

D1.1 Data Collection - sensors

This topic on *sensors* covers its definition (what it is), its function (how it works), and its different types (how they are used).

What is a sensor and how does it function?

According to (Atecentral, 2017), a *sensor* is a device that receives and responds to a signal. This device can sense measured information and convert it into an electrical signal or other necessary output information according to a certain rule to meet the requirements of transmission, processing, storage, display, record, and manipulate information.

The signal can be heat, light, motion, electrical, a chemical reaction, or any number of other environmental phenomena. When a sensor detects one or more of these signals from a device such as a transducer, it will convert into an analog or digital representation, as human-readable display at the sensor location or transmitted electronically over a network for reading or further processing. Generally, sensors are used in all aspects of life to detect and/or measure many different conditions.

An example of a sensor in daily use is the tongue. When it detects food, (the tongue) receives this signal then sends messages to the brain which responds to an output to inform the tongue that the food is good or not, so the tongue is considered as a chemical sensor.

Example of sensor – a temperature sensor.

Other examples of sensors in daily life include; humidity sensors; pressure sensors; proximity sensors; level sensors; accelerometers; gyroscope sensors; gas sensors.



<https://www.techtarget.com/whatis/definition/sensor>

How data searching by modern sensors is carried out?

In agriculture 4.0, most sensors which are used are online/remote/smart sensors. These sensors collect analog data from the physical world and translate it into digital data assets. It acquires information about an object or phenomenon without coming into physical contact with the object. The information recorded from the modern sensors is usually highly accurate and rarely goes wrong. It helps monitor and control mechanisms in a variety of different environments and helps to probe large amounts of information for scientific applications.

Sensors are present in many devices and are applied in a variety of fields of crop and animal production. Therefore, the sensors will also have different components suitable for each specific purpose.

The application of sensors in agriculture

Sensors are already present in traditional agricultural fields such as temperature sensors. Sensors have also been playing an important role in the development of crop and livestock farming towards

sustainable production thanks to provided information which *helps farmers monitor and optimise* their crop/animal production by adapting to changes in the environmental conditions.

With the development of the Internet of Things (IoT), sensors have been applied more and more within the field of agriculture. In modern agriculture, sensors are mainly used for environmental information monitoring, animal and plant life perception, and quality safety and traceability (Xu et al, 2022).

In crop production, sensors are commonly used to collect data on plant development such as nursery, growth and harvesting. Air temperature and humidity, soil temperature and humidity sensors, soil pH sensors, light intensity sensors and carbon dioxide CO₂ sensors are currently applied in the field. Agricultural soil pH and EC conductivity sensors are used to monitor water and fertilizers. In livestock, intelligent sensors help to easily identify animals, detect heat and monitor their health, thus facilitating the isolation and healing of sick cows by identifying, detecting, and following herds.



GreenSeeker sensor collecting NDVI values for weed (a) and (b); detailed pictures from GreenSeeker Hand Held (c) and Pocket Sensor (d); and GreenSeeker mounted on a sprayer (e) and on a motorcycle (f) collecting NDVI values in sugarcane.

Source: <https://www.intechopen.com/chapters/46140>.

The limitations of smart sensors in agriculture

Smart sensors require continuous internet connectivity, however, this is sometimes not available in agricultural fields or farms.

Advanced technologies change so quickly that farmers are not always ready to adopt the latest IoT devices equipped with agriculture sensors.

As a device to collect data, sensors have not yet focused much on personal data protection of users.

Summary of learning objectives of the topic

To understand the concept of „a sensor“ and its function.

How data searching by modern sensors is carried out?

To understand the importance of applied sensors in agriculture and to identify different types of sensors in agriculture.

To be aware of the limitations of sensors in agriculture.

Links to relevant topics

Xu J., Gu B., Tian G. (2022). Review of agricultural IoT technology. *Artificial Intelligence in Agriculture*, Volume 6, 2022, Pages 10-22. <https://doi.org/10.1016/j.aiaa.2022.01.001>

https://atecentral.net/downloads/9418/Sensors_PK_IG.pdf

Remote sensing for agricultural applications: A meta-review - ScienceDirect

<https://www.renkeer.com/agriculture-sensors-list/>

<https://www.sciencedirect.com/science/article/pii/S2589721722000010>

https://wakelet.com/wake/r4s_EUxu_T9puiHLzm0-B

<https://www.agriculture.com/technology/data/sensors-helping-farmers-better-understand-crops>

<https://www.mdpi.com/1424-8220/22/20/7910/pdf>

Key words

sensors

output information

data

information transmission