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Application of Drone in Agriculture

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SUMMARY

Unmanned Aerial Vehicle (UAV) is now very commonly used in remote sensing applications for Agriculture. Equipped with sensors of different types, UAVs can be exploited to identify which zones of the crops need different management, e.g. some kind of input. This gives the farmers the ability to react on time in any problem detected. UAS can be used in a plethora of different applications in Agriculture, such as health monitoring and disease detection, growth monitoring and yield estimation, weed management and detection, etc. As the use of UAVs in agriculture applications is very frequent in the last years and it is considered the future of remote sensing, it is a field that draws a lot of attention.

INTRODUCTION

One of the keys to meeting growing food demand and improving current water usage levels lies in the introduction of new technologies to agriculture, including the Internet of Things (‘IoT), Big Data and Artificial Intelligence. These technologies are beginning to power or enhance new and existing methods and tools, and have already been deployed on farms – connected tractors are a well-known example of new technology already in use. Drones however are a more recent and less mature tool in terms of the new technologies driving the development of agriculture. Currently, most drones for agricultural use are medium-sized (usually for analysis applications) while larger drones are used when there is a need to carry a load (i.e. planting or spraying applications). Like most industries currently using drones, multi-rotor configurations seem to be the favourite in agriculture, likely due to their lower cost and high level of simplicity.

Drone Categories in India

- Nano: Less than or equal to 250 grams (.55 pounds)
- Micro: From 250 grams (.55 pounds) to 2kg (4.4 pounds)
- Small: From 2kg (4.4 pounds) to 25kg (55 pounds)
- Medium: From 25kg (55 pounds) to 150kg (330 pounds)
- Large: Greater than 150kg (33 pounds)

Registration is required for all categories of drone except the Nano category.

Required Drone Equipment in India

Also worth noting is that India has specific requirements regarding the types of features a drone must have to be flown in India (excluding those in the Nano category).

These mandatory requirements include:

- GPS
- Return-to-home (RTH)
- Anti-collision light
- ID plate
- A flight controller with flight data logging capability
- RF ID and SIM/No Permission No Takeoff (NPNT)

Modern commercial on-board sensors that are used for Agriculture, mainly belong to the following four types:

- Visible light sensors (RGB)
- Multispectral sensors
- Hyperspectral sensors
- Thermal sensors

Applications of drones in Agricultural

The versatility of drones provides many different avenues for improving upon existing agricultural processes including: Soil and field analysis Drones are able to produce 3D maps, quickly and cheaply, which are then used for the design of seed-planting patterns and the generation of a wide range of data types with many applications. For example, nitrogen-level management.

1.Crop monitoring

Satellite imagery was previously the most advanced form of crop monitoring, but suffers from some major drawbacks:

• Satellite imagery is very costly.
• Images must be ordered in advance and can be imprecise.
• Poor weather impedes data quality

Drones however can monitor crops much more accurately, frequently and affordably, delivering higher quality data that is updated regularly to provide insight into crop development and highlight inefficient or ineffective practices.

2.Health assessment

Drones can also be used to generate multispectral images of crops (based on the amounts of green and infrared light reflected), which are then analysed to track changes in health and maturity.

The ability to assess the health of a crop quickly and precisely can be invaluable for farmers. If for instance a bacterial or fungal infection is identified, early detection allows for quick action to be taken in order to remedy the issue.

3.Irrigation

Agriculture accounts for the vast majority (70%) of water used in the world – more than twice that of industry (23%). Aside from being wasteful, excessive water usage is increasingly unsustainable as competition for the planet's finite resources intensifies in the face of rapid population growth. Leaky irrigation systems and wasteful field application techniques are two of the factors contributing to inflated agricultural water use figures, and both can be addressed by UAVs.

Drones equipped with special monitoring equipment can be used to identify parts of a field experiencing "hydric stress" (inadequate of water of sufficient quality). They use infrared and thermal sensors to provide snapshots of entire fields, allowing targeted diagnosis of areas receiving too much or too little water.

These drones also allow for the vegetation index (density and health of the crop) to be calculated while the crop is growing, enabling and informing better crop management.

4.Crop spraying

The ability of drones to easily adjust their altitudes and flight paths according to the surrounding topography and geography comes from the use of increasingly sophisticated equipment (rader, LiDAR etc.). This makes them well-suited for crop spraying, as they can scan the ground and apply liquids quickly and with great precision. Some experts argue that crop spraying by drones may be up to five times faster than with regular machinery.

