Internet of Things: Towards Smart Agriculture

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Abstract— Advances in new technologies in this modern age have led to the miniaturization of sensors and efforts to use them in various fields have been successful. Furthermore, the Internet of Things (IoT) and cloud computing in any area lead to the concept of "smart" such as Smart Healthcare Systems, Smart Cities, Smart Mobility, Smart Grid, Smart Home and Smart Metering. One such research area that has seen this adoption is agriculture and thus a smart agriculture. Agriculture is an important resource for large populated countries like India and China. Make money and make a living. Involvement of IoT and cloud computing in the agricultural sector will benefit farmers and the nation as a whole by controlling costs and monitoring performance and maintenance to better produce crops. This article focuses on introducing a smart drone for crop management, where real-time drone data and IoT and cloud computing technologies can help create a sustainable smart farm.

Keywords-cloud computing; Internet of Things (IoT); smart agriculture; smart drone

I. INTRODUCTION

Agricultural techniques and practices play an important role in the most populous countries such as India and China, where the area of agricultural land, the value of production and the land yield per unit are low compared to developed countries. Therefore, food production plays an important role in satisfying the hunger of the nation. To meet these challenges with limited natural resources, we need to engage the emerging technologies in the agricultural sector such as the Internet of Things (IoT) and cloud computing with a variety of machinery or equipment. IoT hopes that the adoption of cloud computing will improve cloud hosting facilities with faster internet speeds, thereby providing better approaches for farmers and manufacturers to make better decisions, reduce costs, and connect devices, collect and distribute data. , Providing efficiency and increasing productivity.

Studying the health status of agriculture has been a growing interest since last years, for which various autonomous techniques are in use. One such technique is robotics, which has jumped into the field of providing interesting and effective solutions for many phases such as harvesting or plowing [1].

The other is satellite technology, where the health of farms is monitored and data is recorded, but to a lesser extent they are not effective. So, here comes the use of drones in agriculture, which can provide smart farming more effectively due to the fact that unmanned aerial vehicles (UAVs) can give farmers a bird's eye view of their fields, thus providing more accurate estimates. Drones are defined as unmanned aerial vehicles (UAVs) [2]. In other words, drone flying devices, which are automatically programmed or remotely controlled, are classified as robot technologies networked by remote control or a ground station [3]. The use of drones provides an opportunity to get an overall survey of the area and make better use of farmer time. Drones with a combination of IoT and cloud computing technologies will enable real-time data extraction, evaluation and solutions for agro-agriculture. This article aims to introduce a smart drone that complements crop screening with farm technologies and remote monitoring with IoT and cloud computing. The data obtained from the drones provide insights into crops such as plant health indicators, plant numbers, plant height measurement, field forecasting, field water mapping, and drainage and improve speed, reliability and cost, Effective service to farmers.

Concept of IOT

The Internet of Things (IoT), now a popular term, describes a system in which the world is connected to the Internet with the help of various types of sensors. This allows objects to be perceived or controlled remotely within existing network infrastructure, and creates opportunities for direct integration into the physical world in computer-based systems, resulting in improved performance, accuracy, and economic benefit in addition to reduced human intervention [4].

IoT is "things", especially everyday items, such as all home appliances, furniture, clothing, vehicles, roads and smart items. Readable, identifiable, detectable, addressable and / or controlled via the Internet. It is a combination of ubiquitous communications, environmental intelligence and widespread computer.

Item recognition ("tagging things"), sensors and wireless sensor networks ("perceiving things"), embedded systems ("thinking things") and nanotechnology ("shrinking things") [5].

Concept of Cloud Computing

The most commonly asked password in the information technology (IT) world today is cloud computing, which describes a computer paradigm that provides on-demand access to large systems / public / hybrid where application data or storage space is privately connected to each other. It describes a new way of adding, using and exchanging web-based information technology services, including providing dynamic, expandable and virtualized resources [6].

The basic premise in inventing the idea of cloud computing is the reuse of information technology capabilities as a key aspect of cost efficiency. It expands the boundaries within the organization by providing a practical approach to enjoying direct cost benefits in computing, utility hosting, content distribution and storage. The term "cloud" can be used to refer to a combination of networks, hardware, storage, and interfaces to provide a service - software that can be used as a service (SAS), as a base (PASS), and as a service (IAS) for infrastructure, in public, private, or hybrid clouds. .

