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Feed The Globe Utilizing IOT-Driven Precision Agriculture

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Abstract

It is clear to every Indian that agriculture is the backbone of our country. It is indeed the case that the created, immature and non-industrial nations derive their food from agriculture. Therefore, individuals cannot overlook the importance of agriculture, on the contrary. It is believed that development in agriculture brings a great change to a country. Along with the advancements in innovation, there are a lot of advancements in agriculture and other fields. Nowadays, new strategies and innovations are carried out for the advanced development of agriculture. With the help of agriculture, we can support the economy of our country. Agriculture in India is carried out with ordinary strategies. The way the majority of our farmers need suitable information makes them much more unpredictable. A great deal of cultivation and farming depends on forecasts, which occasionally fail to materialize. Farmers have to cope with colossal misfortunes, and now and then it happens that they give up everything. Knowing the benefits of adequate soil moisture and quality, air quality and irrigation for yield development, such limitations cannot be ignored. In this paper, a novel idea of precision farming, drones, soil management and livestock management using IOT is presented. The proposed work will have great benefits in the field of agriculture due to its reliability and remote observation. This idea seeks to digitize agriculture and farming activities so that farmers can check crop requirements and accurately predict their growth. This idea will undoubtedly accelerate their business to reach new scales and furthermore be more productive. The implementation of this research work generally depends on the mindfulness of farmers as it brings

various benefits. In this work, brilliant farming is carried out to help farmers by using enormous data for data collection, data pre-processing and data transformation, just as soil moisture sensors and drones have been planned for data collection.

Keywords: Precision Farming, IOT sensors, Robotics, RFID Sensors,

1.INTRODUCTION

The total population is constantly evolving and the Unified Nation estimates that about 83 million people are constantly being added to the world's population. By 2050, the number of people on planet Earth is expected to reach 9.8 billion. The smart agriculture market [6] is expected to reach $18.45 billion in 2022 [12], growing at 13.8%, as shown in Figure 1. While mainstream researchers see the old fears of overpopulation as unwarranted, the rapidly growing human population poses real and persistent difficulties for monetary, agricultural and community infrastructures. Farmers, especially in the emerging and developing economies of Asia-Pacific, Africa and the SAARC region, are faced with an ever-increasing interest in producing more food on smaller areas of land, while struggling to protect their farms from extreme weather conditions, climate change, environmental impacts, market fluctuations, etc. In order to fully feed this enormous population, agriculture needs to change, which is being disrupted by innovative developments such as the Internet of Things, artificial intelligence, machine learning [7], robotics, etc. [12]

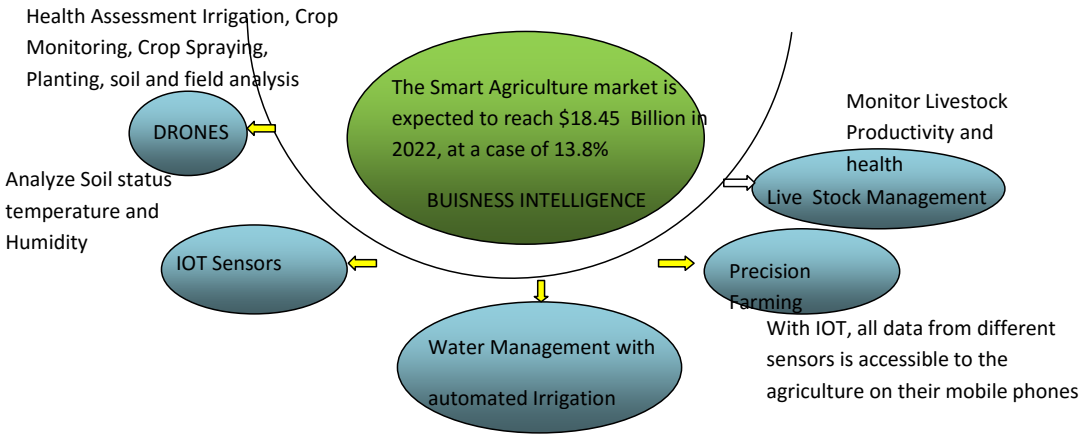

Figure1: Business Intelligence in Smart Agriculture

To meet the growing demands of a growing population and get the maximum return from their farms, farmers are turning to new innovations supported by the Internet of Things (IOT). New "smart farming" applications [6] based on IOT technologies [7] will enable agriculture to reduce waste and improve efficiency. IOT-enabled precision farming techniques provide farmers with useful devices to streamline any cropping

