A comprehensive review of internet of things and cutting-edge technologies empowering smart farming

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The agricultural sector plays an important role in contributing significantly to the gross domestic product (GDP) growth in developing countries. On the other hand, agriculture is widely affected by major factors such as environmental changes, natural disasters, pesticide control, and soil and irrigation-related issues, which reduce crop yield. The convergence of Industry 4.0 and agriculture offers an opportunity to move into the next generation of Agriculture 4.0. The internet of things (IoT), remote sensing, machine learning, deep learning, big data, cloud computing, thermal imaging, end-user apps and unmanned aerial vehicles offer a full-stack solution. IoT provides the ubiquitous connectivity of smart devices to the internet to collect, process and analyse a large amount of agriculture field data more quickly and synthesize them to make smart decisions using various machine learning and deep learning algorithms. This study reviews the challenges and major issues in the IoT agriculture domain and explores its emergence with new technologies. It covers the existing literature and illustrates how IoT application-based precision agriculture solutions have contributed. A case study on weed detection for smart agriculture using the YOLOv5 model is presented, achieving high accuracy. Finally, various IoT agriculture use cases are discussed, along with current research issues and possible solutions for future IoT-based agriculture advancement.

Keywords: Cutting-edge technologies, internet of things, precision farming, smart agriculture, weed detection.

changes in the previous several decades in terms of its methods and use of contemporary strategies together with cutting-edge technology. However, conventional farming methods are region-centric in many nations. All farmers in a region cultivate the same general set of crops according to the same practices for sowing, nurturing, watering and harvesting times. These actions lead to unpredictability, excessive resource utilization and unchecked waste creation. Some of the challenges faced by the agricultural sector are: (i) lack of sufficient knowledge and standard practices of the latest framing trends. (ii) For the timely operation of crops, labour shortage and high labour charges are the main problems. (iii) Deficiency of soil nutrients occurs due to the same crop pattern followed after each harvest in a certain area-centric approach. (iv) Overuse of fertilizers, insecticides and pesticides with premature or delayed treatment of crops in traditional farming techniques. (v) Crop yield degradation due to depletion of the topsoil layer, environmental changes and unpredictable atmospheric effects. Numerous studies have focused on addressing the challenges that the agriculture industry faces in the realm of internet of things (IoT)[2]. The collection and analysis of data, coupled with the development of specialized smart solutions, will be crucial to the future of agriculture. State-of-the-art IoT technology properly plans limited resources and optimizes IoT to increase productivity and reduce costs[3]. Crop productivity is influenced by many factors, including environmental monitoring, field management, soil and crop monitoring, movement of an