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USE OF IOT AND DRONES FOR AGRICULTURE

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ABSTRACT
Since the advancements in the field of automation every task that involves risk and is time consuming can be automated by using certain tools and techniques efficiently, similar tasks can be done in the field of agriculture and forestation using IoT and Industrial drones, as we see the daily increase in population leads to development in infrastructure for the population live and which also leads growth in food demands and pollutions. To keep check on this factor we can use certain kind of automations to make use of abandoned lands which can be used for agriculture to keep up with food demands and for Forestation to keep down the population alerts.

Keywords: Internet of Things, Smart Agriculture, Sensors, Drones.

Introduction
As India majorly depends on agriculture for food demands, there very less advancements made or seen there. While other countries are using ultramodern technology to efficiently increase the yield, we still restrain to use modern technologies. Developed countries use IoT and drones for precision agriculture. In 2001, The University of Bourgogne considered using RC- aircraft equipped with a camera to fetch agriculture field images. Blair started developing a fixed-wing UAV in 2006 and used in the same year. ("Agricultural Drones, A History - Genovix") The Japanese were the first to successfully apply UAS technology to agricultural chemical spraying applications in 1980's, and crop dusting in the 1990's. Over 2,000 Yamaha RMAX unmanned hellos spray about 2.5 million acres a year, covering about 40% of the country's rice paddies in Japan. Among the applications, stress detections and quantification are the one that has received the greatest amount of attention, due to the potential positive impact that early stress detection can have on the agricultural activity. Consequently, a large amount of data has been generated and a wide variety of strategies have been proposed, making it difficult to keep track of the current state of the art on the subject and the main challenges yet to be overcome. ("Application of drone in agriculture: A review") In this context, the aim of this article is to supply a comprehensive overview of the application of Drone (UAVs) in agriculture to check and assess plant stresses such as drought, diseases, nutrition deficiencies, pests, and weeds etc.
Along with drones for the crop health and diagnosis we can use smart sensors to watch soil moisture, temperature, etc to make the data robust by which we can make our analysis right enough by using which we can decide what type of crop can be grown and how can be grown.
"Some typical applications of Agriculture IoT Sensor Monitoring Network technologies using cloud computing as the backbone had also surveyed." ("Communication Systems of Smart Agriculture Based on Wireless ... - UMY") Control networks and information networks integration of IOT technology has been studied based on the actual situation of agricultural production in India. Remote monitoring system with internet and wireless communications combined is proposed. At the same time, considering the system, information management system designed. "The collected data by the system provided for agricultural research facilities"

Applications of IoT and Drones in Agriculture
3.1 Soil Monitoring

Finding the moisture content in the soil was a very tough method. And according to that judgement and experience the crop which is to be cultivated at that time was fixed. It used to take a long time, many a times while watering the crops some crops used to die because of excess amount of moisture present in the soil as the farmers do not know about the moisture already present in the soil. But with the help of sensors are used to check the soil moisture level so that Proper amount of moisture is provided to the soil whenever and wherever necessary so the crops being cultivated will not be affected and a great yield would be produced.

3.2 Irrigation System

The agricultural sector accounts for about 85% of the world's fresh water supply. Unfortunately, this is growing rapidly due to the growing population and the great need for food. When dealing with agriculture we often come across a few efficient irrigation systems that lead to water loss instead of soil moisture. With the help of sensors in measuring temperature, humidity, pH, and soil moisture within the fields it will be able to irrigate only the regions or areas that need to be irrigated in a completely automatic way.

3.3 Weather Monitoring

Besides the soil monitoring sensors are also available for monitoring data related to humidity, temperature, pressure, precipitation, etc which helps us to figure out the weather patterns, which helps us to cultivate the suitable crop according to weather.

3.4 Monitoring Greenhouse Gases

Greenhouse gases and agriculture goes hand in hand. The increase in amount of greenhouse gases increases the temperature, which can directly affect the crops which is not good. Sensors and UAV's can be used to check these gases which can alert us before the crops get affected and one can take precautions.

3.4 Spraying

Before even we start sowing seeds for the crop first, we need to supply nutrients to soil for the better growth of crops. It being a time consuming and a labour-intensive work it can be done by drones efficiently even after the crops grow, they need pesticides depending on distinct types of crops which can also be done by drones.

This is not at all limited to agriculture, this can also be used for taming the forest fires which causes >33,000 deaths each year globally by replacing the human work with drones.

