

Electronic Sensors and Agriculture

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The agricultural sector has seen a significant transformation with the use of computers and electronics in practices. These advancements revolutionized the way crops are grown, livestock is managed, and resources are utilized.

The use of computers and electronics in agriculture is helping precision farming. This involves using data analytics, GPS technology, and sensors to monitor and optimize crop production. With collection and analysis of data on weather patterns, soil conditions and crop health, farmers can make decisions on irrigation, fertilization, and pest control, which leads to resource efficiency and increased yields.

The introduction of automated machinery and robotics has reduced labour costs and streamlined farming operations. Drones, robotic harvesters equipped with sensors and cameras can perform tasks like planting, spraying, and harvesting with precision and efficiency. The integration of Internet of Things (IoT) devices and cloud computing has enabled real-time monitoring and control of agricultural processes. Farmers can remotely monitor temperature, soil moisture levels, and crop growth using mobile applications and make adjustments to optimize production.

For smart farming revolution sensors are needed, that provide data-driven insights and enable precision farming techniques. These sensors monitor, measure and manage the agricultural ecosystem in ever-more complex. A sensor works by detecting physical or chemical changes in the surrounding environment, which it converts into an electrical signal. This signal is then used for information gathering. Thus, farmers gain insight into every aspect of their operations, enabling informed decision-making and resource optimisation.

Temperature and humidity sensors

Temperature and humidity play crucial roles in determining crop health and productivity. Sensors are designed to monitor these environmental factors and are critical tools for optimising growing conditions and mitigating the impact of climatic fluctuations. Humidity sensors provide data about atmospheric moisture levels, helping farmers to manage irrigation schedules, prevent fungal diseases and adjust greenhouse environments. The integration of temperature and humidity data with advanced data analytics helps farmers to forecast weather patterns, anticipate crop stress events, and make data-driven decisions about pest management, irrigation and the timing of harvests.

Soil moisture sensors

Water is vital for nourishing crops and sustaining ecosystems. Dielectric soil moisture sensors use the principle of dielectric permittivity, measure the ability of soil to hold an electrical charge, affected by the amount of water present. These sensors provide real-time data on soil moisture levels, helping precise irrigation management and water conservation efforts. They also play a crucial role in monitoring soil health to help prevent waterlogging and soil compaction. By maintaining optimal moisture levels, farmers can reduce the risk of crop diseases and root rot.

Biosensors

Biosensors offer farmers information of the physiological status of their crops and the surrounding environment. Biosensors, equipped with biological components detect specific biological molecules or pathogens that are present in plants or soil. These sensors provide real-time data on plant health, nutrient levels and the presence of disease. Farmers can make timely decisions about crop management and protection.

Location sensors

For efficiency in agriculture, location data is vital. Location sensors use GPS to triangulate a position, giving farmers very precise dynamic data of their fields and assets. For example, the sensors assist in identifying variations in topography, mapping of fields, delineating boundaries, and optimising planting patterns. Location sensors enable farmers to track the movement and utilisation of machinery and equipment. Using software they help with tasks such as seeding, weeding and hoeing.

Optical sensors

Optical sensors give information about the physiological status of a crop by using light waves to assess key indicators of plant health. A primary application is for the measurement of chlorophyll in leaves – a vital metric of photosynthetic activity and nutrient uptake. This helps farmers to detect nutrient deficiencies and stress conditions early on. They also can identify various biotic and abiotic stresses that may impact crop growth like pest infestations and water stress. These sensors offer early warning signals.

Electrochemical sensors

These sensors function by converting chemical reactions into measurable electrical signals, allowing farmers to assess soil quality, detect environmental pollutants and monitor nutrient levels. This includes assessing pH levels,

nutrient concentrations, salinity levels and the presence of any harmful pollutants, such as heavy metals. It also allows farmers to optimise the application of fertiliser, with associated cost and environmental savings.

High-quality sensors can be expensive depending on farm size. Sensors in any require regular calibration and maintenance to ensure accuracy and reliability. In the harsh agricultural environment, sensors though well designed,

could be susceptible to wear and tear, dust, moisture, exposure to various contaminants. So, adjustments and replacements are sometimes required.

Farmers can have successful and resilient crops, good yields, and now can adapt to the dynamic challenges posed by climate change. Therefore, sensors are also catalysts for a greener, more resilient future.

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About the Author

Vishwas Kale is Managing Director, Vijayesh Instruments Pvt Ltd, Pune and has more than thirty years' experience in instrumentation. He was twice President, International Society of Automation (ISA, USA) in India, now its Honorary Senior Life Member, Advisory Member of Industrial Process Measurement and Control Committee of Bureau of Indian Standards (BIS), Member of Experts Panel of NCTS-Indian Institute of Foundrymen among many positions he holds with various organizations. He has received awards for innovative products.

Author of two books:

- Instrumentation and Process Control Techniques in Foundries
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