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Smart Agriculture using Internet of Things (IoT) for sustainable agriculture

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Introduction

Agriculture is a key pillar of any country's economy, significantly contributing to GDP and driving economic growth. In the current era, developing nations like India face a rapid surge in population, creating a pressing need to adopt innovative agricultural technologies to enhance food production and meet growing demands. Additionally, climate change poses significant challenges, leading to reduced agricultural yields and threatening food security.

Smart agriculture, powered by the Internet of Things (IoT), is transforming traditional farming by integrating advanced technologies to improve efficiency, productivity, and sustainability. IoT in agriculture relies on key components such as sensors and devices, cloud platforms, data analytics, drone technology, and automated systems. Sensors and devices facilitate site-specific management practices tailored to crop needs. Essential resources like water, fertilizers, and pesticides can be applied precisely based on real-time requirements, minimizing waste and reducing environmental impacts. IoT systems also enable timely pest and disease management by signaling their occurrence, reducing dependency on chemical inputs and lowering production costs(Alatise and Hancke,2020).

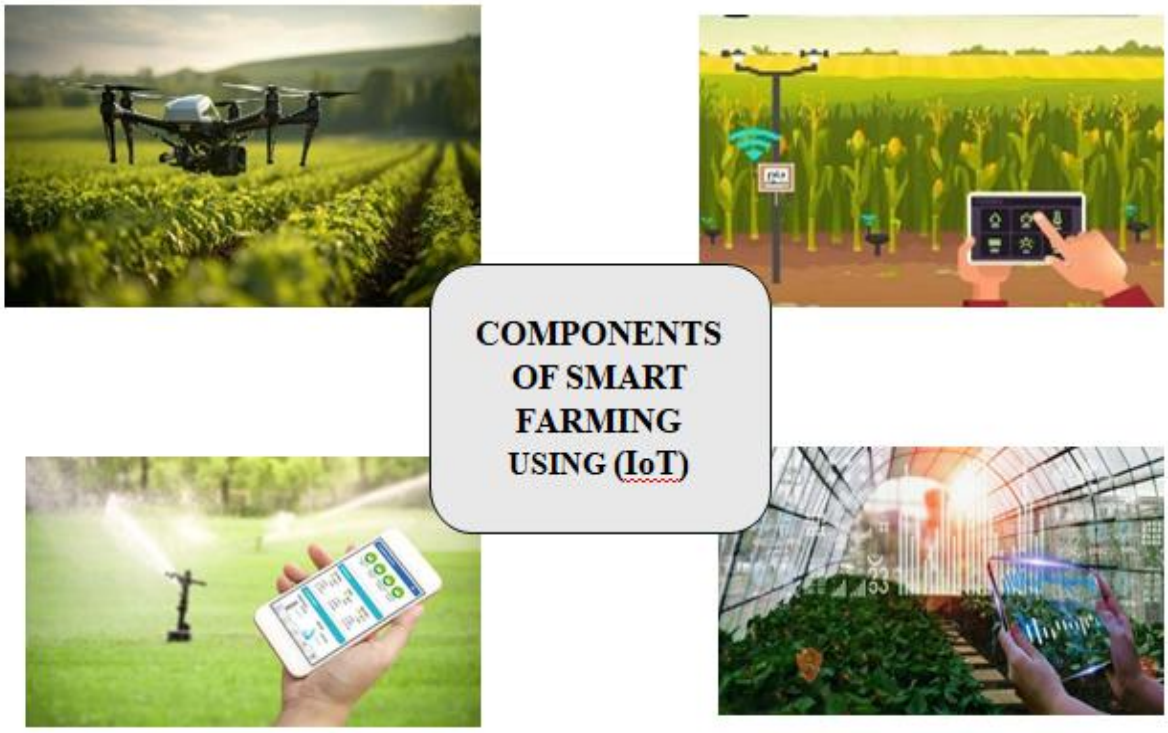
Components

Cloud platforms consolidate diverse data, providing farmers with actionable insights for better decision-making regarding cropping patterns and management practices. Data analytics harness these insights to predict crop diseases, pest infestations, and irrigation needs. Drones enhance precision farming by assisting in planting, spraying, and harvesting activities. IoT technology eliminates the requirement for manual interventions. It has created a system that can design a smart greenhouse capable of monitoring and automatically controlling the environmental parameters required for the crop's growth. It makes a cloud server that provides remote access to the intelligent greenhouse along with control option(Haseeb et. al, 2020).

Applications

The applications of IoT in agriculture are diverse, including precision farming, smart irrigation, livestock monitoring, supply chain management, and crop health monitoring. Precision farming uses technology-driven approaches to analyze and manage field variability, ensuring that agricultural practices are executed at the right place, time, and method to maximize profitability, sustainability, and land resource conservation. IoT-enabled irrigation systems adjust water supply based on soil moisture levels and weather forecasts, optimizing water use. Additionally, IoT devices provide real-time

tracking of perishable agricultural produce from farm to market, ensuring quality, reducing waste, and increasing farmer income (Tripathy *et. al*., 2021.)



Merits and Demerits

By enhancing productivity and promoting efficient resource utilization, IoT can mitigate risks associated with weather changes, pests and diseases in agriculture. However, challenges such as high initial costs, lack of reliable internet in rural areas, and the need for technical skills hinder its widespread adoption among farmers in developing countries. Addressing these barriers will be essential to unlock the full potential of IoT in agriculture.

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