Role of Internet of Things (IoT)

In Promoting Sustainable
Economic Growth in India 2047

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2. DEVELOPMENT OF INTERNET OF THINGS (IOT) FOR SMART AGRICULTURE

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Abstract

The Internet of Things is the current hot topic. The "Internet of things" (IoT) is a term used to describe a network of physical objects that are connected and have the ability to sense, act, and compute. The idea of a smart object is made a reality with the assistance of sensors, actuators, and embedded microcontrollers. These "smart" objects get data from the environment of development, process it, and then start the appropriate activities. Thus, the Internet of Things will deliver previously inconceivable benefits and assist people in living a wise and opulent life. The Internet of Things (IoT) has become a hot topic in scientific research due to its potential uses. The significance and practical use of these technologies are hot topics of debate and investigation, but in the fields of agriculture and forestry, they are far less so. In this paper, IoT applications in agriculture and forestry have been examined and discussed. It has also accurately introduced IoT technology, agriculture IoT, a list of potential

application domains where IoT is applicable in the agriculture sector, the advantages of IoT in agriculture, and a review of some literature

Keywords: - IoT, Smart agriculture, Agricultural IoT, International Telecommunication Union (ITU)

Introduction

The developing nations have majority of their GDP dependent on agriculture [1]. Agricultural activity extends from crop Cultivation (farming), timber to livestock rearing for domestic Consumption or economic purposes as raw materials to other Activities. It has been the primary precursor for human Evolution. The ever-increasing population has put on immense Pressure on agriculture sector to meet the demands of G plrowing population and technology. The estimated world Population is expected to reach 8.5 billion by 2030 and 9.7 Billion in 2050 [2]. China and India represent the two most Populated countries in the world with more than 1billion People, with 19% and 18% of the world population. The Population of India is expected to surpass that of China by 2022 [2]. These countries are also heavily dependent on Agriculture to sustain the availability of livelihood of their Growing population. The major challenges in agriculture in Developing nations and rural areas can be stated as follows:

☐ Quality of crops and land available for farming and Agriculture
☐ Lack of availability of utilities like electricity, machines, Irrigation.
☐ The low economic condition of farmers.
☐ The disparity between product prices from farmers to Customers.

☐ Climatic change has unpredicted adverse effect on the Farming process and outcomes.
☐ Lack of technology in agriculture either due to lack of Access, high cost of commissioning and operation or Due to knowledge.

Review of Literature

1. Kamlesh lakhwani & et.al, (2021) the research Development of IOT for smart Agriculture, The Internet of Things is the hot point in the Internet field. The concepts help to interconnect physical objects equipped with sensing, actuating, computing power and thus lends them the capability to collaborate on a task in unison remaining connected to the Internet termed as the "Internet of things" IoT. With the help of sensor, actuators and embedded microcontrollers the notion of smart object is realized. Wherein these smart objects collect data from the environment of development, process them, and initiate suitable actions.

2. Adithya Vadapalli1 &etal,(2020) this paper analyses the Smart Agriculture System using IoT Technology The farming of agriculture has started past 12000 years back, Neolithic age gave birth of civilization, Farming and later being continued as traditional farming practices. India being an agrarian's country, Mostly Indian farming are dependent on rains, soil, dampness and environment challenges .Our farmers upgraded to modern state of art technology in cultivation. Globally the IoT systems has contributed its application in many fields and proven to be successful. It is the time that Indian farmer need to introduce the Smart Agricultural systems for higher crop yield. The productivity with compilation of data from sensors, actuators and modern electronic gadgets the farmer can monitor agricultural fields.

3. Muhammad Ayaz & et.al, (2019) In their study explained IOT Applications Smart Agriculture, Despite the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of the Internet-of-Things (IoT) based technologies redesigned almost every industry which moved the industry from statistical to quantitative approaches. Such revolutionary changes are shaking the existing agriculture methods and creating new opportunities along a range of challenges the traditional farming practices.

Smart-agriculture

Although smart agriculture IoT, as well as industrial IoT in general, aren't as popular as consumer connected devices; yet the market is still very dynamic. The adoption of IoT solutions for agriculture is constantly growing. Namely, COVID-19 has had a positive impact on IoT in the agriculture market share. A disruption in the supply chain, and the shortage of qualified workers, has propelled its CAGR to 9, 9%. In fact, as per recent reports, the smart framing market share is set to reach $6.2 billion by 2021. At the same time, the global smart agriculture market size is expected to triple by 2025, reaching $15.3 billion (compared to being slightly over $5 billion back in 2016).

Smart Agriculture using IoT

Another very important domain in the internet of things is the agricultural domain. IoT is responsible for modernizing the agricultural field by using proficient methods and instruments to manage crops,

soil and animals. This in turn has led to decrease in the waste generation and a phenomenal increase in productivity. This is smart agriculture using IoT.

IoT use cases in agriculture (with examples)

There are many types of IoT sensors for agriculture as well as IoT applications in agriculture in general:

1. Monitoring of climate conditions

Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity (i.e. precision farming). Some examples of such agriculture IoT devices are all METEO, Smart Elements, And Pycno.

2. Greenhouse automation

Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity. Specifically, greenhouse automation systems use a similar principle. For instance, Farm app and Grow link are also IoT agriculture products offering such capabilities among others. Green IQ is also an interesting product that uses smart agriculture sensors.