II. LITERATURE REVIEW

We conducted a literary study on smart agriculture using research papers, journals and articles. A paper [7] discussed vague control methods for irrigation and water conservation in agriculture, providing information on crop and site characteristics. It describes a protocol for field implementation of a fully automated irrigation system. Another paper [8] proposed a greenhouse surveillance system based on agricultural IoT with a cloud where sensors were installed on the farm to periodically collect information from the Department of Agriculture and store the information online. Some other documents [9] [10] [11] proposed the agricultural use of a wireless sensor network for crop field monitoring, where systems have two types of sensor nodes, one to measure different parameters such as humidity and temperature. , The tip that senses an image to take pictures of crops.

Most documents focus primarily on irrigating farmland. One such paper [12] discussed the neural computing modeling of the crop, the importance of better managing limited water resources in arid areas and accurately determining plant water needs. Another paper [13] to manage irrigation in agriculture is the proposed Automatic Smart Irrigation Support System (SIDSS), where the system assesses the weekly irrigation needs of a garden, based on both soil measurements and climate variables, collected by several autonomous nodes in the field. Some other documents using the Internet of Things [14] [15] [16] proposed smart irrigation systems, where the perceived data is sent to the smart gateway via a network, and then for a web service. GSM (Global System for Mobile Communication) also proposed a method for tracking insect traps using image sensors and Aspic. They used distributed imaging devices which are operated using wireless sensor networks. This method only detects pests, but does not suggest any method to control the pests.

Some articles on smart farming say that precision farming is now practiced in many countries. Precision farming is satellite farming or site-specific crop management (SSCM) based on observing, measuring and responding to inter- and intra-file variations of crops [17]. Fujitsu in Japan has developed a model for the use of cloud computing in agriculture, which can be used in other fields such as environment, medicine and maintenance [18] [19] where the model is a sequence of steps, inputs-data storage-visualization-analysis-algorithm.

III. PROPOSED WORK

Drones are in use for many commercial applications due to their ability to fly without an on-board pilot and act as an eye in the sky. But these drones have limited capability and are used in the permitted area. We are integrating it with smart technologies to expand their capabilities and make greater use of the data collected by drones. IoT and cloud computing involvement in the proposed model drones, give them the concept of "smart". The purpose of this proposed model is to provide intelligent cultivation control to farmers. Smart drones are very modern, with sensors within these UAVs feeding into network infrastructure, where drones are connected to other devices via Internet technologies that enable communications so that they are smart, and these devices now have real-time properties of many dimensions.

A. Architecture of Smart Drone

The drone technology used for the model is Sky Drone FPV2 (First Person View) and compresses of a camera module, a data module and a 4G / LTE modem. The smart drone would be a Fixed wing aerial vehicle which can carry many sensors, achieve greater speeds, have longer flight time and cover large areas. It will have an embedded software for flight planning and control based on GPS (Global Positioning System) navigation, as well as Google maps and is furnished with the

complete ICT (Information and Communication Technologies) equipment for data processing from sensor devices, which means that the processing results are available immediately after the flight to authorized users. The proposed model consists of 3 modules – Sensing, Communication and Coordination.

Sensing: Synchronous type of sensors - flight and navigation sensor and camera sensor are installed in the Smart Drones for exclusive useful/user data collection. The flight and navigation sensors like vision sensor, gyroscope, tilt and current sensors, GPS are controlled by the drone status, flight parameters, the sensors also aid the navigation and monitor the immediate or farther environment of the drone in order to detect and avoid unexpected obstacles. Cameras used in the Smart Drone should have at least a 12- megapixel resolution with different frequency ranges, as they present the basic useful load of drones used for monitoring in agriculture like

Identify pests, weeds and diseases which help inoptimizing pesticide usage and crop sprays.

Estimate the crop yield, i.e., provides the plantcounting.

Provide data on soil fertility by detecting nutrient deficiencies.Measure irrigation and control crop by identifying areas where water stress is suspected.Visual cameras are used for capturing images during day- light, while a thermal camera may be used for night vision, seeing through smoke or fog, vegetation monitoring, fire and heat detection using infrared patterns, etc.