operation. These technology-driven practises aim to increase crop yields and profitability while reducing the amount of traditional inputs (water, fertiliser, insecticides and herbicides) needed for crop development.
This idea not only seeks to do away with the primitive techniques associated with farming, but also serves the region by opening up new opportunities for employment. The most important function is to monitor plant growth using digital tools. This allows you to determine exactly where the various limits are on which development depends. In addition, it helps the farmer to control several agricultural areas at the same time. Since a large part of the checks are done remotely, it helps the farmer to collect data that is important for his business in his spare time. The system is designed to be easy to understand by including a simple graphical user interface and mobile messaging. Since control through a system requires less labour, people with physical disabilities can also be used to monitor the fields.

2. CONCEPTS OF PRECISION FARMING

IOT-powered techniques for precision agriculture [6] (Figure 2) give farmers effective tools to optimise any farming task [7]. These technology-driven practises aim to increase crop yields and profitability while reducing the amount of traditional inputs (water, fertiliser, insecticides and herbicides) needed to grow crops. In essence, smart farming uses less to achieve more. Precision agriculture, satellite agriculture and site-specific crop management (SSCM) are agricultural management approaches that focus on observing, estimating and responding to crop variability both in the field and between fields. Researchers seek to develop an integrated decision support system (DSS) for farm management that increases returns from inputs while safeguarding assets.

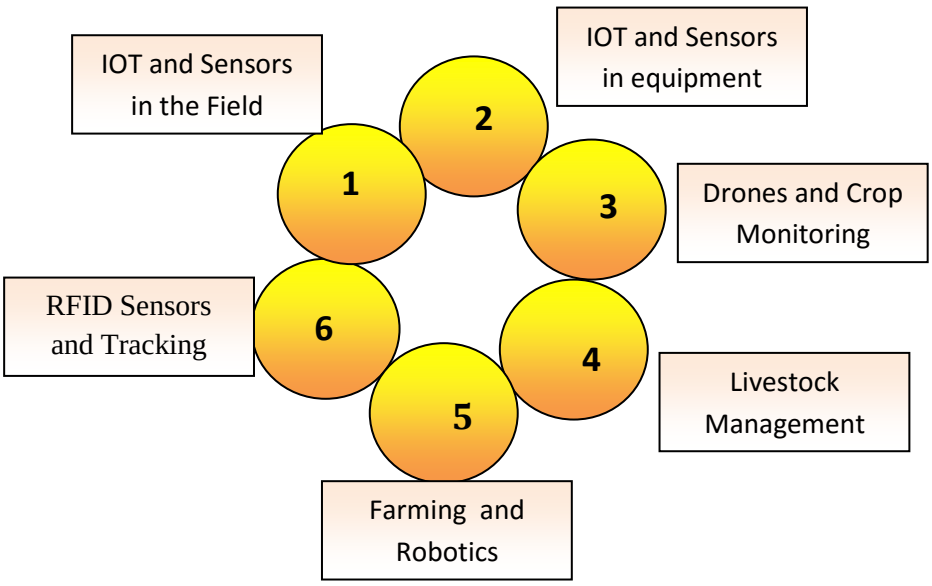

Figure 2: Precision Farming

3. DISCUSSION OF PRECISION FARMING

3.1. IOT and Sensors in the Field

Sensors on equipment and materials enable the Internet of Things [10][6] to simplify and streamline the collection, control and distribution of agricultural resources. Field sensors, combined with image recognition technology, allow farmers to monitor their crops from any location. These sensors transmit real-time information to farmers and allow them to make changes to the crop. In this way, farmers benefit from IOT sensors being used in the fields, resulting in higher food production with less waste - exactly what this industry needs. Sensors are crucial to the operations of many businesses. They can alert you to potential problems before they become major issues, allowing businesses to carry out predictive maintenance and avoid costly downtime.

