

IoT-Based Smart Agriculture: A Survey

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Abstract - Agriculture is one of the important things that decide the economy of the country. Because of the advancement of technology, the IoT plays a significant part in increasing food or agricultural productivity. This paper discusses about various smart agriculture system, implementation of smart agriculture system, enabling technologies and advantages of Smart Agriculture (SA). The fundamental goal of SA is to use technology such as IoT, robotics, sensors, and location monitoring devices, as well as artificial intelligence. The final goal is to increase the agriculture products in terms of quality as well as quantity. The advantages of smart agriculture are utilizing the water and fertilizer appropriately; increase the crop yield, etc.

Keywords- Crop yield, Internet of Things, Artificial Intelligence, Smart Agriculture.

I. INTRODUCTION

Agriculture and its needs are extremely difficult to meet in the modern era. Agriculture is a heart of every nation's economy especially in India. Also, the major part the people lives and survives through agriculture [1]. The report says

that farmer suicides rates in every year up to 40%. It is due to the poor rain and climate conditions. In India, the farmers are facing the severe scarcity and drought. To overcome these issues, IoT is a suitable technology to increase the crop yield and agriculture productivity. The IoT is a technology that is connected various sensors through Internet [2-4]. Fig.1 shows the Smart architecture components.

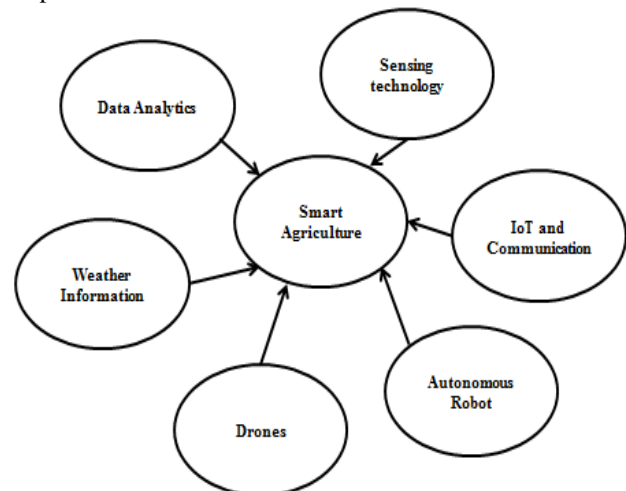


FIG.1 SMART ARCHITECTURE COMPONENTS.

Smart agriculture is a farming management using recent technologies to increase the quantity of the agricultural crops. In the 21st century, farmers access the soil scanning, IoT and GPS. The aim of smart farming is to make decision making support for the farm land. The smart farming focuses on the factors such as population growth, man power and climate change, etc [5-7]. The smart irrigation block diagram is shown in Fig. 2.

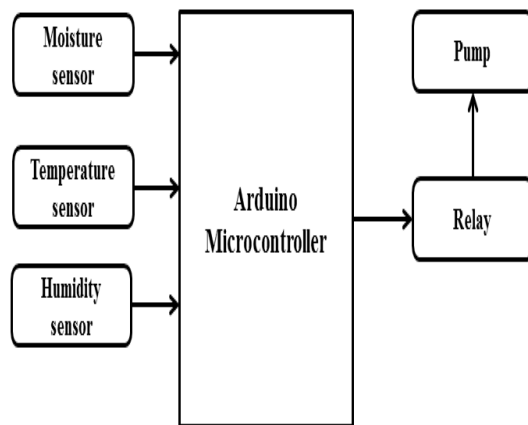


FIGURE. 2 SMART IRRIGATION BLOCK DIAGRAM.

In smart agriculture, the problem statement is to provide the decision support system that handles the different farm related activities such as moisture, humidity and temperature in the soil. In agriculture, the weather condition increases the water usage. So, the water level is managed either manually or automatically by the farmers in their farmland. Hence, the smart agriculture is a right technology that reduces more time consumption [8].

The following is the structure of the paper: Section 2 highlights the different smart agricultural solutions that are now available. System 3 provides the conclusion of the smart agriculture.

II. VARIOUS IOT BASED SMART AGRICULTURE

Cicioglu and Calhan [9] proposed IoT based smart agriculture in corn field. The primary aim of this work is to increase more amount of corn harvestment in the large scale farm field. For this application, it uses heterogeneous network that able to sense wind, pH value, light intensity, temperature, etc. Actually, all the sensor nodes form clusters. In each clusters, one node acts as coordinator node and remaining all the nodes act as members in the cluster. The data is then sent to the drone, which acts as a relay node, by all of the coordinating nodes. Finally, the relay node can exchange the data to sink. Therefore, this type of

communication can cover large scale network and achieve the farm production effectively.

A potential IoT-based irrigation system for agricultural was developed by Bhanu et al. [10]. IoT is an connected networking devices that exchange the data over Internet and establishes the communication without human involvement. This work is considered the parameters, namely soil type and moisture, temperature, oxygen, light intensity, nutrients, etc. This work is collected all the above mentioned parameters through sensors and exchange the data to the cloud. Later, this system performs the decision making using the parameters from the cloud storage. The proposed system is implemented using ThinkSpeak and it is provided the better performance than traditional agriculture process.

All microcontroller units collect the values of the environment and transfer them to a cloud storage system for storage and retrieval [11]. The user can view all the farm environment data can be viewed through mobile application. Based on the reading, the farmers can take necessary actions in the agriculture fields. Therefore, it improves the agriculture food productivity and utilizes the resources optimal way.

