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Drone – Applications in Agriculture

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Farmers are now facing diverse problems in Agriculture. Climate change, soil quality, prevalence of weeds, insects, population growth, urbanization and deteriorated environment has been identified as global concerns. Climate change is now having a major impact on food security and more than 815 million people are chronically hungry and among them 64 % are situated in Asia. Adoption of modern technologies in agriculture, such as the use of drones or unmanned aerial vehicles (UAVs) can significantly enhance risk and damage assessments and revolutionize the way we prepare for and respond to disasters that affects the livelihood of vulnerable farmers and the country's food security. Drone is frequently utilized in farms to help the farmers as a part of "Precision Agriculture" to modernize farming in developed countries. Within a few years, drones will become more common in both large and small farms in developing countries too. Modern farmers have already started using high-tech solutions such as UAVs for monitoring and forecasting in agriculture. Drones can collect data on crop yield, livestock health, soil quality, nutrient assessments, weather and rainfall patterns, and other aspects. This information is then utilized to produce a more accurate map of any existing problems, as well as remedies based on highly dependable data.

Component of Agricultural Drone

Component of agricultural drones include

- Frames
- Controller Systems
- Propulsion Systems
- Camera Systems
- Navigation Systems
- Batteries (power systems)
- Other Components (Wires, connectors, carry cases, sprayers, and sprinklers)

There are different kinds of unmanned aerial vehicles available and can be categorized into the following groups: 1. Fixed wing. 2. Rotary wing. 3. Tethered vehicle. 4. Lighter-than-air (LTA).

Application of Drones in Agriculture

Drones can be used to monitor any type of crop in any location. Integrating drone technology can boost up crop yields, save time, make land management more sustainable and improve long-term performance.

1. **Soil and field analysis:** Drones equipped with remote sensing cameras collect data from the ground with the help of electromagnetic spectrum to analysis the soil and field. Different elements reflect different range of wavelengths, which can be used to distinguish between them. Drones gather raw data and use algorithms to transform it into

useful information. As a result, they can be used in a variety of farming applications, such as monitoring the following parameters:

- Crop health: damage made by pests, nutrient deficiencies, color change due to pest infection.
- Vegetation catalogues: leaf area, treatment effectiveness, phenology, yield.
- Plant growth: plant height, LAI and plant density.
- Plant inspection: plant size, field statistics, stand number, compromised field, planter skips
- Water requirements: water requirement according to climatic situation, water-stressed parts of the field/ orchard in need of watering
- Soil investigation: nutrition concentration in plant, nutrient availability for plant nutrient management This information aids farmers to determine the most efficient planting, crop management and soil management practices.

2. **Planting of seed from air:** Every year, about 15 billion trees are cut down for horizontal agricultural growth, mining and specially for urban sprawl. However, we can quickly afforest using drone-seeders. These drones use a pneumatic firing device that shoots seed pods deeper into the soil in some areas, such as in hilly terrain or mangrove forests. Two flying drones can plant up to 40,000 seeds into the ground in a day. A drone in just ten minutes can plant equal to the average human can plant. It can achieve an emergence rate of 90 % and decrease planting costs by 85%.
3. **Spraying operation in agriculture:** Spraying chemicals to kill pests and unwanted plants like weeds is now critical for crop health. For quicker spraying, drones can carry appropriately sized reservoirs that can be filled with fertilizers, pesticides, herbicide, plant growth regulators (PGRs) etc. Sometimes manual spraying operations are very difficult because of the crop's height, so smart farms use drones for spraying, which reduces the contact of humans with fertilizers, pesticides and other harmful chemicals. Spraying capacity is up to five times faster than traditional machinery and completes a spraying in a 1 ha field in less than 40 minutes. It saves 30% pesticide.
4. **Crop health assessment:** Drones equipped with sensors that can scan crops using visible and near-infrared light can be used to track crop health over the time and monitor response to remedial measures. This can be programmed to detect details such as NDVI, water stress or lack of specific nutrients in crops.
5. **Crop count and plant emergence analysis:** Unmanned aerial vehicles (UAVs) are a useful, faster and cost effective technology for obtaining data on crop emergence, drive replanting decisions and help predict yield using drones and high-resolution data combined with Machine Learning algorithms (MLAs). This system produces 97% accuracy in its output using data obtained with drones and Photogrammetry. Drones equipped with LiDAR sensors allows for the estimation of tree/crop biomass change based on differential height measurements, which is used to estimate timber production in forests.
6. **Irrigation monitoring and planning:** With thermal cameras and remote sensing abilities, drones can help to solve irrigation related problems and can split the areas by different moisture regime. This helps in planning the irrigation precisely.
7. **Disaster risk reduction:** FAO has partnered with national counterparts in developing systems to use drones for data collection that assist in Disaster Risk Reduction (DRR) efforts. These useful data are then loaded into modelling systems with analytics capabilities, which produce insightful results. Such data can help the government better organize disaster relief and response services while also providing high-quality, dependable recommendations to rural areas. Drones prompt immediate action on the ground, much faster than manual detection, analysis, and action.

8. **Wildlife conservation:** Drones with thermal cameras can be used to track, inspect, and monitor livestock from multiple angles. Drones have the potential to revolutionize forest and wildlife conservation research. They provide a bird'seye view of forests and wildlife, as well as information, imagery, and data that would otherwise be difficult or prohibitively expensive to obtain.

Additional Benefits of Drones in Agriculture

- Less manpower is required, and this is an outsourced solution. As a result, there is less reliance on departmental personnel.
- The results can be obtained in a short period of time (roughly 3-4 weeks), allowing for quick processing.
- A drone can fly in any type of weather. Although drones are water resistant, image quality can be harmed if photos are taken in rainy conditions.
- Drones can assist farmers in maximizing the use of inputs (seed, fertilizers, and water), responding more quickly to threats (weeds, pests, and fungi), reducing crop scouting time (validating treatment/actions taken), improving variable-rate prescriptions in real time, and estimating yield from a field.
- Drones can be used to monitor any type of crop in any location. As it is a relatively new agricultural technology, its market and application are expected to expand significantly in the upcoming years.
- The technology has also proven useful in gaining a comprehensive picture of plant emergence and population, which can aid in replanting decisions.
- Drone data's high resolution can be used to assess crop fertility, allowing agricultural professionals to apply fertilizer more precisely, reduce waste, and plan irrigation systems.
- Given the vast terrain that needs to be surveyed, drones are more efficient and are allowing users to capture high resolution imagery faster than other methods.

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