


Chapter 8


Green Intelligence in Agriculture: Integrating AI-Driven Irrigation, Energy Management, and Sustainability for Eco- Smart Farming System

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ABSTRACT

The integration of AI and IoT is transforming autonomous systems, enabling data-driven solutions in industries like precision farming, smart irrigation, utility maintenance, healthcare, manufacturing, and transportation. This work presents a framework explaining AI-powered IoT networks and their role in industrial automation. It highlights AI techniques like machine learning and real-time analytics to enhance efficiency. The research examines challenges in AI-IoT integration, such as energy management, security, interoperability, infrastructure limits, and data privacy. Implementation examples show how these technologies transform smart cities and industries, improving decision-making and adaptability. It also explores the societal and ethical impacts of AI-driven innovation, emphasizing fairness and sustainability. Additionally, the text outlines future directions in emerging agricul-

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ture technologies, and government policies in farming. By fostering collaboration, it provides insights for experts and engineers, equipping them with tools to develop efficient AI-driven frameworks.

1. INTRODUCTION

Combined with accurate agricultural and smart irrigation techniques, the transformed agriculture turned into the one founded on the usage of the Internet of Things (IOT), Artificial Intelligence (AI) and Geographical Information System and Sensor-based automation. The new technologies do co-exist with providing farmers with a larger resource management capacity which translates into increase in crop yields and a lesser amount of environmental impact. The basic element of accurate farming known as smart irrigation provides efficient water distribution through real-time data analysis used for automated systems and accurate water distribution. The effective energy consumption management system proves necessary to achieve optimal efficiency along with stability in these systems. Power optimization techniques and artificial intelligence analytics platforms are included in the energy management systems of accurate farming with smart irrigation systems and renewable power systems are included. Specific cultivation practices consume vital amounts of energy that translate to high expenses and acute ecological damage. The combination of solar-powered irrigation systems with smart grid technology enables farmers to reduce their energy waste by increasing their productivity levels. An introduction explains why proper energy management is essential in accurate farming with smart irrigation systems as well as the future approach in agricultural stability as well as a fundamental approach to stability (Raliya, 2024).

1.1 Definition of Precision Farming and Smart Irrigation

Precision Farming is an advanced agricultural approach that uses technology to increase agricultural management to increase resource usage and increasing efficiency. This includes applications of devices such as GPS, IOT, drone and AI-operated data analytics for monitoring and management of field variability in crops, soil and climatic conditions. By enabling farmers to make data-operating decisions, accurate farming helps improve crop yields, reduce input costs and reduce environmental effects through efficient use of water, fertilizers and pesticides.

Smart Irrigation refers to an automatic and technology-operated irrigation system that optimizes the use of water based on real-time data, weather conditions and soil moisture levels. Unlike traditional irrigation methods, smart irrigation uses IOT sensor, AI algorithms and remote-controlled systems, when crops to ensure precise

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