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Precision Farming-The Digital Approach

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SUMMARY

Today, farming is barely sustainable without implementing modern farm technologies. Scarcity of input with the rapid development of precision technology based on sensors, farmers can achieve successful crop production with less or precise input. Digital information regarding weather, soil conditions, and crop health has the potential to maintain precise agricultural operations to help modern farmers optimize their inputs and achieve a high level of farm productivity. As a result, farming is becoming digitalized, précise and more efficient.

INTRODUCTION

The most important tools in precision agriculture management are sensors, which provide accurate data. These sensors are available for the purpose of soil condition analysis to real time application of nitrogen, growth regulators and water. These sensors help farmers for quickly and easy determination of various soil and crop factors crucial for farming along with above factors. In striving to manage successful farm production, care should be taken in regards to crop characteristics too. Using crop sensing technology, the farmer is able to improve crop conditions by measuring plant water potential, yield quality, stage of development (ripeness), nutrient levels, pest and disease infections, and various morphology factors such as biomass, leaf area, and distribution of plants and organs.

Crop sensing technology works using one of three principles of measurement:

- Mechanical.
- Acoustic.
- Optical.

Mechanical Crop Sensor:

Mechanical sensors operate based on a plant contact. They are classified according to the parameter to be measured.

Crop water potential Sensors: The relative changes in the leaf's turgor pressure measuring sensor. The leaf is placed between two magnets which measure the difference between plant turgor and magnetic pressure. Low plant turgor will increase magnetic pressure, thus indicating that the plant lacks sufficient water, making, irrigation necessary. Such sensors can measure changes in leaf turgor pressure in real time.

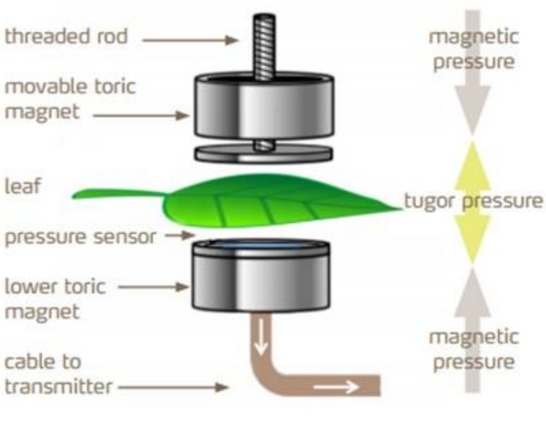

Fig. The working principle of water Potential sensor **Fig. Water Potential Sensor installed on lemon tree**

Crop biomass density measuring Sensors: in which the sensor has a pendulum system which passes over the crop under a certain angle, thus detecting differences within the crop. In measuring the crop biomass, the sensor serves to be beneficial, as it regulates nitrogen applications over specific areas as well as ensures optimum plant protection.

Fig. Crop biomass sensor in the Field

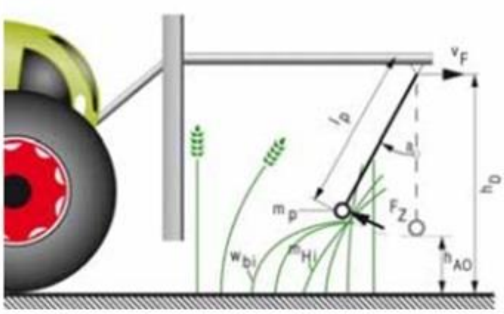

Fig. working principle of sensor for crop biomass Measurement

Acoustic Crop Sensor:

Acoustic sensors have a miscellaneous appliance in farm management. These sensors detect the plant geometric structure by emitting an ultrasonic wave signal to the plant. The sensor emits the signal as a repeated sweep under a certain frequency (usually 50-100 kHz). As a result of the application of ultrasonic energy to the plant, several echoes occur. Each echo contains information about the geometric structure of the plant, i.e. the structure of the foliage. This information can be captured by extracting features from the echo signal into geometric features related to the foliage structure (size, shape, orientation, and overall positioning of the leaves).

Some of the targeted basic applications are:

Soil cultivation: These sensors can be used either to control variable rate application equipment in real-time or in conjunction with a Global Positioning System (GPS) to generate field maps of particular soil properties and detect the rows of plants from the soil.

Weeding: In Precision Agriculture, images coming from camera-based sensors are commonly used for weed identification and crop line detection, either to apply specific treatments or for vehicle guidance purposes. Accuracy of identification and detection is an important issue to be addressed in image processing detect the plants from the weeds

Herbicide application: Herbicide application is one of the technical and important practices which decide the yield and quality of the production.

With the help of sensors we can manage the proper application of herbicide to detect the actual plants and weeds so we can spray on targeted plants.

