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Sensors for Agriculture

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Introduction

The concept of smart farming, or precision agriculture involves the usage of sensors in agriculture, to make a better understanding of crops' microclimate, resource conservation and for monitoring the environmental impacts and challenges. The sensors installed in the farmers' field has proven to be efficient in agriculture by transmitting the data from field, which will help the farmers to not only monitor, but also to improve their inputs and will provide awareness of the changes in field ecosystem. A sensor is a device that detects particular inputs, such as light, motion, pressure, heat, or moisture, and reacts to them by converting them into representations or signals that humans can interpret and understand. They are positioned at weather stations, installed in drones and some robots, which are used in agriculture. They are controllable through mobile apps, made specifically for proper monitoring of the sensors.

Sensors used in agriculture

1. **Optical Sensors:** These utilise light for measuring the soil properties. These sensors, which are mounted on cars or drones, enable the collection and processing of information about plant colour and soil reflectance. Clay, organic matter, and soil moisture content can all be measured by optical sensors.
2. **Mechanical sensors:** These estimate the mechanical resistance of soil or compaction of soil. The sensors employ a probe that reaches into the ground to measure resistive forces using load cells or strain gauges. The holding forces created by the soil's

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cutting, smashing, and displacement are recorded when a sensor travels through the soil. The ratio of the force required to enter the soil channel to the frontal area of the tool engaged with the soil is shown by soil mechanical resistance, which is measured in a unit of pressure.

3. **Electrochemical sensors:** These function through detection of specific ions in the soil, such as potassium, hydrogen, nitrate, etc. Samples from the field are taken to the laboratories for determining the pH by the use of ion-selective electrodes. The soil's chemical information is gathered, processed, and mapped with the use of electrochemical sensors. They are typically mounted on sleds with unique construction.
4. **Dielectric soil moisture sensors:** With the use of a dielectric constant, this sensor calculates soil moisture levels. These are used in conjunction with rain gauges located across the farm. When the vegetation level is low, this enables for the observation of soil moisture levels.
5. **Electronic sensors:** It is mounted on tractors and other outdoor machinery to inspect equipment performance. The information received is then instantaneously transmitted to computers or sent via email to others using cellular and satellite connection networks. The information can then be retrieved by the field executive using their office computer or mobile device.
6. **Location sensors:** The range, distance, and height of any point within the field are determined by these sensors. They rely on GPS satellites to accomplish this.
7. **Airflow sensors:** Its measurements can be taken while moving to certain areas within the field and aims to measure soil air penetration. The pressure required to force a predetermined amount of air into the ground at a predetermined depth is the desired output. Diverse identification signatures are produced by diverse soil properties, such as compaction, structure, soil type, and moisture content.
8. **IoT agriculture sensors:** The ability to connect multiple devices has been implemented in nearly every part of our lives as the Internet of Things (IoT) has grown in popularity. It only seems natural that automation finds its way into agriculture, as it will have a significant impact on it.This sensor offers in-field data in real-time, including soil temperature at various depths, air temperature, rainfall, wind

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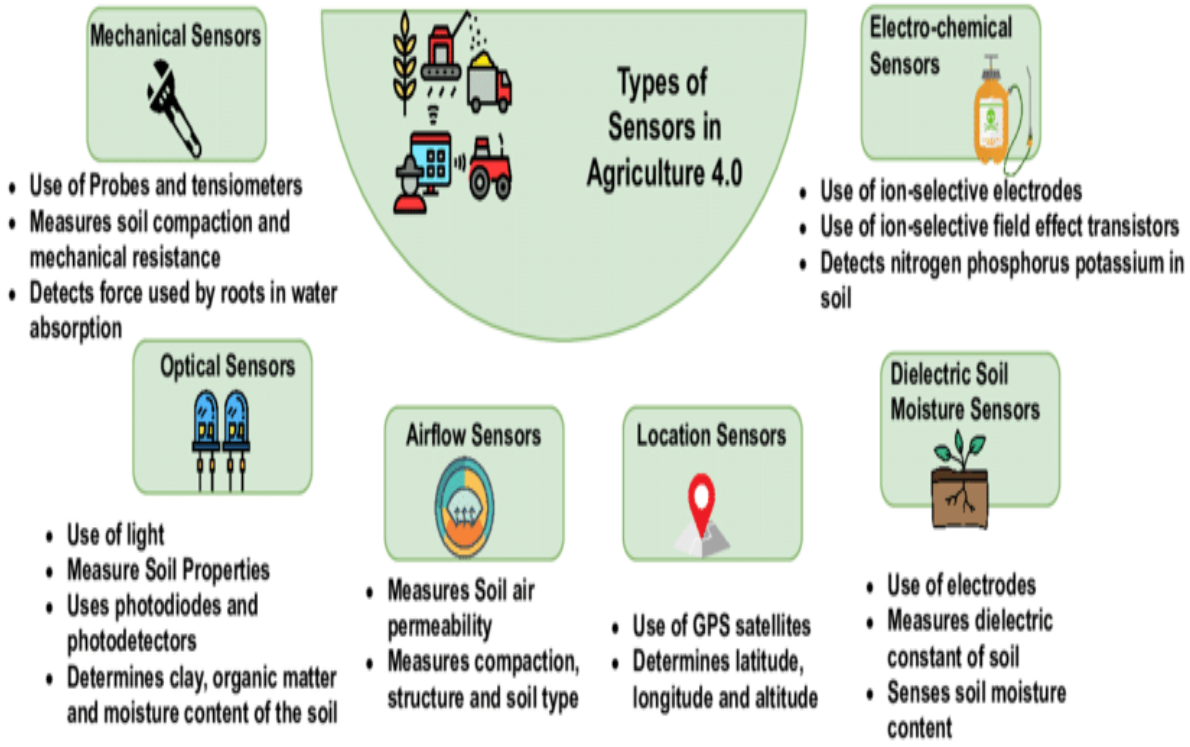
speed, leaf wetness, dew point temperature, chlorophyll, wind direction, solar radiation, relative humidity, and atmospheric pressure.This shows that farmers are knowledgeable about when their crops are ready for harvest, how much water is being used, the condition of the soil, and whether any further input is required. At predetermined intervals, this is monitored and recorded with the help of these sensors.



Benefits of sensors:

1. Sensors in agriculture were developed to meet the growing need for food while using as few resources as possible, such as water, fertilizer, and seeds.
2. They are simple to use, maintain and operate.
3. Sensors are less expensive and of higher quality.
4. For the fields and crops, they can be used to measure pollution and global warming.
5. These sensors have wireless chips that allow them to be controlled remotely.

Demerits of sensors:

1. There can be variations in the reliability and accuracy of sensors, which can result in errors in measurements.
2. For attaining optimal operation, some sensors may necessitate frequent calibrations or maintenance.

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3. Sensors may fail to accurately detect some environmental elements or fluctuations, limiting their ability to deliver comprehensive insights.