Data from sensors can also be examined for patterns, allowing business owners to gain insights into important patterns and make informed, evidence-based decisions .Sensors come in many shapes and sizes. Some are designed to contain many individual sensors that allow you to monitor and measure many data sources. In industrial operations, it is important that sensors have digital and analogue inputs so that they can analyse data from older sensors. There are many types of IOT sensors and an even greater number of applications and use cases. Below are the most popular types of IOT sensors [10][4] and some of their use cases.

- **3.1.1 Temperature sensors:** Temperature sensors [5] measure the amount of thermal energy in a source and can thus detect temperature changes and convert them into data. Machines used in manufacturing often require specific ambient and equipment temperatures. In agriculture, soil temperature is also an important factor in plant development.
- **3.1.2. Moisture sensors:** The smart moisture sensor [11] enables farmers to overview the total water consumption per irrigation, week, month and season. It also provides real-time data that helps farmers reduce labour, thereby reducing costs and environmental impact.
- **3.1.3 Accelerometers:** The researchers propose a predictive maintenance scheme SVMs [1] using data from accelerometers that measure vibrations in a crane engine. It also uses information from multiple sources in a semiconductor manufacturing process, both operating in a cloud environment, as confirmed by the architecture.
- **3.1.4. Gyroscope:** to highlight a gyroscope [18], an accelerometer and a magnetometer - which, as indicated, are key components for a fruitful cultivated navigation framework. "We explain that the gyroscope measures rotation, the accelerometer measures velocity increase and the magnetometer measures the field of attraction," he said. "These readings allow us to determine the roll, pitch and yaw angles.
- **3.1.5 Infrared heat sensors:** Infrared heat sensors [8] measure and map surface temperature and heat distribution passively and non-intrusively, making them useful for leaf temperature monitoring and other agricultural applications.
- **3.1.6 Optical sensors**: There is a wide range of optical sensors [16] used in agriculture. They range from sensors used to analyse soil properties to sensors installed in combines to measure the protein content in wheat grains during harvest.

4. IOT and Sensors in Equipment

Sensors are installed in agricultural equipment to monitor the condition of the machine and more. Under the term "precision agriculture", tractors and other agricultural equipment are equipped with navigation systems and a variety of sensors. Some of these sensors are GPS -enabled [1] so they can compensate for uneven ground. Yield planning and harvest documentation functions are built into the cab of some implements. The downtimes of the machines are reduced by the interaction of these sensors.

5. Drones and Crop Monitoring:

To combat drought and other environmental factors, drones are commonly used to monitor crops (Figure 3). To increase the effectiveness of precision agriculture [7], crop monitoring devices are needed.

Figure 3: Drones and Crop Management

These devices are usually placed in the field where they monitor water levels, crop health and other biochemical and physical properties relevant to the situation at hand. With the help of crop monitoring tools, a farmer can proactively address anomalies, put together models and strategies based on predictions, and prevent potentially harmful pests.

6. IOT Enabled Livestock Management

Livestock management, also known as livestock monitoring or precision livestock management [17] [2], uses IOT-enabled devices to track and monitor the health of livestock, mostly cattle. The functions of IOT-enabled livestock management solutions (Figure 4) take the speculation out of herd health. Using a wearable collar or tag [17] battery-powered sensors monitor the animals' environment, temperature, blood pressure and pulse, and send the data to farmers' devices in near real-time.

Figure 4: How it functioning in IOT-enabled livestock management

This permits farmers to monitor the health and area of each individual animal in their herd from anyplace as well as receive alerts if something falls outside of the normal range. Maybe than genuinely take a look at the vitals of each individual animal to check if an illness has spread, they know quickly which animals is affected and which are not. Besides tracking health, Livestock monitoring solutions[17][2] can use GPS tracking to gather and store historical information on preferred grazing spots or use temperature tracking to determine the peak of mating season.