Communication: The communication and networking block is responsible for the information flow and needs to be robust against uncertainties in the environment and quickly adapt to changes in the network topology. The Smart Drone will have an antenna with nearly isotropic radiation intensity patterns and has 4G/LTE modem with embedded IoT wireless technologies like Wi-Fi, ZigBee that are tested for aerial net- works which help in the wireless communication to remotely control the drone and receive the data acquired from the drone. The drone proposed will include a WiFi communication module plus a computation, storage and/or actuation capabilities that characterize the IoT. The IoT devices can be any of the smart devices like mobiles, laptop, iPad etc. which act as a gateway and provide the internet access when required and available. These communication devices connect to the drone from anywhere on any device. The data to be collected from the drone is controlled by the smart device at the remote location. Since the proposed drone is embedded with WiFi, the information collected can be sent on to the cloud at real time and can be viewed across internet. The data collected is stored in the application cloud and used for data analysis, evaluation and provide best practices and techniques for a certain situation to the farmers.

Coordination: The coordination block focuses on adapting to the needs of the application of interest. It contains 3 main components - Mission Control, Mission Planning and Sensor Data Analysis. We would develop a distributed and centralized coordination strategies to handle both the static and dynamic environments. The mission control unit takes the users input and dispatches it to the desired components, mission planning breaks down the high-level tasks to flight routes that are to be visited and certain actions for each waypoint. Finally, the sensor data analysis mosaics the images taken by different sensors, combine them to a single large overview image and is presented to the user.

Process Flow:

The phases that will be performed in the proposed model are

- Pre-planning: The pre-planned path is to be calculated first and define the search engine for the drone.
- Searching: The drone takes off and follows the assigned path while images are captured and analyzed on-board.
- Detection: Depending on the required application of the drone, we adapt the detection algorithm to detect any uncertainties in the field by the sensors embedded in the drone.
- Streaming: The captured images or any data is collected on the IoT device at real time. The streaming is also con- trolled accordingly by the devices and the data collected is transferred to the cloud system.
- Data Analysis: As per the requirement and the question under concern, the data is taken from the cloud system for analysis and evaluated by the concerned researchers and possible solutions are made which will help the farmers to practice in their fields.
- Cultivation Control: The information received from the drones can help in the control of the cultivation, like the drone embedded sensors detect the soil, humidity, health of the plants which help farmers predict their fields and the next steps to be performed.

Intelligent cultivation control is possible by makes use of this smart drone where the problem is just not restricted to small group and controlling mechanisms are also offered by the researchers with the data obtained in the cloud.

Agricultural information has very much importance these days for the development of world's agriculture. By using cloud computing database, information and records of specific processes in plant production can be maintained, thus help in analysis of Productivity, property based on production curve. The advantage of using the cloud computing storage server is that the cost of data as a service is reduced, as now the user is provided with the extra facility to request only the required service for the required time from the server. The information gathered also helps in addressing the key problems that occur in such specific processes of production, analyze the potential management defects, measurement, make production plans etc. All this information relevant to the agricultural need can be stored in a centralized location i.e., a single location and thereby data availability can be achieved. This data can be accessed by the end users such as farmers, experts, researchers etc. easily any time from any location through the devices that are connected to them, where IoT comes to play. Based on Cloud Computing, Agricultural Information Cloud is to be constructed and thus Smart Agriculture can be obtained using Smart Drones, Smart Irrigation etc.

The Smart Drone proposed is coupled with these technologies, used to fly on an agricultural land to detect all the required parameters with the help of the sensors built in it and the cameras to get the images or live streaming which help in building a sustainable smart agricultural practice by preventing the outcomes of any disasters, predictions of the field and best practices to be followed in the farm land.

IV. CONCLUSION AND FUTURE WORK

The goal of smart farming with the advent of IoT is to provide farmers with the latest technology in agriculture and agriculture for better crop production by capturing the current real-time status of cultivation, to understand the progress of agriculture and to improve farming practices with additional features and benefits. This article discussed the proposed prototype of the eye-catching smart drone for cropland that is more effective than satellite technologies for creating smart agriculture. The importance of the public cloud in agriculture is discussed because it promotes resource sharing, cost savings and data storage.

V. REFERENCES

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