IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

# An IOT – Based Precision Farming Using Drone Technology

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## Abstract

Precision farming, often known as precision agriculture, is a farm management technique that makes use of technology and information to detect, analyse, and regulate the temporal and spatial variability within a field. Its objectives are to minimize production costs, protect the land resource, and maximize output and profitability. Food consumption is rising as a result of the population's exponential growth. To address these needs, the farmers' traditional methods proved to be inadequate. Thus, automated techniques and drone technology were introduced. Drones are a highly effective tool for aerial monitoring, analysis, and spraying of crops. The main objective of this study is to illustrate the application of drone technology in agriculture, namely in the areas of weed management, crop health monitoring, disease monitoring, soil fertility maintenance and spraying.

**Keywords:** Drone, weed management, crop health monitoring, disease monitoring, soil fertility maintenance and spraying.

**Introduction:** Unmanned aerial vehicles (UAVs), also referred to as drones, began to be developed more than a century ago and were first employed in combat and other military operations. In the 1800s, these drones were developed for use by intelligence services and the military. Drones and conventional aircraft are different in that drones don't transport a pilot who is human. They can fly freely or be remotely controlled by a human pilot operating from the ground with systems outfitted with software-guided planning.

Thousands of drones are currently in use globally for a range of purposes, including photography, farming, the armed forces, and many more. Additionally, drones are equipped with capabilities that go beyond human constraints. Drones can soar 400 meters above the ground to capture the most breath-taking images of the surrounding natural scenery. A recreational drone features HD cameras to take clear photos, a GPS unit and tracker to fly farther than the human eye can see, and even a portable LCD that can be controlled from a distance.

Drone use is growing beyond the military and enthusiasts to include sectors like agriculture. Drones designed especially for farming are currently available for

purchase. There exist a range of characteristics equipped with tools to support farmers in overcoming obstacles to improve crop yield. Both large and small crops can find it easier to manage the agriculture industry with the aid of a drone.

This article's goal is to give a thorough overview of drones (UAVs) in agriculture and how they are used to monitor and evaluate plants stressors like illness, drought, inadequate nourishment, weeds, vermin, etc.
Crop observation for disease, pests, nutrients, and water stress and general plant health is a crucial component of accuracy farming activities. This study explains how drones may be a great tool for the agriculture sector.

**System requirements:**

**Hyperspectral Sensor**

Data from hundreds or even thousands of wavelengths, covering the visible, near-infrared (NIR), and shortwave infrared (SWIR) portions of the electromagnetic spectrum, is usually collected by hyperspectral sensors. This wide range of wavelengths offers a multitude of insights about the structure and chemical makeup of plants.

**Early Disease Detection:** Farmers can take corrective action before the diseases spread by using hyperspectral data to identify small changes in plant health that are indicative of early-stage diseases.

**Nutrient Deficiency Mapping**: Hyperspectral sensors can map agricultural nutrient shortages, assisting farmers in identifying and focusing on regions that require extra fertilizer.

**Monitoring of Water Stress in Crops:** Farmers can minimize water usage and optimize irrigation schedules by using hyperspectral data to evaluate crop water stress.

**Weed Identification and Control:** Hyperspectral sensors are able to differentiate between various types of vegetation, which allows for more precise identification and targeting of weeds without causing damage to desired crops.

**Yield Estimation and Prediction:** Hyperspectral data can be used to evaluate crop maturity and production, which helps farmers plan their harvest schedules and use resources as efficiently as possible.