7. Farming and Robotics

Smart Robotics (Figure 5) in agriculture would improve productivity and lead to higher and faster yields, similar to how robots and artificial intelligence are used in other industries. We are very excited to share with you some insights and news on new developments in precision agriculture and robotics [13] in our robotic harvesting webcast, which will lead to higher productivity and better use of land while containing the rising costs of farming. The integration of artificial intelligence, machine learning [7][15] and IOT devices is nothing new in modern agriculture. Various sensors provide agronomists with meaningful, valid and relevant data that helps them increase the effectiveness of their farms by guaranteeing better yields and reducing crop protection costs.

With the help of artificial intelligence [13], farmers can track weather changes, rainfall, pest infestations and more to ensure precise application of water, fertilisers and pesticides based on accurate data. All this data and its analysis is the guarantor of a modern farming operation as a whole. That's why more and more growers are exploring the possibilities of simulated intelligence to gain benefits by advancing crop yields and quality.

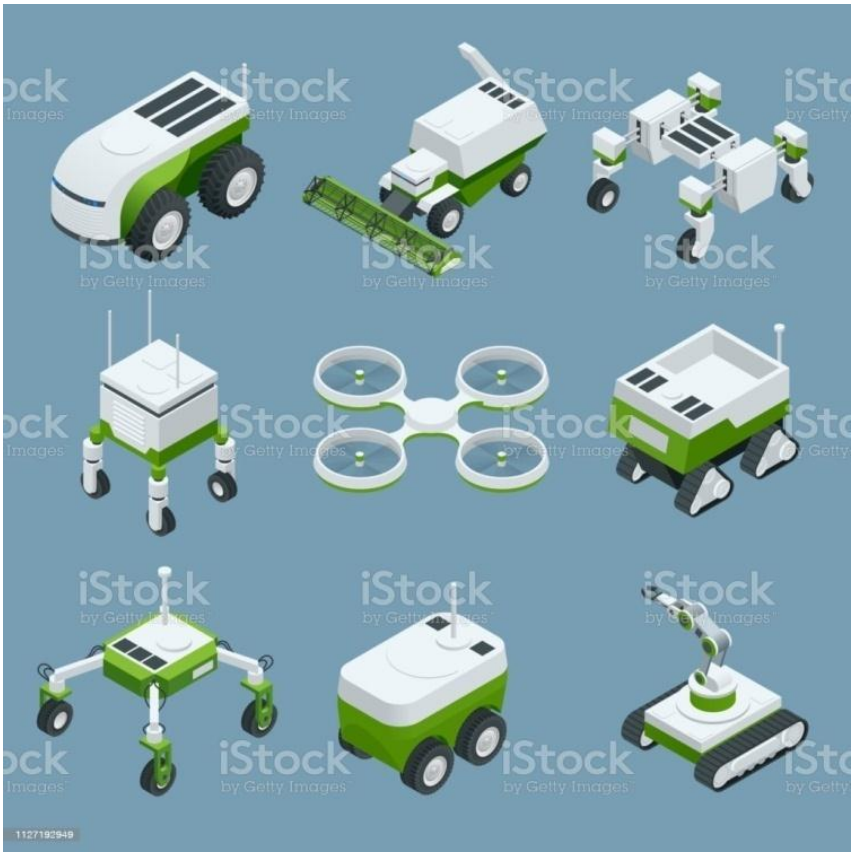

Figure5: IOT Smart Industry Robots in Agriculture, Farming Robot, Robot Greenhouse, Agriculture Smart Farming Technology.

Various soil sensors can collect information on soil temperature and moisture, nutrient and fertiliser levels, and more, so farmers can see how their crops are faring throughout the season. Artificial intelligence offers the ability to examine data over a long period of time and present agronomists with crop development patterns that they can use to predict yield and intervene in time if needed. Artificial intelligence tools and devices [13][15] have already proven to improve agriculture and are likely to do so in the future.

8. RFID Sensors And Tracking

RFID sensors can be used to track food from the field to the shop after harvest. This means that the buyer or end customer wants to track the food they consume from its farm of origin to the place where they bought it. Given the increasing reliability of producers and their responsibility to deliver fresh food, this innovation can potentially increase customer trust in producers. Whether used in agriculture to track livestock or in a warehouse to monitor a producer's supply chain, the basic principles of how an RFID tracking system [9] works are much the same. First you need the right tools RFID tags, antenna, RFID reader, computer database with asset tracking software.

