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INTERNET OF THINGS (IOT) IN AGRICULTURE: A BRIEF INTRODUCTION

Subhradip Bhattacharjee

subhradip25@gmail.com

Agronomy Section, ICAR- National Dairy Research Institute, Karnal, Haryana-132001, India

Precision agriculture has emerged as the last big thing in Agriculture. Over the last fifty years, agriculture development was focused on improving the yield as well as the financial condition of the farmer. However, deeper scientific insights have shed light on the delicate balance of ecological stability and its sophisticated relation with crop yield and humans as consumers. Precision agriculture has emerged as a resort to optimizing the inputs to minimize the impact on the environment. During the 20th century, productivity depended on three primary factors i.e., mechanization, improved seed material, and high inputs as the only means to enhance production. Although the production target was achieved with these three factors, the ill effects of soil degradation, pollution, and deforestation started getting felt in no time.

For example, currently, 70% of the total usable water is being used in agriculture, although a large part of it is laden with pesticide residues and other chemicals. Hence precision agriculture is the need of the hour to carb this chemical from entering the food system. The latest addition to precision agriculture is “Internet of Things” or “IoT”. Coined by Kevin Ashton in 1999, IoT refers collection of data from “thing” or a group of “things” and subsequently processing it with the help of artificial intelligence (machine learning) and taking an efficient and timely decision based on it. This transition has resulted conventional farming into smart farming.

IoT- key components

In IoT the data is transferred to the database in real time, where a preinstalled application takes a concise decision based on data knowledge which the program was previously trained which ultimately converts the conventional agriculture into a cyber-physical agriculture module. As compared to human intervened precision agriculture where

manpower is used to collect, analyze, and decisions making, this sensor-based fully automatic system has resulted in higher precision, lesser waste, and lesser human error. The basic architecture of IoT contains three layers; IoT platform, IoT gateway, and IoT devices.

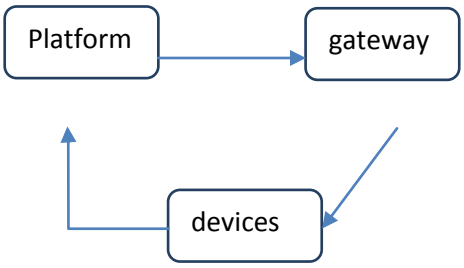

Fig1: three layers of IoT

The "Things" in the Internet of Things

Sometimes there is a lot of confusion between "device" and "things" on the basis of terminology. In general, a device is a piece of equipment that essentially has the mandatory capability of communication with sometimes added additional capability of sensing, actuation, data capture, and data processing. In the case of things, it can be an object from the physical world or from the virtual or information world which has the ability to integrate into the communication network.

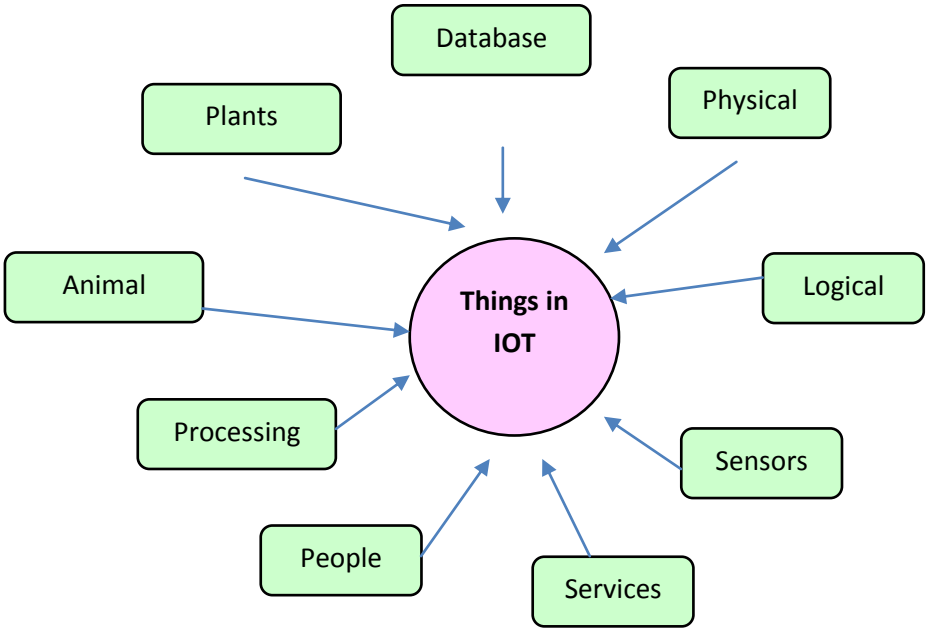

Fig 2: different states of IoTs (adapted from)

From an agricultural point of view, a few of the important things can be:

1. Location capturing sensor: the sensors which can determine elements of geographic locations.
2. Electrochemical sensors: to determine pH, EC, and other chemical and enzymatic actions
3. Photosensor: sensors that can determine the organic matter, soil properties, moisture content, etc.
4. Mechanical sensors: sensors that can determine the soil's physical properties, including penetration resistance, bulk and particle density, etc.
5. Moisture sensor: The sensors that can record the moisture content of the soil.

Architectural stages of IoT

The whole architecture of IoT is divided into four stages.

Stage 1: This is the first and primary stage and consists of sensors that receive information and data from things. The raw data is then processed and organized in the proper format for further processing.

Stage 2: In this, all the collaborative data is cleaned along with converted from analog to digital format. This stage is also known as the gateway stage as all the data has to pass through this stage.

Stage 3: The third stage is called "edge" while the process is called "edge computing". The "data or information" from the second stage isreceived through various gateways either by wired or wireless transmission. Usually, the edge receives data by wireless modes such as WiFi or similar technologies. An imperative characteristic of good architecture is to process data closer to the ends; thus, pre-analytical processing takes place here to support subsequent processing.

Stage 4: This stage is considered the final stage where the actual processing is done which is mainly based on cloud computing. Data analysis, management, archival, and management is the major element here. This stage is also responsible for decision-making. After processing the data, analysis is done according to the purpose, and valuable results are obtained which help in control, management, and decision-making.

Characteristics of IoT

The International Telecommunication Association has mentioned several characteristics of IoT which are:

1. Interconnectivity: ability to connect with global information and communication infrastructure.
2. things- related services: privacy and consistency in things-related services.
3. Heterogeneity: ability to communicate with diverse types of devices with different protocols.
4. Dynamic change: the nature of the devices to adapt and act even if the environment changes.
5. Large scale: The ability to connect with a large number of devices generating a large amount of data.
6. Maintenance-free operation: It is highly desired that IoT devices should work without human intervention hence staying maintenance-free for a long time is a desirable characteristic.

Conclusion

Being a new technology Internet of Things holds a lot of opportunities in agriculture, especially in Precision farming. The process will enable a higher boost in efficiency, resource conservation, timely management, and better profitability by using arrays of sensors, cloud computing, and artificial intelligence.

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