5.Mid-field weed identification

Using NDVI sensor data and post flight image data we can create weed maps that will help the farmers in easily differentiate the high weed intensity areas from healthy crop areas which are growing alongside them.

6.Cattle herd monitoring

Drones with thermal sensors are the solid option for monitoring herds from overhead, they see whether animals are missing, injured or birthing. Thus drones give livestock farmers a new way to keep an eye on their livestock at all the times resulting greater profits.

7.Crop insurance

Aerial imagery can be used to quickly classify surveyed areas into cultivated and non-cultivated land, and to assess how much damage has been caused by natural disasters. Crop insurers and insurance policy holders also benefit from readily-available and easily repeatable drone imagery. In India, insurers are planning to use UAVs to conduct assessment of crop losses after natural disasters, allowing them to more accurately and quickly calculate payouts. They can use the same data to construct statistical models for risk management, based on

historical yield, pest, and weather data. Drone data might also be useful for the early detection and prediction of pest infestations, data that insurance companies could share with farmers. Finally, drone data can be used to detect insurance fraud, preventing fraudsters from insuring the same piece of land multiple times, or claiming damage where there is none.

8. Soil and field analysis

Drones can be used for soil and field analysis. They can be used to produce accurate 3-D maps that can be used for early soil analysis on soil property, moisture content, and soil erosion. This is very important in planning seed planting patterns. Even after planting, drone-driven soil analysis provides data for irrigation and nitrogen-level management in the soil.

9. Planting

Though not quite prevalent just yet, some manufactures have come up with systems able to shoot pods with seeds and plant nutrients into the already prepared soil. These drone-planting systems will decrease planting costs by 85 percent.

Benefits of Drones in Agriculture

- Automatic piloting and operations
- Automatic analysis for real-time decisions
- Increase of precision in remote sensing
- Advanced integration with sensor networks and robots on the ground
- It can be deployed quickly and repeatedly thus it saves the time
- can obtain imagery at sub-decimetre resolution
- Highest economic benefit (improve the yield and profitability)
- Spot disease/problems faster
- Reduces waste of water, chemicals other inputs
- They could limit the amount of pesticide sprayed
- Environmental friendly
- We can plan for the future because it generates maps accurately for better crop planning and land management
- Cost effective
- Drones are ethical, as they are used for their predetermined motive, and are not used to cause any kind of harm to the plants and animals
- UAVs have several advantages over satellites and piloted aircraft: they can be deployed quickly and repeatedly; they are less costly and safer than piloted aircraft; they are flexible in terms of flying height and timing of missions; and they can obtain imagery at sub-decimetre resolution. This hyper spatial imagery allows for quantification of plant cover, composition, and structure at multiple spatial scales.

Limitations

1. Weather dependencies: weather is constantly changing and drones are vulnerable to these conditions. Severe weather interrupts drones.
- Wind speed-they may cause turbulence
- Very low and very high temperatures affect the sensors
- Precipitation-heavy rain intercepts radio signals

2. Flight time and flight range
3. Initial cost of purchase
4. Laws
5. Interference within the airspace
6. Connectivity
7. Knowledge and skill

General Rules for Flying a Drone in India

1.All drones except those in the Nano category must be registered and issued a Unique Identification Number (UIN).
2.A permit is required for commercial drone operations (except for those in the Nano category flown below 50 feet and those in the Micro category flown below 200 feet).
3.Drone pilots must maintain a direct visual line of sight at all times while flying.
4.Drones cannot be flown more than 400 feet vertically.
5.Drones cannot be flown in areas specified as "No Fly Zones", which include areas near airports, international borders, Vijay Chowk in Delhi, State Secretariat Complex in State Capitals, strategic locations, and military installations.
6.Permission to fly in controlled airspace can be obtained by filing a flight plan and obtaining a unique Air Defence Clearance (ADC)/Flight Information Centre (FIC) number.

CONCLUSION

Over the past decade there have been a growing number of examples of applications of drones in farming. However, there are still some crucial limitations related to drones including high initial costs, sensor capability, strict aviation regulations and lack of interest from the farmers may impede adoption of drones. Hence it is clear that the application of drones in farming is still in its early stage and maybe there is a considerable amount of room for further development concerned to both the technology and the various applications.

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