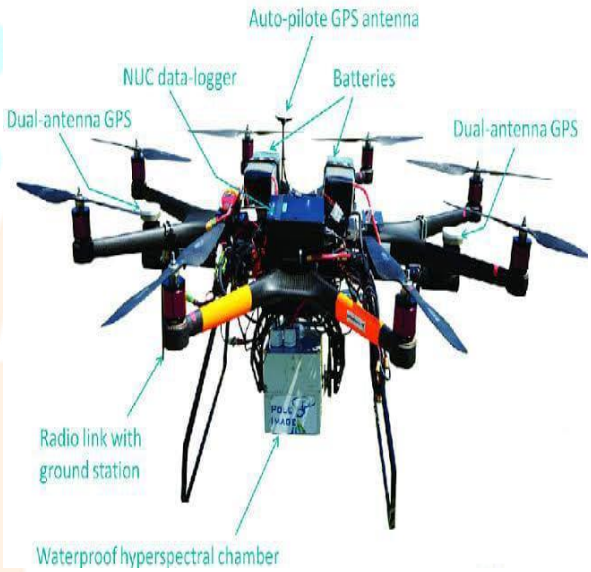


**Fig1.**Hyper-DRELIO(Hyperspectral **Dr**one for **E**nvironment and **L**ittoral **O**bservations)

Spectral data is gathered for hyperspectral imaging using an image spectrometer, often known as a hyperspectral camera. A hyperspectral camera records a scene's light in each of its distinct spectral bands, or wavelengths. It records the spectral information of each pixel in the image and outputs a two-dimensional image of the scene.

A hyperspectral image is the end product, in which every pixel represents a distinct spectrum. This distinct spectrum bears similarities to fingerprints. Every substance and compound has a unique spectral signature because of the ways in which they interact with light. The spectra can be used to identify and quantify the materials in the scene, much like fingerprints can be used to identify an individual.

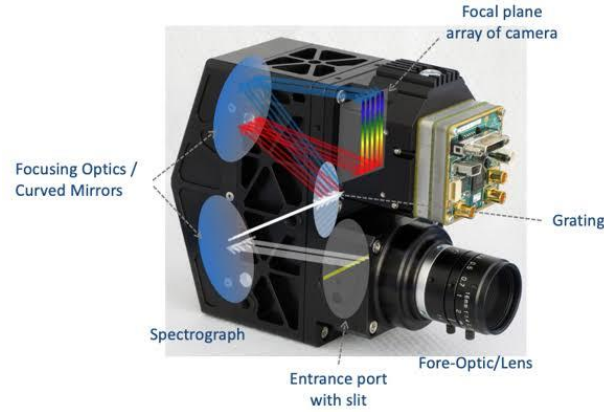


**Fig 2.** Hyperspectral Sensor


**Fig 3.** Accelerometer Sensor

Thus, hyperspectral sensors are an effective tool for precision agriculture because they give farmers thorough information about weed infestations, crop health, nutrient status, and water requirements. By using this data, crop management techniques can be improved, their negative effects on the environment can be minimized, and profitability can rise.

## Accelerometer Sensor

Accelerometers are especially helpful for tracking vibrations, identifying motion, and assessing how the weather affects the health of crops.

### The Accelerometer Sensor's Features

**Vibration measurement:** In real time, the accelerometer can determine the amplitude of vibrations. Farmers can detect possible problems, such as crop damage or equipment failure, by comparing these vibrations with a predetermined baseline.

**Movement Detection:** Accelerometers are capable of detecting motion in the surrounding area of the sensor, whether it be from moving cars or people. This feature is very helpful for protecting agricultural land and keeping an eye on employee activity.

**Environmental monitoring:** Temperature, humidity, and pressure variations can all be measured with accelerometers. Farmers can learn more about the general health of their crops and the surrounding environment by integrating several sensors.

## Gyroscope Sensors

In drone agriculture, gyroscope sensors are essential, especially for applications involving precision spraying. By giving precise control over the spraying mechanism and guaranteeing even coverage of the target area, they offer real-time data on the orientation and angular velocity of the drone.

### The Gyroscope Sensor's Features

**Enhanced Spraying Precision:** By reducing tilt and roll movements that can cause an uneven spray distribution, gyroscope sensors help keep the drone stable and level. By ensuring that each plant receives the appropriate dosage of pesticide or fertilizer, precision spraying maximizes crop yields while minimizing waste.

**Decreased Drift and Environmental Impact:** Gyroscope sensors reduce spray drift by keeping a steady spray pattern, which stops fertilizers or pesticides from accidentally spreading outside the targeted region. By applying specifically, the risk of environmental contamination is decreased, and non-target vegetation is safeguarded.

**Enhanced Productivity and Efficiency:** Drones with gyroscope sensors can fly more productively, requiring fewer passes to cover a field. For agricultural activities, this efficiency means quicker completion times and higher production.

**Adaptability to Terrain Variations**: The spraying system can stay stable and productive even across uneven or sloping ground because of the ability of gyroscope sensors to correct for variations in terrain.

Drones can function in a variety of agricultural contexts thanks to their versatility.