3.5 Crop Monitoring

The most crucial factors in the production of plants are their health, both the quantity and quality of soil yield Micronutrients and Macronutrients. After that, after the plants have started to grow, it is necessary to watch the growth stages of the plants to improve productivity. It is particularly important to understand the interaction between plant growth and the environment to prepare and improve plant health.

Traditionally the farmers perform all these precautions themselves by observation and judgment, but these observations and judgments are inaccurate and prompt. Instead, these days we can use drones (UAVs) to capture aerial photographic data. After which this data can be processed to generate useful outcome or understanding out of them.

3.6 Field / Terrain Mapping

Mapping and Monitoring of fields, which enables farmer to work out on different variety of crops and with different techniques on a particular zone in future. The main important part is that it helps in gathering geo-referenced data on harvesting yield and its qualities.

Evaluation of terrain plays a significant role in crop selection because different crop requires different terrain to grow, this evaluation can be done by using a LIDAR based drones which can records videos or captures images which can then be processed using different analytical software's to create the map of that area.

3.7 Yield Monitoring

Plucking the produce at right time is as important as growing it because a ripped fruit or veggies are not going get profits as the perfect one, for this purpose sensors can log the data related to climate surround the produce which changes according to the state of produce after processing the data we can full proof it by capturing images of crops using drones.

After which these images can be processed and compared using different image processing algorithms with the microclimate changes logged by sensor to know the exact time for plucking the produce.

3.7 Disease Monitoring

Both UAV's and remote sensing using sensors can be put into work to detect any illness caused or going to be caused to the crop and take precautionary steps to prevent it. To Infections in crops are diagnosed by RGB sensors, hyperspectral sensors can be used to detect sever infection in later stages.

3.8 Location and Intrusion Tracking

Different sensors and UAV's can be used to detect animal location & movement over the field. We can use simple system which can senses any movement using Infrared & Ultrasonic sensors and alert the farmer about the movement or even set a buzzer/ alarm for the same. Similarly, we can use set of drones to watch livestock while grazing, etc.

Challenges in Adopting IoT & Drones in Agriculture

1. The major issue can come down to the protection and maintenance of the sensors from the environment situations like heavy rainfalls, extreme temperatures etc.
2. Reliable network for the transmission and energy efficiency can also be a problematic are in a large open field in the middle of nowhere.
3. Costing of the sensors can also affect in the model that one is trying to make for the purpose and what will be the outcome as different sensors cost differently and produce different range of outcome base on the price of it.
4. Lack of standardization is also an issue as no one system can be used for the other one as the sensors will vary depending on the size, location, weather condition, etc of the fields.
5. Understanding of the advance technology and how to use it will be an integral part of adoption such advancements. After installing everything if the user is unable to use it or understand the functioning of the system it will be of no use.

Research Methodology

4.1 Background

Previously in India agricultural land was checked and analysed based on human intuitions and experiences which was good because many populations were farmers but as years progressed lesser population stared to take farming as an occupation the major reason begin the lack of information on what, where and how to grow something. But with some advancements the use of technology in agriculture, like use of IoT sensors were introduced by which certain automation was done to the before used methods but this sensor was majorly used for watering purposes, such as open and closing of water pumps, etc. As some more time as gone by increased sensors have been released for different purposes, which can be used in conjunction to amplify the output generated by the sensors and use it in an effective way

This paper purposes an initial system which can be used to collect data from multiple sensors on different factors of farming which can be processed to make decision on what type of crop can be grown, in what conditions and how to maintain appropriate conditions for them to grow healthily by continuously collecting and processing the sensor data while the sensors can be good for land related information, drones can be used for the different aspects at budding stage of crops like spraying, weed control, crop health monitoring, etc.