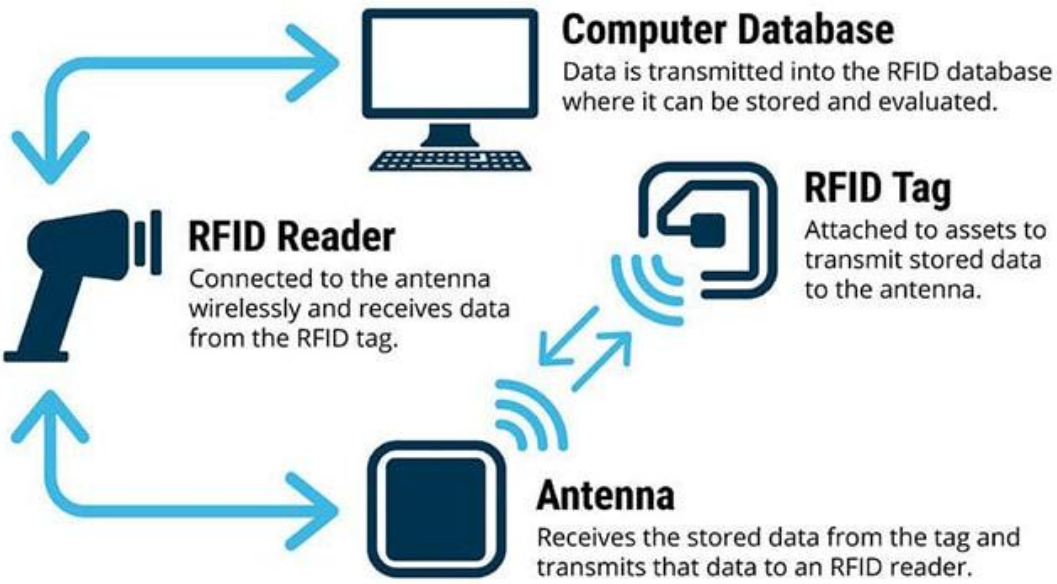

Figure 6: RFID Asset tracking process

Once the right equipment is in place, the RFID asset tracking process (Figure 6) can be divided into four phases.

- Data is stored on an RFID tag with a unique electronic product code (EPC) and attached to an asset.
- An antenna identifies the signal near the RFID tag.
- The RFID reader is wirelessly connected to the antenna and receives the data stored on the RFID tag.
- The RFID reader transmits the data to an asset tracking database where it is stored, analysed and processed.

Depending on how we want to use our RFID asset tracking system, the initial process is relatively simple. However, there are several factors that need to be considered when choosing the right hardware.

9. CONCLUSION

IOT-enabled agriculture has helped translate modern technology solutions into proven knowledge. This has helped bridge the gap between production, quality and quantity of yields. Collecting and importing data from the various sensors for use in real time or for storage in a database ensures quick action and less damage to crops. Seamless, intelligent workflows and evolved business processes mean that produce is processed faster and reaches supermarkets in the shortest possible time.

10. FUTURE ENHANCEMENT

Given the overwhelming growth of the world's population, which according to the Food and Agriculture Association (UN) will increase by 70% in 2050, shrinking agricultural land and the depletion of finite natural resources, the need to improve agricultural yields is critical. Another problem burdening agriculture is the increasing use of labour in agriculture. Moreover, the agricultural labour force has been declining in a large part of the countries. Due to the decline in agricultural labour, the introduction of internet connectivity solutions in agriculture has been initiated to reduce the need for manual labour. IOT solutions are designed to help Farmers Bridge the gap between supply and demand by ensuring high yields, profitability and environmentally friendly production. This method of using IOT innovations to ensure ideal use of resources to achieve high crop yields and reduce operating costs is called precision agriculture. IOT technologies in agriculture include specialised equipment, wireless connectivity, software and IT services.

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