**Real-time Data Analysis and Optimization:** Gyroscope sensors offer real-time data on the direction and motion of the drone. This data can be evaluated to optimize spraying parameters and modify the system's performance in response to changing circumstances.

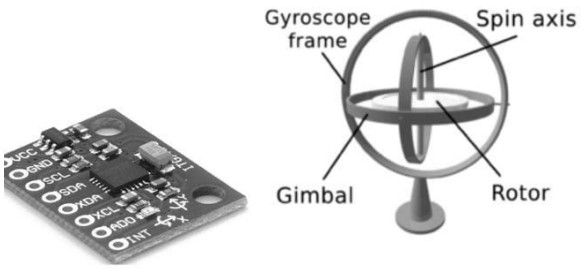


**Fig 4.** Gyroscope Sensors

## GPS (Global Positioning System)

Precision agriculture relies heavily on GPS technology, which gives drones the ability to carry out a variety of jobs accurately and effectively.

**Crop monitoring:** plant height, leaf area, and nutrient levels are just a few of the health-related data that drones may gather. This information can be used to pinpoint the parts of the field that require care, such as those impacted by pests or drought.

**Irrigation management:** Drones can be used to identify sections of a field that require irrigation and to monitor soil moisture levels in irrigation management. By ensuring that crops receive the proper amount of water, this can help to increase yields and decrease water waste.

**Field mapping:** Drones can be used to map fields in great detail. These comprehensive maps can be used for a number of purposes, including determining which parts of the field are suited for growing different kinds of crops and arranging crop rotations.

**Livestock monitoring:** Drones can be used for livestock monitoring, including keeping an eye on the whereabouts and general health of sheep and cattle. This can be used to track animal movements and spot overgrazed sections of the pasture, in addition to helping to protect the safety and health of the animals.

**Search and rescue:** Drones can be used for search and rescue operations in agricultural areas, including looking for injured or lost individuals as well as lost livestock.

In the agricultural sector, GPS technology is still relatively young, yet it is already having a big impact on farmers' daily operations. GPS technology is expected to become even more crucial in agriculture as it advances.


**Fig 5.** GPS

## Workflow of Drone

The drone is equipped with sensors like a hyperspectral, accelerometer, gyroscope, GPS, and many other components. When the drone is operated on a particular farm, it travels accurately with the help of GPS, which makes it easier to navigate and map a specific field section. Using hyperspectral sensors, it helps to detect the disease, nutrient deficiency, and amount of water and weed required for the growth of the plant. It also helps to evaluate production; this helps the farmers plan their harvest schedules and use the resources efficiently. Accelerometer sensors and gyroscope sensors are used to spray a dosage of

pesticides or fertilizers on a plant in order to maximize crop yield by minimizing waste.

In conclusion, the exact data that drones provide on crop health, pest and disease management, and precision agriculture is revolutionizing the agriculture sector. By implementing this state-of-the-art technology, farmers may increase productivity, lower input costs, and support sustainable food production.

**Conclusion**

Drones have the potential to significantly change agriculture in India. Due to the labor -intensive nature of farming, today's youth are not drawn to it. Drones' implications could inspire young people to pursue careers in agriculture. In the end, they can increase yields and productivity by saving farmers money, time, and effort. Crop fields can be captured on camera-equipped drones that have high-resolution capabilities. Then, using sophisticated computer algorithms, these photos can be used to detect and track a number of variables that affect crop health, including nutrient levels, water use, and the presence of pests or diseases. Farmers can optimize resource use and improve harvests by utilizing drones to deliver precise amounts of water, insecticides, and fertilizer to individual plants. In order to sustain crop health, farmers may promptly respond with the required measures when drones help detect plant stress early on. Farmers no longer need a sizable team to manage vast areas of land effectively, thanks to drone support. This lessens the environmental impact of utilizing pesticides and other chemicals, in addition to lowering labor expenses. Utilizing precision-agriculture instruments like sprayers, seeding, and soil probes, drones may harvest crops more precisely and efficiently. Drones can be used to keep an eye on and lessen the environmental effects of agricultural operations. Drones can be used, for instance, to manage wildlife habitats on farms, detect and clean up pollutants, and stop soil erosion.

Therefore, drone integration in agriculture has the potential to improve environmental stewardship, save expenses, and boost productivity overall. Drones are probably going to become more and more important in agriculture in the future as technology develops.

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