Chapter 9
Intelligent Farming Utilizing a Soil Tracking Device

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ABSTRACT

In order to optimize resource use, having information that is both up to date and accurate is vital. Agriculture utilizes sensors to determine the nutrients, moisture, organic matter, and clay present in the soil. To connect sensors that are positioned in a variety of locations, several technologies are used. Even in the absence of an internet connection, its data will automatically be uploaded to the cloud. Sensors transmit data to adjacent local base stations at varied distances using WiFi, LPWAN, LoRa, and Bluetooth, among other technologies, before transferring it to a distant central base station (CBS). Maintaining the integrity of the signal requires line of sight, coding, and modulation. The data collected by CBS is uploaded to the cloud so that it may be analyzed for trends and visualized. Farmers will now be able to get frequent and up-to-date information without needing to physically be present at the event.

INTRODUCTION

The current global population of 6.9 billion people is anticipated to reach 8.7 billion by the year 2050, which is a significant rise from the number in 2016. As a consequence of a rise in affluence, individuals are increasing the amount of protein that they consume in their diets. A research conducted by the Food and Agriculture Organization of the United Nations (FAO) found that agricultural producers should increase their production by a factor of 65% over what it now is. Food producers need to boost their production in order to meet the demands of a growing global population. As a result of the expansion in population, there will be a demand for food that is almost fifty percent more than it was in 2013. It is anticipated that the rise of urbanization will continue (Mall, P. K. et al., 2023) to add another 2.4 billion people who reside in urban regions. Even though there is a rising need for food, the number of people living in rural areas is decreasing due to increasing urbanization. This leads to a decrease in the number of individuals who work in agriculture. In addition, the population of rural areas is rapidly aging,

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which will lead to a significant lack of available labor in the not too distant future. As a consequence of population growth and urbanization, agriculture on a global scale is becoming unsustainable, and already 25 percent of the world's arable land is ruined. It is estimated that close to forty percent of the world's rural population has water scarcity problems, which is evidence that water resources are already being used to their fullest capacity. In order to boost output, imbalanced fertilizers are used, which has a negative impact on the quantity of nutrients in the soil. Nitrogen (N), phosphorus (P), and potassium (K) are the primary nutrients found in soil; the others, such as iron, manganese, zinc, boron, and chlorine, are considered to be of a lower importance. The correct proportions of these nutrients are critical to the growth of the plant and the production of high-quality fruit and vegetables. Macronutrients like nitrogen are responsible for the production of amino acids, whilst phosphorus and potassium contribute to the expansion of plant growth, the process of photosynthesis, and resistance to disease. The fertility of the soil is diminished as a consequence of inefficient watering practices, an application of fertilizer that is out of balance, and a lack of awareness of the precise nutritional requirements of a particular crop. Traditional agricultural practices are being modified in response to changes brought about by scientific and technological progress. The advancement of technology in agricultural production helps to meet the actual requirements of consumers while also preserving the delicate equilibrium that exists between the supply and demand of food. The way that current farms and agricultural operations are run is distinct from their historical counterparts as a direct result of developments in automation. These developments include sensors, gadgets, equipment, information technology, and speedy transmission networks. Technologies such as GPS (Samanta, D. et al., 2021), robots (Alam, A., 2022), sensors (Alam, A., 2022), and aerial pictures are all used. Farmers are able to make more effective use of water, fertilizer, and other resources with the assistance of modern technologies. As a result of technical improvements, bigger and smaller farmlands are merging and becoming more interconnected than in previous decades, which are expected to result in an increase in both the productivity of agriculture and the efficiency with which it is carried out. It is essential to gather data in order to recognize patterns, and it is estimated that there will be 4 million more data points than on a regular farm. The Internet of Things allows the analysis of both structured and unstructured data (Reepu, S. Kumar, et. al., 2023) in order to give more information on the production of food (Kumari, M., et. al., 2022). According to Ghosh, R. et al.'s 2020 research, IoT platforms are transforming agricultural frameworks into real AI frameworks by using machine learning, AI, and other types of AI to data collected from field sensors. Studying and combining data on the weather, seeds, soil, disease probability, and insect attacks might help farmers make better judgements.

Observation of the Soil and the Characteristics of the Soil

The soil is the primary component that supports the food web. The upkeep of the soil is an essential component in ensuring the continuity and safety of the food supply. It is a significant natural deposit, yet most people don't realize how essential it is. The composition and personality of the soil is influenced by a variety of factors, including the parent material, age, climate, animals and plants that eat the soil, as well as changes in location. Minerals, water, organic matter that has decomposed, air, and microorganisms that are still alive are the fundamental components of soil.

The function of the land may sometimes cause the composition of the soil to shift. For instance, agricultural soil consists of between 20 and 30 percent air, 45 percent minerals, 5 percent organic material, and the same amount of water. In addition, the exact composition is affected by a variety of elements, including the kind of crop grown, the terrain, the temperature, and the humidity, among other things.