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Review

A survey on the 5G network and its impact on agriculture: Challenges and opportunities

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ABSTRACT

Over the next decade, the superfast 5G network will play a critical role in farming industries to improve the yields and quality of crops while using minimal labor. Smart and precision farming allows farmers to be more informed and productive. The advent of 5G will considerably change the nature of jobs in farming and agriculture. The internet of things (IoT)-based cloud computing service in the 5G network provides flexible and efficient solutions for smart farming. This will allow the automated operation of various unmanned agricultural machines for the plowing, planting, and management phases of crop farming and will ultimately achieve secure, reliable, environmentally friendly, and energy-efficient operations and enable unmanned farms. This paper provides a complete survey on 5G technology in the agricultural sector and discusses the need for and role of smart and precision farming; benefits of 5G; applications of 5G in precision farming such as real-time monitoring, virtual consultation and predictive maintenance, data analytics and cloud repositories; and future prospects.

1. Introduction

Agriculture is the primary source of livelihood and plays a vital role in most countries' economies. Agriculture is not only associated with crop production but also includes animal breeding and land cultivation to offer food, fiber, and medicine. Different types of agriculture are practiced in different regions across the world, focusing primarily on providing healthy food to feed the population worldwide. Agriculture is the main source of income for developing countries. It ensures food security for a country and produces material for industry. Modern farming started approximately in the 18th century, referred to as the British Agricultural Revolution, when in a short period, many improvements were made to farming, leading to a major yield increase and more efficient methods. A four-field system and selective cross-breeding program were implemented to increase crop size as well as yields, replacing the three-field crop rotation system. The first subsequent revolution in agriculture took place between 1900 and the 1930s, when mechanized agriculture allowed each farmer to produce enough for 26 people. This agricultural revolution brought techniques such as soil management and the advent of various new farming tools. After many decades, a second revolution, known as the Green Revolution, took place in the 1990s. Genetically modified crops that are pest resistant and need less water were introduced with the help of scientific advancements, allowing each farmer to feed 155 people. The second revolution promoted the use of mechanized tools in farming practices, increasing the rate of production as well as the quantity of crop yield. The third revolution, also described as a green revolution, was the phase when genetically modified crops began to be used by almost everyone, leading to greater produce output.

With the rapid growth in the world population (World Population Clock, 2020), as shown in Fig. 1, food production worldwide has to be increased rapidly. An enormous demand has to be served cost-effectively without wasting resources such as water and electricity. Food losses (Dora et al., 2020; Lipinski et al., 2016) during food production account for 32% in developing economies. Conventional farming practices lead to erratic production, overutilization of resources, and unrestrained production of wastes. To meet those demands, farmers need more sophisticated technology to produce more from limited labor and land. This is where automation comes in.

The smart farming/agriculture (Grogan, 2012) concept using modern technology is the solution to increase the quantity and quality of agricultural products with minimal loss and labor. Precision farming and

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