3. Crop management

One more type of IoT product in agriculture and another element of precision farming are crop management devices. Just like weather stations, they should be placed in the field to collect data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health. Thus, you can monitor your crop growth and any anomalies to effectively prevent any diseases or infestations that can harm your yield. Arable and Semios can serve as good representations of how this use case can be applied in real life.

4. Cattle monitoring and management

Just like crop monitoring, there are IoT agriculture sensors that can be attached to the animals on a farm to monitor their health and log performance.

For example, such sensors can identify sick animals so that farmers can separate them from the herd and avoid contamination. Using drones for real-time cattle tracking also helps farmers reduce staffing expenses. This works similarly to IoT devices for pet care.

For example, SCR by Allflex and Cowlar use smart agriculture sensors (collar tags) to deliver temperature, health, activity, and nutrition insights on each individual cow as well as collective information about the herd.

5. Precision farming

Also known as precision agriculture, precision farming is all about efficiency and making accurate data-driven decisions. It's also one of the most widespread and effective applications of IoT in agriculture.

For example, CropX builds IoT soil sensors that measure soil moisture, temperature, and electric conductivity enabling farmers to approach each crop's unique needs individually. Combined with geospatial data, this technology helps create precise soil maps for each field. Mothive offers similar services, helping farmers reduce waste, improve yields, and increase farm sustainability.

6. Agricultural drones

Perhaps one of the most promising agri tech advancements is the use of agricultural drones in smart farming. Also known as UAVs (unmanned aerial vehicles), drones are better equipped than airplanes and satellites to collect agricultural data. Apart from surveillance capabilities, drones can also perform a vast number of tasks that previously required human labor: planting crops, fighting pests and infections, agriculture spraying, crop monitoring, etc. DroneSeed, for example, builds drones for planting trees in deforested areas. The use of such drones is 6 times more effective than human labor. A Sense Fly agriculture drone eBee SQ uses multispectral image analyses to estimate the health of crops and comes at an affordable price.

7. Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-time data, the use of data analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc.

For example, the Crop Performance platform helps farmers access the volume and quality of yields in advance, as well as their

vulnerability to unfavorable weather conditions, such as floods and drought.

8. End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in-built accounting/reporting features.

IoT based smart farming cycle

Data is the center of any IoT based technology. In order to ensure optimization, smart farms must form a continuous and constant cycle that collects and analyzes data to perform the next set of actions.

The following is an example of a smart farming cycle:

☐ Observation: sensors are used to sense the surroundings and collect information about the soil, temperature, humidity and so on.

☐ Diagnostics: the information collected from sensors are sent to IoT based cloud platforms for data analytics.

☐ Decisions: based on the analysis done the farmers make relevant decisions to generate better outputs.

☐ Actions: when the tasks are operated the cycle repeats itself from the beginning.

☐ Some of the applications of IoT in the agricultural domain are as follows:

☐ Sensors to monitor and track the status of crops and insects

☐ Drones for monitoring the livestock such as hens

☐ Automated water pumping systems to water the crops according to convenient times

☐ Machines for performing route operations and ensuring proper functioning of systems

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Benefits of IoT in Agriculture

We are increasingly reliant on technology in today's world for almost everything we do. And when it comes to farming, the reliance is only going to grow in the years ahead.

Benefits-of-smart-farming

Cost management and waste reduction thanks to the increased control over the production. Being able to see any anomalies in the crop growth or livestock health, you will be able to mitigate the risks of losing your yield.

IoT Smart Solutions in Agriculture

Precision Agriculture

Precision agriculture is a farming management approach that uses digital technologies to enable farmers to make better decisions about where, when, and how much to fertilize, irrigate, and spray pesticides

Crop Monitoring

Crop monitoring involves the use of sensors, drones, and satellites to monitor crop health and identify locations requiring attention. Crop monitoring systems also include all data such as crop health, humidity, rainfall, temperature, and more. Sensors help farmers determine the best time to sow crops and harvest them, and can also detect problems early.

Livestock Monitoring

Livestock monitoring uses sensors and RFID tags to track the location and health of livestock. This information aids ranchers in determining the condition of their livestock.

Irrigation Management

Irrigation management uses sensors to detect when and how much water is needed by individual plants. This saves water and also reduces weeds and runoff.

Smart Pest Control

Sensors detect the presence of pests and then dispense pesticides as required to protect crops. This helps reduce pesticide usage and can be used with smart irrigation management for targeted spraying only where it is needed.

Fertilizer Management

When fertilizer gets too low, sensors notify farmers so they can use a crop-yield map to determine which areas need more fertilizer.

They can also track how much fertilizer has been used by each plot or farm throughout the season.

Weather Forecasting

Farmers employ satellite weather forecasts to decide when it is appropriate to plant or harvest in the course of the season. Weather stations with smart sensors can collect data and send valuable information to a farmer.

Conclusion

The applications and infrastructure requirements of using IOT in agriculture. People always required eating and drinking. For this, the development of the agriculture sector is always a priority. Use of IOT in agriculture has a big promising future. IOT is a driving force to increase agricultural production in a cost-effective manner. Smart farming through IOT technologies helps the farmer in increasing the productivity and reduces the waste generation.

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