SMART AGRICULTURE USING INTERNET OF THINGS (IoT)

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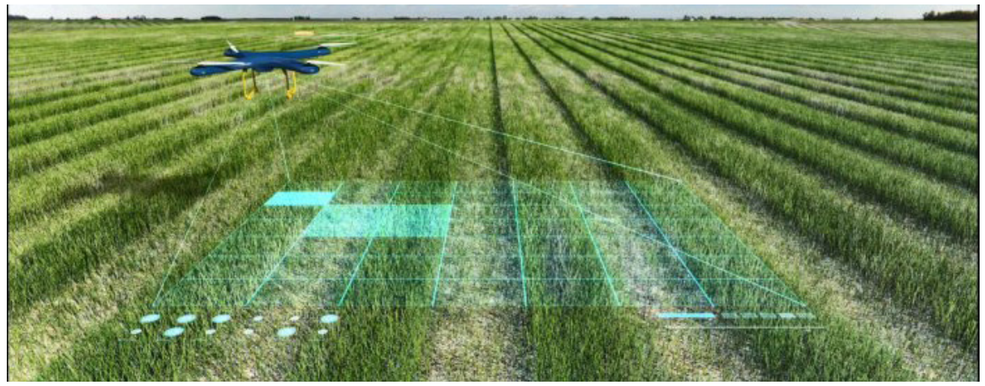
With the world's population growing at an exponential rate, the UN Food and Agriculture Organization estimates that the world will need to produce 70% more food by 2050, shrinking agricultural lands, and depletion of natural resources, the need to increase farm yield has become critical. The scarcity of natural resources such as fresh water and arable land, combined with slow yield trends with respect to several crops, has exacerbated the problem. Another reason of concern in the Indian agriculture is the changing composition of the agricultural workforce. Furthermore, agricultural labour has declined in the majority of countries. As the agricultural workforce declines, the adoption of smart agriculture using internet connectivity solutions in farming practises has been triggered in order to reduce the need for manual labour without affecting the productivity in agriculture. Smart agriculture is an emerging approach which includes communication technologies, information, IoT-enabled sensors, automation, and predictive analysis to increase the number of crops grown in a year. With the continuous advancement of technology as a potential innovation, IoT is on its way to becoming a ubiquitous global computing network where everyone and everything will be connected to the internet. ITU (International Telecommunication Union) defined the Internet of things as a technology that mainly resolves the interconnection between human to a thing, thing to thing, and human to human. Intelligent sensors, RFID (radio-frequency identification), GPS (global positioning systems), infrared sensors, remote sensing, mobile communication, and other communication networks are the build-up for the IoT. The primary goal of IoT is to create a network by combining various sensor devices such as GPS, RS, RFID, laser scanners, and networks to comprehend the information sharing of global things. IoT encompasses millions of networked embedded smarts devices that are capable of accumulating information about themselves, their environment, and associated smart devices and connecting this information to other devices and systems via the Internet. A wide range of sensors are used in agriculture, including soil moisture sensors, water-level sensors, equipment used to sample the state of the atmosphere at a given time, meteorological sensors (monitors the current state of the atmosphere), heavy metal detection sensors, biosensors (detection of an analyte), gas sensors (detects the presence of gas), etc. Farmers can adopt IoT to effectively use fertilisers and other resources for increasing the quality and quantity of their crops. Farmers cannot be physically present in the field 24 hours a day. Besides that, farmers may lack the knowledge to use various tools to determine the ideal environmental conditions for their crops. IoT provides them with an automated system that can function without human supervision and can notify them to make appropriate decisions to deal with various types of problems they may encounter while farming. It can reach and notify the farmer even when the farmer is not in the field, allowing the farmer to manage more farmland and increase their production.



AREAS OF APPLICATION OF IoT IN AGRICULTURE:

There are four broad areas of application of IoT in agriculture viz. Sensing & Monitoring, Analysis & Planning, Control & Automation, and Logistics & Traceability.

1. Sensing & Monitoring:
- Moisture stress
- Soil health and quality
- Plant growth and health
- Pest infestation and disease
- Weather conditions
- Livestock movement and health

2. Analysis & planning
- Yield estimation
- Irrigation scheduling
- Agronomic operations
- Crop cycle planning
- Livestock medication

3. Control & Automation
- Irrigation automation
- Variable rate application
- Agriculture robotics
- Hydroponics and aeroponics
- Herd management

4. Logistics & Traceability
- Counterfeit protection
- Food fraud prevention
- Food safety and quality assurance
- Compliance and certification
- Food waste reduction
- Efficient food movement

IoT TRANSFORMING THE FUTURE OF AGRICULTURE:

1. **Sensors:** IoT sensor data provides a real-time picture of what is happening in the field. Farmers will be able to determine the maturity of crop, time and amount of irrigation requirement, soil health and fertilizer application or any other input required for the farming.
2. **Drones:** Drones also known as unmanned aerial vehicles (UAV) is a flying robot that does not need human operator and can be controlled remotely. Farmers can use drones to help them with crop surveying, soil/land analysis, livestock tracking, and monitoring.
3. **Smart Greenhouses:** A smart greenhouse designed with the help of IoT intelligently monitors as well as controls the climate, eliminating the need for manual intervention.
4. **Livestock tracking:** Farm owners can use wireless IoT applications to collect data on their cattle's location, well-being, and health. This information aids in disease prevention and reduces labour costs. IoT agriculture sensors can be attached to the farm animals to get details around their health, temperature, grazing pattern, activity, and nutritional levels.

CONCLUSION:

The use of IoT can enable farmers to practice smart farming as farmers can spend less time in the fields while increasing crop yields with smart farming. IoT applications helps in collecting meaningful data that can be used to increase efficiency in the field but its understanding is important to realize the potential of IoT-based smart farming and implement IoT solutions profitably.