

Internet of Things (IoT) in Agriculture

Sanjay Rathour¹, Aakash Sunaratiya² and Abhishek Patidar³

ICAR-Research Scholar, Department of Agronomy

^{1,2}College of Agriculture, G.B. Pant University of Agriculture and Technology,
Pantnagar, Uttarakhand, 263153

³Indian Agricultural Research Institute, Pusa, New Delhi, 110012

ARTICLE ID: 86

Summary

The term Internet of Things was coined in 1999 by Kevin Ashton, co-founder and Executive Director of the MIT Auto-ID Center, while he was giving a presentation at Procter and Gamble as their Brand Manager. The presentation that Ashton made for Procter and Gamble was meant to introduce RFID tags to manage the supply chain so that the location and stock at the hand of each item coming out of it can be more easily monitored. Requests will grow and collapse, disruptive business models will crop or die, but people will always need to eat and drink. For this reason, the development of similar areas as food and husbandry will always be precedence, especially given the dynamics we observe in the world moment. Thus, IoT used in husbandry has a big promising future as a driving force of effectiveness, sustainability, and scalability in this assiduity.

Introduction

IoT operation in husbandry could have a life-changing impact on humanity and the earth because a food product is getting more complicated and expensive as a result of extreme rainfall, degraded soil, and drying lands. It has been prognosticated that there will be further than 9 billion people on the earth by 2050. That's a lot of mouths to feed. Fortunately, there are stopgap thanks to fleetly developing Agritech and IoT operations for smart husbandry. The IoT bias range from ordinary ménage particulars to sophisticated artificial tools. By 2025, the number of Internet of Effects (IoT) connected biases will grow dramatically, from 13.8 billion in 2021 to 30.9 billion by 2025.

What is IoT?

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-



human or human-to-computer interaction. In the internet of things, a thing can be anything from a person with a heart monitor implant to a farm animal with a transponder, an automobile with sensors to warn the driver of low tire pressure, or any other object that has a unique IP address and can transmit data over a network. IoT is being increasingly used by organizations in many industries to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and enhance business value.

IoT: How does it work?

It consists of web-enabled smart devices that use embedded systems, like processors, sensors, and communication hardware, to collect, send, and act on data from their environments. Sensor data collected by IoT devices can be shared by IoT gateways, where the data can be sent to the cloud for analysis or can be analyzed locally. These devices may exchange information with one another and act on the information they receive. People can interact with devices:- for example, to set them up, give them instructions, or access the data:- but most of the work is done without human intervention. IoT applications determine the connectivity, networking, and communication protocols used with web-enabled devices. AI and machine learning can also be used to make IoT data collection processes easier and more dynamic.

The use of IoT in Agriculture

- ✚ **Agriculture Vehicles:** In general, the operation of husbandry vehicles is the core of productive husbandry. Using smart vehicles significantly increases this effectiveness and drives robotization to traditional husbandry.
- ✚ **Agriculture Drones UAVs** or simply drones have also gained fashionability in the assiduity. In utmost cases, drones work as an IoT- grounded monitoring system in smart husbandry, as the tools for ranch mapping and on-demand irrigation and fungicide treatment. X aircraft P30 is an independent factory protection drone. It uses advanced algorithms for outstanding flight capabilities and precise chemical scattering, which helps reduce up to 30 fungicide materials and save 90 of water.
- ✚ **Smart sprinklers, lights, coolers,** heaters for case, automated irrigation grounded on the use of smart sprinklers helps growers significantly reduce water consumption and therefore makes husbandry more sustainable. Connected coolers and heaters in storehouse and transportation installations produce better conserving conditions for

the product and help reduce waste. Intelligent LED lighting automatically adjusts to the changing conditions and ensures every part of a hothouse or storehouse space gets the right quantum of light. Digital Lumens produces just the kind of intelligent LEDs which grease energy operation monitoring and demonstrate agrarian robotization using IoT in action. Combined with remote control and data analytics features, this result provides advanced effectiveness in managing storehouse and transportation means.

- ✚ **Autonomous greenhouse** the majority of spreads in the Netherlands are covered by glass, and vegetables are grown in independent glasshouses. The Dutch use connected technology, detectors to cover CO₂ position, moisture, LED light, factory health, and data analytics to maintain a sustainable terrain in the glasshouses. Therefore, they gather 10 times the average yield from a traditional open field. Piecemeal from unexampled effectiveness, growing food in smart glasshouses is clean as it requires much lower water and fungicides. Considering the unstoppable benefits, environmental benevolence, and dexterity of independent glasshouses, they could come to the result to the challenges tilling confronts and therefore make the future of IoT in husbandry.
- ✚ **IoT husbandry detectors:** There's a wide range of IoT detectors used in husbandry, including soil, moisture, humidity, light, air temperature, CO₂, solar energy detector, and numerous others. Installed throughout the fields, in the IoT- grounded monitoring systems, on smart husbandry vehicles and rainfall stations, detectors continuously collect data and bring visibility and control into husbandry operations. The combination of data coming from different detectors allows growers to make crop models and prognosticate how crops will grow in the given conditions, integrate perfect husbandry practices, produce harvesting strategies, etc.
- ✚ **Gyroscope and image:** Gyroscope and image detectors are extensively used in robots, independent vehicles, and drones for field health monitoring, geo-mapping and land analytics, independent irrigation, and crop fertilization.
- ✚ **Near Infra-Red And EC:** This movable soil scanner uses near-infrared and EC seeing for real-time soil diagnostics and recommendations on ground fertilizing and

treatment. IoT agriculture detectors used by the scanner shoot information to the data processing center, which sends the perceptivity right to the planter's phone.