Badhe et al. [12] proposed smart agriculture and soil nutrition detection system. The technology based agriculture provides the more productivity. The cultivation is difficult without knowing the soil condition. Thus, it causes the financial losses to the farmers. This work is used various sensors, namely temperature, light intensity, moisture level, pH value and humidity. The MCP3204 receives the sensor values that are sent to it. Finally, the data is delivered to the cloud through a Raspberry Pi, which is powered by a rechargeable lithium-ion battery. Finally, the farmers can view the sensor readings through mobile application or web application. Therefore, the farmers get benefit in terms of agriculture product production using modern technologies.

The smart farm management system developed by Sekaran et al. [13] is based on the IoT. The adaptation of IoT in agriculture provides various benefits in terms of managing the crop and monitoring the crop. This paper proposed an architectural framework in IoT with agriculture field. Thus, it increases the crop yield and monitors the crop using cloud storage. It provides the real time analysis of the collected from the agriculture field and the farmers can take appropriate action in the field. This system is comprised of sensors, which measure temperature, humid, moisture levels, and water usage. Sensors capture data, which is then stored in the cloud. Thus, this system improves the productivity of the crop in the agricultural field.

A smart irrigation system based on IoT technology and machine learning algorithms was proposed by Goap et al. [14]. The IoT based smart irrigation technology assists farmers in achieving optimal water usage. This work is proposed machine learning algorithms to predict the



irrigation requirements using the sensors, namely temperature, moisture and environmental conditions, etc. Here, the sensor nodes are deployed on the farm land. The nodes then form a cluster, and all of the nodes transfer data to a single CH, also known as a coordinator. This system is predicted the water requirement and actuate the actuators accordingly in the farmland.

The smart agricultural monitoring system presented by Rajakumar et al. [15]. Agriculture is one of the huge livelihood providers in India. The agriculture consumes 83% of water in India. So, effective usage of water resource most needed. This work proposed a automatic plant irrigation system with Arduino. The process of this system is to provide the water automatically the plants based on the soil moisture. All the sensor readings are stored to cloud storage. Whenever the user or farmer requires the status of the farm land, they can view through either mobile application or web application.

Atmaja et al. [16] proposed a smart agriculture using WSN and IoT. This work focus on the communication system of smart agriculture. Basically, the sensors generate the data and exchange the data using WSN. The collected data from various sensor nodes are stored in cloud storage. The farmer can view the sensor readings through mobile application. They can see the sensor readings, namely pH value, moisture value, etc. Also, this system is attached the actuator such as solenoid valve. Based on the sensor readings, the valve will be opened or closed. This system is provided 100% of success rate. Thus, it is effectively utilized water resources.

Sushanth and Sujatha [17] proposed smart agriculture system using IoT. This work designed a good agricultural system that makes use of cutting-edge technology such as Arduino, the IoT, cloud computing and WSN. This system uses the sensors, namely temperature, moisture, movement of the animals and humidity. Based on the sensor readings, this system send the SMS alert like moisture level is low, animal is moving, etc. The farmers get the alert either SMS or mobile application. In the mobile application, the farmers can view all the sensor readings.

Sivabalan et al. [18] proposed Effective utilization of water and energy in smart agriculture using IoT. Water is a precious resource in the world. The non-renewable resource is getting exhausted due to the over population. According to a report, agriculture and industry consume up to 55% of all freshwater resources worldwide. This paper proposed a new suitable method to utilize the resource appropriately and at the same time we should get more agriculture productivity. This work is used Raspberry pi for its implementation. The microprocessors control the sensors and actuators. Based on the sensor readings, the water resources are used optimally. Thus, it increases agriculture productivity.

Sidhanth Kamath et al. [19] proposed IoT based smart agriculture. The modern technology is providing the solution for monitoring and controlling but it is not providing prediction of the best crop for the particular farm land. This paper proposed low cost IoT based smart agricultural system that predicts the best crop based on the sensor readings. This work is used the sensors, namely humidity and soil moisture sensors. Based on the sensor readings, this system suggests the best crop for the particular farm land.

Tapakire and Patil [20] proposed smart agriculture using Thingspeak. Agriculture is one of the major developing and survival sector. The challenges in agricultures are crop yield, nutrition level, and crop monitoring and irrigation system. The work used the components are raspberry pi, sensors, camera and motors. Raspberry pi is a microprocessor and it is a controlling unit for various sensors and actuators. The soil is managed in accordance with the findings from it. The readings from the soil moisture sensors are afterwards saved in the cloud storage system. Camera is used to provide the live streaming of the farm land. The sensor reading can be viewed in ThingSpeak.

Karthikeyan et al. [21] proposed moisture control and temperature monitoring using IoT. The IoT is a new technology that makes a revolution in all fields to enhance the lifestyle of the human. In smart farming, the devices like micro controller, sensors and communication module plays a important role. This paper proposed the IoT based smart agriculture that performs the real data analysis like temperature and moisture and it is stored to cloud storage. The live data is stored in ThinkSpeak. The farmers can be viewed the sensor readings from the farm land.

IoT and machine learning have been proposed by Reddy et al. [22] as part of a smart agricultural system. Agriculture is an important sector in India because it balances both requirements of food and employability of the people. The modern techniques increase the crop yield gradually. So, the proposed smart irrigation system predicts the water requirement of the particular crop in the field using machine learning. The water requirement is decided by these three parameters, namely temperature, humidity and moisture. Microprocessors, sensors for temperature, humidity, and moisture are included in the proposed system. The microprocessor collects the data and stored it to cloud storage. The decision tree forecasts irrigation requirements in farmland.

V. CONCLUSION

Agriculture is one of the important things that decide the economy of the country. Due to the rapid advancement of technology, the IoT has a significant impact on food and agricultural productivity. This paper discussed about various



smart agriculture system, implementation of smart agriculture system, enabling technologies and advantages of smart agriculture. Robots, sensors, location-tracking systems, and artificial intelligence (AI) are some of the technologies that will be used in smart agriculture. Thus, it increases the food and agriculture productivity.

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