Fruit harvesting: Fruit picking or fruit harvesting is a seasonal activity that occurs during harvest time in areas with fruit growing wild or being farmed in orchards.

Sensor is used to find the fruit inside the tree canopy.

Grain and forage harvesting: The development and application of precision agriculture technology to forage crops offers scope for improved management practices and targeting of inputs. In particular, the ability to measure forage throughput on a harvester would form the basis for improved management decisions and the ability to exploit precision agriculture technology, including accurate application of forage additives. The aim of this project was to develop a forage throughput sensor and to use that sensor to record yield variability and to accurately control additive application.to detect the harvested area, thus avoiding overlapping.

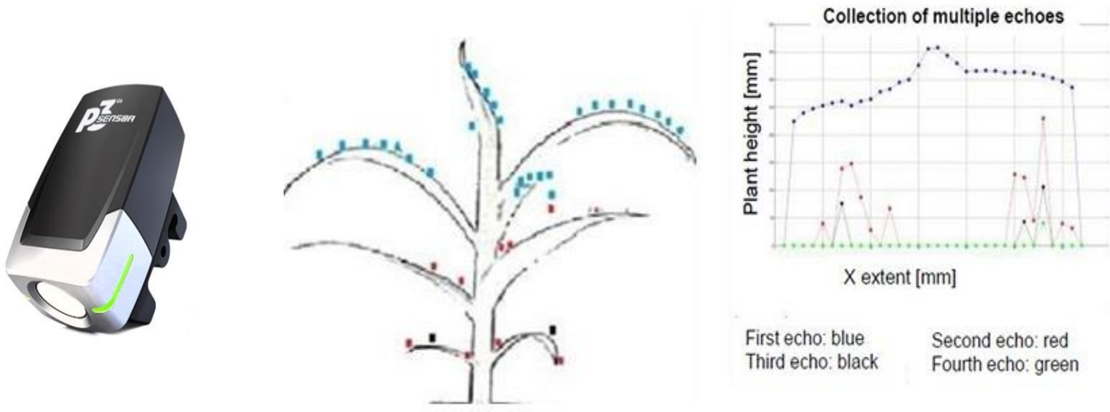

Fig. The working principle of acoustic sensor

Additionally, the leaf structure greatly influences the amount of reflected ultrasonic sound. In general, the more leaves on a plant and the larger the leaves, the greater the percentage of ultrasonic sound that will be reflected by the sensor.

Optical Crop Sensor:

There is a very wide range of optical sensors used in farming which measure the agricultural crop reflectance. These sensors can be classified according to the platform. These include:

- **Satellites** – use cameras to collect images from great distances
- **Aerial (airplanes, UAV)** - use cameras to collect images from long distances
- **Ground-based** - collect reflectance data from short distances and can store it in a text file

The ground sensors can also be classified as active or passive based on the light source. Active sensors have their own source of light. This source can be a wide range light or a specific wavelength. Oppositely, passive sensors require an external source of light, such as the sun and are not able to work at night. They may also indicate different, inaccurate readings when there are clouds or shadows. Passive sensors need to be positioned at an exact distance from the plant in order to be able to capture the crop reflectance. Another limiting factor is the dew presence which can change the reflectance in both visible and near-infrared. In other words, it increases the reflectance but affects the visible light. Optical crop sensors evaluate various crop conditions by using specific wavelengths, from monochromatic to multi-spectral (<10 wave bands) and hyperspectral (>10 wave bands). By shining light of specific wavelengths at crop leaves, sensors are able to measure the type and intensity of the light wavelengths reflected from the leaves back to the sensors. Different colour light waves can be used to measure different crop conditions.

Fig. Optical sensor for nitrogen requirement detection.

Fig. Optical sensor for weed detection

Measuring crop reflectance, optical sensors are used to evaluate crop conditions related to nitrogen. They can estimate crop parameters like LAI (Leaf Area Index), leaf chlorophyll content, soil cover, dry matter, water content, yield, nitrogen content, and many others. An optical sensor, connected to a GPS, is able to use geographical coordinates to create maps from reflectance measurements. This map can help identify the parts of the field that are experiencing more stress, thus saving the use of inputs.

The Era of Data Farming Has Already Begun

Farming based on sensors is a daily activity that is growing increasingly important to more and more farmers. Having the possibility to precisely monitor in-field variability and make decisions based on data will completely transform farm management. Precision farming allows farmers fast and easy determination of various soil and crop factors crucial for farming. Because of this, crop sensing technology is one of the fastest growing segments in precision farming. This cost-effective method may greatly improve crop yields, while at the same time saving the inputs and environment. In the era of digital farm technologies and data-driven decisions, every farmer has the opportunity to make farming more efficient and easier than ever.

REFERENCES

Precision Farming by B L Jana.

Automated Guided Vehicle Systems by Ullrich Gunter.