animals attack by alerting the owner with a text. This geo fencing is used for sending message or mail if anything is stolen like bike and also if any crop damage occurs. It also provides security for all wireless local network

D. *Geo-fencing*

These drones derive the aerial imagery will be used to quickly and also it classifies the cultivated and non cultivated areas in survey manner we can access the damage which is caused by the natural disasters in INDIA they are planning for UAVs to conduct the assessment of crop loss after natural disasters in this there are two types of crop insurances are there they are:

- crop-yield insurance
- crop-revenue insurance

E. *Reaching the unreached*

Agricultural information will be difficult to access manually we can collect the information of regions/areas using drones and also it is used for targeting or locating the sprayer of chemicals for managing the crop. It reduces the pesticide footprint of the field.

F. *Real-time imaging*

It is very dynamic in temporal and spatial domains and it is monitoring for management demands for high capability temporal resolution these are able enough to capture the real time truth at a resolution of few centimeters which are not possible to capture and also

these drones helps to capture good quality images under the circumstances*:*

G. Monitoring and specific applications

In this the drones can fly and capture large variability in the field scale it will be used for real time agriculture fields it provide the information about the variation of crop health which is due to biotic and abiotic stresses it gives the proper data which will be useful in farming for detecting in the presence of ethylene for fruit ripeness, etc.

H. Crop monitoring

Crop monitoring is the biggest task for the former because of vast field and low efficiency in crop monitoring[5][7][6][8] it's a big task for farmer. Monitoring challenges in agriculture unpredictable of weather conditions which leads to risk and high maintenance costs. Government also allows the drone technology in India. In agriculture farmers also using the drone technology to measure and observe crop growth. Sometimes former needs to goes into the field day time or night time to
check the plants health and soil erosion but he cannot go because of climatic conditions but drone technology helps you to observe the plant. In future drones are changing the agriculture and improving the production. It is twenty times faster than the human survey. So the formers have benefits in both sides cost efficiency and time.

Fig. 7. Crop monitoring using drone

I. Irrigation

An agriculture is a UAV utilize to farming common to help to increases the crop production[7][6][8][9][10] and also monitoring crop growth. Irrigation appliance of plant how much water needed in the certain time and also irrigation helps for to grow crops, revegetate and landscapes it helps for the when the less amount of water and less amount of rainfall in troubled soil in dry areas. There are different types of irrigation. Basically, irrigation means to water the fields .The types of irrigation methods include: Surface irrigation, Micro-irrigation, Drip irrigation, Sprinkler irrigation and Sub irrigation. These days drone technology ruling the agriculture. Drone can monitor the field with the help of using sensors like thermal, multispectral, hyperspectral sensors can analyze how much moisture present in soil and how much dehydrated. Using the thermal cameras once the crop grows drone can calculate the vegetation, it's health of the plant and temperature plant and also it's calculate the how much heat is

required for the plant to grow and drone are very much useful even in irrigation purpose.

Fig. 8. Field with less water content

J. *Crop Health Assessment*

Crop health assessment is one of the most important in the agriculture field[7][6]. Health assessments is not only for good health on crops but also for dead crops also make important because some fungal, bacterial forms on tree so need to analyze the crops, fields more. To redeem bacteria from crops using agriculture drones technology. Agriculture drones can scans the plant with the help of visible and near infrared lighting to identify the plant health. When drone goes top of the field drone carries the this device it identify the which plant is reflecting for more green light compare to other plants and NIR light also. This information make a spectral images form so that it shows the plant health. Very fastly save an entire information about field .it discover the sickness of plant, Now former can easily understand that which pesticides or fertilizer need to use. These are some possibilities to infections for that crop failure happened. Because of this type of cases farmer will loss the total amount invested to the field. But to overcome this drone will helps agriculture field to tracking the these type of inflected type onwards to prevent the costly losses. Safeguard the overall health of growth and victory of their crop.

4. EXISTING WORK

There is an increase in the level of research and developments in agriculture drones. The research is being carried out both, at academic institutions in form of projects and by corporate companies across the world. One such prototype is developed by researchers at Saga University in southern Japan, where a pesticide sprayer drone is developed, keeping in mind the following objectives: (i) To reduce the manual method of spraying pests and (ii) To expand their product into commercial market. The use of bug zapper and the scanning of agri field for
insects before spraying makes it suitable for use during day and night.