- ✚ **Humidity and temperature:** These detectors give automated humidity, temperature, and EC monitoring and enable effective and waste less irrigation. This is also a good illustration of how using IoT in husbandry can reduce water consumption.
- ✚ Precision Agriculture (Remote Sensing).
- ✚ Crop Monitoring.
- ✚ Weather Conditions.
- ✚ Soil and Water Quality.
- ✚ Irrigation Monitoring.
- ✚ Data Analysis.

Benefits of IoT in husbandry

- ✚ **Bettered effectiveness:** Moment's husbandry is in a race. Growers have to grow more product in deteriorating soil, declining land vacuity, and adding rainfall change. IoT- enabled husbandry allows growers to cover their products and conditions in real-time. They get perceptivity presto, can prognosticate issues before they are, and make informed opinions on how to avoid them. Also, IoT results in husbandry introduce robotization, for illustration, demand-grounded irrigation, fertilizing, and robot harvesting.
- ✚ **Expansion:** IoT- grounded glasshouses and hydroponic systems enable a short food force chain and should be suitable to feed these people with fresh fruits and veggies. Smart closed-cycle agrarian systems allow growing food principally everyplace—by supermarkets, on towers' walls and rooftops, in shipping holders, and, of course, in the comfort of everyone's home.
- ✚ **Reduced coffers:** The plenitude of Ag.IoT results are concentrated on optimizing the use of coffers — water, energy, land. Precision husbandry using IoT relies on the data collected from different detectors in the field which helps growers directly allocate just enough coffers to within one factory.
- ✚ **Cleaner process:** Smart Husbandry using IoT is a true way to reduce the operation of fungicides and diseases. Not only does perfection husbandry help directors save water and energy and make tilling greener but also significantly scales down on the use of

fungicides and toxins. This approach allows getting a cleaner and further organic final product compared to traditional agrarian styles.

- ✚ **Dexterity:** One of the benefits of using IoT in husbandry is the increased dexterity of the processes. Thanks to real-time monitoring and vaticination systems, growers can snappily respond to any significant change in rainfall, moisture, air quality as well as the health of each crop or soil in the field. In the conditions of extreme rainfall changes, new capabilities help husbandry professionals save the crops.
- ✚ **Bettered product quality:** Data-driven husbandry helps both grow more and more products. Using soil and crop detectors, upstanding drone monitoring, and ranch mapping, growers more understand detailed dependencies between the conditions and the quality of the crops. Using connected systems, they can recreate stylish conditions and increase the nutritive value of the products.
- ✚ **IoT challenges in husbandry:** Smart husbandry systems using IoT and big data technology could be the rescuer for the whole assiduity. But integrating technology in traditional agrarian processes has not been without its own problems.
- ✚ **Connectivity:** You need to give connectivity throughout the agrarian terrain — fields, warehouses, barns, glasshouses, etc. to make an IoT system work. And this is a lot of space to work with. Immaculately, it should also be a dependable continued connection that could repel severe rainfall events and open space conditions. Unfortunately, the connectivity still poses a problem on the Internet of Effects in general, as different systems use different protocols and data transmission styles. Hopefully, attempts to regulate this area, introduce norms as well as the development of 5G technology and the space-grounded Internet can soon break this problem and give fast and dependable Internet connection for every space anyhow of its size and conditions.

Conclusion

The focus on smarter, better, and more efficient crop growing methodologies is required in order to meet the growing food demand of the increasing world population in the face of the ever-shrinking arable land. The development of new methods of improving crop yield and handling, one can readily see currently: technology-weaned, innovative younger people adopting farming as a profession, agriculture as a means for independence from fossil



fuels, tracking the crop growth, safety and nutrition labelling, partnerships between growers, suppliers, and retailers and buyers. This paper considered all these aspects and highlighted the role of various technologies, especially IoT, in order to make Agriculture smarter and more efficient to meet future expectations. For this purpose, wireless sensors, UAVs, Cloud-computing, communication technologies are discussed thoroughly. Furthermore, a deeper insight into recent research efforts is provided. In addition, various IoT-based architectures and platforms are provided with respect to agriculture applications. A summary of current challenges facing the industry and future expectations are listed to provide guidance to researchers and engineers.

