A REVIEW APPROACH OF IOT ENABLED SMART AGRICULTURE 5.0: SUSTAINIOT-5.0

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ABSTRACT

The evolution of agriculture in the modern era presents a significant challenge, with food safety and healthy food being primary concern of the society. Integrating technologies into these critical domains improves crop quality and achieves greater sustainability. The Internet of Things (IoT), combined with advanced technology, drives the transition to the fifth generation of farming- Smart Agriculture 5.0. By merging cognitive decision-making with human-machine collaboration, Smart Agriculture 5.0 signifies a transformative shift toward resilient, intelligent, and sustainable agricultural systems. This paper presents a comprehensive study identifying current research gaps and highlighting the advantages of a proposed advanced architecture aimed at developing a more efficient and user-friendly agricultural ecosystem. The focus of this design is to integrate the capabilities of IoT and Machine Learning with emerging computing paradigms to support the future of agricultural practices. The proposed architecture, SustainIoT-5.0, consist of five core layers— Perception, Network, Data Processing, Application, and Management & Governance— to enhance crop quality and promote long-term sustainability. The goal is to provide a future-ready framework that ensures efficient utilization of resources within the evolving smart agriculture landscape. In order to fill the identified research gaps, this study suggests a five-tier architecture called SustainIoT-5.0 based on the review's findings.

Keywords: *Internet of Things (IoT), Smart Agriculture, Agriculture 5.0.*

1. INTRODUCTION

The issue of food production in the twenty-first century becomes increasingly critical as the global population continues to grow. By 2050, between 9.4 to 10.1 billion people are expected to depend on planet biodiversity for survival [1]. Sustainable agriculture offers a way to enhance farming efficiency while protecting the environment and safeguarding the essential needs of future generations. Crop rotation is one of smart farming's key contribution to sustainable agriculture [2]. The concept of Internet of Things (IoT) gains popularity in 1999 through the work of the Auto-ID Centre at MIT and its related market research [3]. The IoT refers to a network of interconnected smart devices that enables real-time data sensing, collection, processing, and communication over the Internet. Mini solar panels provide the minimal power required to operate an IoT based system, making it functional even in areas lacking conventional electricity or village infrastructure [4]. Initially, researchers used Information and communication technology (ICT) based techniques in agricultural field with moderate success. Currently researchers explore IoT technology as a more advance alternative in agriculture [5]. This evolving concept often known as smart farming- also termed as agriculture 4.0" or "5.0,"- integrates Big Data analytics, Cloud Computing, Wireless Sensor Networks, Artificial Intelligence, Machine Learning and the IoT into modern farming practices.

This study presents a layered architectural review for Smart Agriculture 5.0, known as SustainIoT-5.0, which methodically incorporates digital technology into contemporary farming. The goal of the architecture is to provide a thorough framework that enables intelligent and sustainable agricultural