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Table. 2. A comparative study on different works on drones in the area of agriculture

Advantage	**Methodology**	**Advantage**	**Disadvantage**
U M Rao Mogili and B B V L Deepak[12]	• BLDC motor connect with the rotors in directions of the UAV configuration model. • The controller used to activate the nozzle of the sprayer.	• To overcome scarcity of labour and human intervention. • To spray faster(based on nozzle type) • Reduces wastage of water and chemicals	Scope for: • Low volume sprayers • Nozzle size • Battery performance • High flight time • Low development cost
Janna Huuskonen and Tim Oksanen[13]	• Primary tillage with crop residue covered. • Aerial imaging with drone. • Image processing and forming management drones. • Soil mapping.	• Can visually view the representations of latitudes and longitudes through AR glasses. • Can be able to view climatic aspects visually.	AR glasses with GNSS need to be improved for better communicated with the operator.
Pivoto et al.,[14]	• Characterize the scientific knowledge about SF. • To describe current SF prospects in brazil from the perspective of experts in this field.	South Korea has important centres of research and technology development.	• Investments in R&D are needed • Farmers acquire equipment from several companies.
Potrino et al.,[15]	• Multi-temporal remote sensing data focused on real-time monitoring of agricultural crops. • Coordination protocols in drones environment in precision agriculture domain.	• Using the cameras monitoring the plant problem easily. • Using algorithm we can easily identify the problem and we can detect easily with the help of drone on spraying onto the plants.	• Cost problem • We need to fix the high cost of camera then you can detect the problem with the help of drone.

However, researchers at Panjabrao Deshmukh Krishi Vidyapeeth, Nagpur are currently testing drones in association with companies like Tata Consultancy Services, Aegis Hyderabad, Thanos Hyderabad and Padsons. The initial test time was 5 minutes, and tested

over half an acre of land and able to spray over 5 litres. The estimated cost was around 5.5 lakh rupees in Indian currency. However, the cost factor is still a concern factor for farmers to adopt for these.

Till now, the focus was laid on only the concept of spraying over the field. But, a student at KL University, Guntur focused on more than one application[11], i.e, harvesting, crop rotation, spreading the seeds,collecting data from plants, and many more. This project was funded by the University and its total making costed around 2.5 lakhs in Indian currency.

When it comes to commercially available drones[1], the top 3 companies to watch out for, in India, are Asteria Aerospace (Bengaluru), Quidich Innovation Labs and ideaForge. Most of the companies are established as startups, and are focusing on the areas of aerial photography, monitoring and most importantly, in agriculture productivity enhancement.

Though most of the works focused on betterness in agriculture, one of the most important drawbacks is the affordability, the manufacturing costs and lack of advanced technologies in development commercially. If companies and governments collaborate together and encourage even the people involved in such research, then in future, there will be definitely an affordable drone available for all, and can solve the agri problems easily.

So, after making a research on different works, we are going to develop a drone sprayer for spraying pesticides to eliminate pests from field, with a sprayer quantity of minimum 0.5 litres capacity. Here we focus on the efficiency in spraying over the field in a duration of around 5 minutes, based on the capacity of the battery use.

5. COMPARISON TABLE

There are different works carried out by researchers, scientists and students across the world. A comparison is made to understand better on the basis of drones used in agriculture for various purposes as shown in Table 2.

So, out of the above comparisons, with each one of them focusing on the objective of agriculture, each of the works is differentiable in the methodologies. For instance, some drones make use of the concept of image processing, multiple drones, artificial intelligence, wireless transmission of data, and many more. Some of the areas like artificial intelligence is still in research stage and is in need of further developments, especially when it comes to configuring with drone applications. Apart from that, to configure the flight controller, which is termed as the brain of the drone, open-source software like adru-pilot, libre-pilot, etc are made to use, which are even self sufficient for our current work.

6. CONCLUSION

In all the previous works surveyed, the drone technology is possibly the most preferable one in agriculture, now and even in future. It proved to be useful not only in eliminating pests, but also in satisfying other applications like soil and field analysis, plantation, observation, irrigation and most importantly, the health of a plant. Apart from improving the efficiency of the field by eradicating pests, the present works on drones offer one of the crucial solution to save water by monitoring the required amount of water required by the crop beforehand and providing the same. Some of the works include usage of swarm of drones for the same purpose and with more efficiency. This kind of technology is in initial stages and can bring a rapid change in the area of agricultureonce implemented on a large scale.

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