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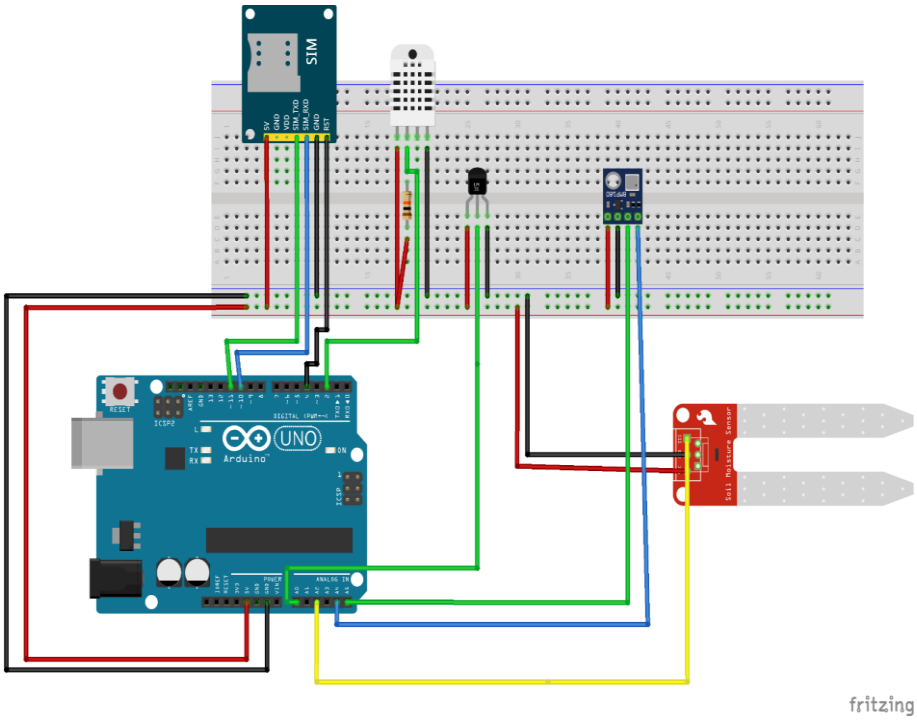
4.2 Architecture

Below is the proposed system using multiple sensors and Arduino Uno R3 as the microcontrollers for the collection of data from the sensors.



4.2.1 Sensors Used

Arduino Uno R3:

Arduino Uno R3 is an ATmega328P based microcontroller board. It has 14 digital I/O pins, 6 analogue input pins, a USB port, an ICSP header, a barrel power jack and a reset button. Its operating voltage is 5V. It can be coded using Arduino IDE, which can be uploaded to it using the USB A to USB B cable, the code is written in C or C++.

Humidity Sensor (DHT22):

These sensors are made of two parts, a capacitive humidity sensor and thermistor. It also consists of a chip inside which does analogue to digital conversion and outputs a digital signal with humidity reading.

It works with 3-5V power, good for humidity reading of 0-100% with 2-5% accuracy and temperature reading of -40 to 80% °C with ±0.5°C accuracy

Soil Moisture Sensor:

This sensor is good to measure the health of the soil it generates reading based on the water content level in soil, to take readings stick fork-shaped conductive probes to the soil. These probes have two exposed conductive plates that will act as a variable resistor whose resistance will vary depending on the water content in the soil. ("Arduino Soil Moisture Sensor Tutorial - Circuit Digest") This sensor produces an output voltage according to the resistance by measuring which we can figure out the moisture level.

Barometric Pressure Sensor (BMP180):

It is a high precision sensor; it is used for checking change in altitude, but it can also be used to predict the rainfall. It also has a temperature sensor in it cause pressure changes based on temperature also. It can measure pressure range between 300-1100hPa with ±0.12hPa and can run within the -40 to 80°C. General, concept to expect rain is that when the air pressure is low it is likely to rain to when there is high pressure.

Temperature Sensor (LM35):

LM35 is an analogue temperature sensor whose electrical output is proportional to °C, it does not require any external calibration. The main advantage is that it is linear i.e., with every degree rise in

temperature the output rises by 10mV.So if the output is 0.28V/280mV the temperature will be 28°C. It can read temperature between range -55 to 150°C.

GSM Module:

It uses GSM (Global System for Mobiles) and GPRS (General packet Radio Services) to communicate with another device wirelessly. It uses 2G network to connect with the internet and supports Quad-band (EGSM 900, GSM 850, DCS 1800, PCS1900). ("Interface GSM module with Arduino | GSM Module working") ("Interface GSM module with Arduino | GSM Module working") This can be used for sending sensor data and for receiving commands if any of the sensor needs it. It is used as mode of communication for this system it can also be replace by ZigBee, Wi-Fi depending on the connectivity where the system is going to be mounted.

Conclusion

In this paper we have discussed different use cases for drones and IoT sensors which can efficiently carry out certain tasks without human intervention, we have also discussed challenges that are faced in the current methods of agriculture and after the implementation of the proposed system. This paper also provides a first system design with some can start their research and keep adding to it. This paper can be beneficial to researchers, tech-enthusiast, agriculture universities and how is working on IoT technology in the field of agriculture.

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