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Use of Machine Learning and IoT in Agriculture

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Abstract: Artificial Intelligence (AI) and Internet of Things (IoT) are nowadays phenomenon technology, and it is used in modern agriculture. In agriculture, wireless sensors are used to collect data on soil, water, soil moisture and other environmental aspects to monitor and monitor soil health and to achieve greater benefits from the perspective of farmers and the environment. In these days, the use of artificial intelligence is everywhere from our daily life to space technology, automobile industry to medical facilities. As a passage of time, the use of AI technology and different sensors also used in Agriculture, this is called smart farming or Precision Agriculture. In this study, review of different machine learning (ML) techniques and IoT are discussed which were used in agriculture.

Keywords: IoT, Machine Learning, Precision Agriculture, Smart Farming.

I. INTRODUCTION

Agriculture is a crucial part of the global economy, but the pressure on agricultural systems would increase as human populations continue to evolve. Precision agriculture, now known as digital agriculture, is evolving into a new field of research that uses data - intensive methods to improve agricultural efficiency while increasing environmental impact. Agricultural systems are able to increase productivity and efficiency in crop production through the use of machine learning and artificial intelligence, as well as data analysis. Companies use computer vision and deep-learning algorithms - learning how to process data captured by drones and software - to monitor plant and soil health. Machine learning models are developed to track and predict the health of plants, soil conditions and other aspects of the environment such as temperature, humidity and humidity, as well as crop yields [1]. Precision farming, also known as smart farming, is a key element of sustainable intensification, as is the use of machine learning and artificial intelligence [2].

Machine learning is designed to unravel, quantify, and evaluate data - intensive processes in the agricultural environment in new ways, using data from sensors, computers, drones, sensors, and other technologies. The data generated in modern operations is complemented by sensor variants that allow for more accurate analysis of the data and lead to greater accuracy and faster decision-making.

In this study upcoming sections are: section 2) machine learning, provide details and types of machine learning section 3) talks about IoT and the working of IoT system, Section 4) Literature Review, a different research study in which machine learning and IoT were used in agriculture are discussed and section 5) is a conclusion.

II. MACHINE LEARNING

ML is the process of training a machine to do what humans do naturally through knowledge and practice. It can also be defined as automating and improving a computer's learning processes based on its interaction with human support. A Fig.1 shows machine learning type and different techniques.

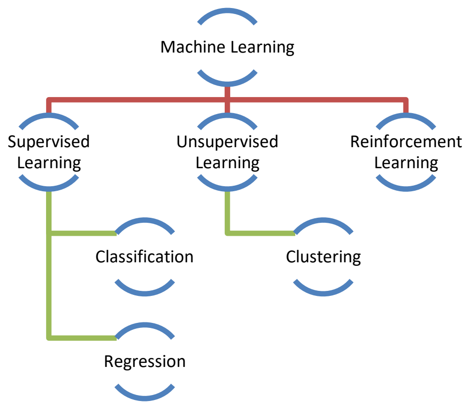

Fig. 1. Different types of Machine Learning Technique

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Unsupervised learning is when an input record is given and left to a learning algorithm to find hidden patterns in its input. This technique is useful to identify clusters of input data with names and answers. In supervised learning, a teacher trains a machine to perform at the expected level, developing a set of rules for the learning process, such as the use of labels, reactions and labels.

Reinforcement Learning is where the agent works with the environment in which he works, and can learn how feedback works. The aim is that it adopts a behaviour that is optimised after it has received incentives for a certain period of time. With sound policies, it can achieve the goal even earlier, the three main components of this method include agent, environment and behaviour.

III. IoT

The IoT is the concept of transmitting data without the need for human or human interaction with a computer. The IoT ecosystem consists of web-enabled smart devices that use embedded systems to collect, send and respond to data collected in their environment, and to collect and send data from the environment. IoT devices share their collected sensor data by connecting to the cloud, where data is sent and analysed.

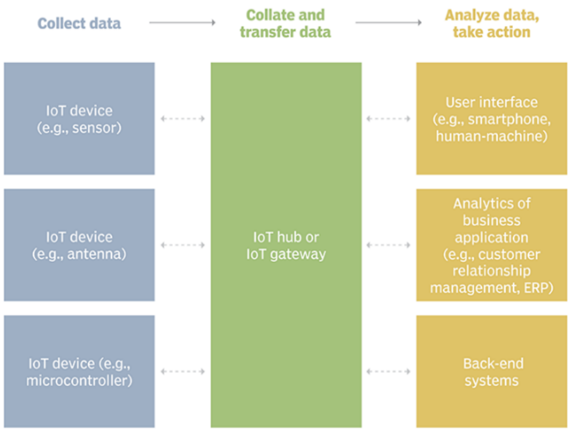

Fig. 2. Working of IoT System [3]

Fig. 2. represents the working of IoT system. The connectivity, networking and communication protocols used in web-enabled devices depend largely on the specific IoT application being deployed. IoT can also use artificial intelligence (AI) and machine learning to make these processes more efficient and intuitive for users and developers. These devices do most of the work without people interacting with them, such as setting them up, giving them instructions, or accessing data. Sometimes these devices communicate with other related devices and act as a gateway to get information from each other [3].

IoT is one of the most renowned advanced technologies we have seen in recent years, with a wide range of applications in agriculture, healthcare, healthcare and other industries. IoT places unimaginable demands on the data generated every second, especially in the fields of agriculture and food production. IoT, which combines emerging technologies for integrating high-resolution plant production systems with an advanced machine learning and artificial intelligence and data analysis technologies. The IoT is essentially designed to provide industry with an intelligent, digitised way to track and monitor all existing items that can carry traceable sensors. Intelligent sensors are therefore connected to each other and able to send collected data in real time to a central interface (usually a web interface).

IoT in agriculture, therefore allows us to keep everything under control and analyse the data collected for statistics and useful forecasts. IoT devices and different types of analysis that analyse the data they collect and participate in strategic decision-making.

IV. Literature Review

In [4] suggests the automation of irrigation systems on farms, and the proposed solution is based on the idea that the Internet of Things (IoT) would be an important part of the future of agriculture in the United States and around the

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world. As it is a well-known fact that water is such a scarce resource, the waste of this important resource must be minimised. Monitoring systems, whose main purpose is to solve over-irrigation, soil erosion and crop yields, have been developed to facilitate and efficiently manage irrigation problems. The proposed solution will be developed by setting up a system where each region of operation would be covered by different sensor modules that transmit data to a common server. IoT and machine learning - based predictions of irrigation patterns supported by ML support the development of a data set of irrigation and soil erosion monitoring systems. The core helps to classify and quantitatively predict the plants that are needed for irrigation, such as the number of plants in the soil, the moisture level of the soil, the water content and other factors. This data set provides information about agriculture in various regions of India. A comparative analysis of different algorithms suggests that the random forest regression provides the best results for predicting RH compared to the other algorithms.

In [5] the author examines the use of multiagent-based information gathering in agriculture and proposes a new approach to the application of WMSN based on soil parameters for agricultural monitoring. This work only takes into account the effects of soil moisture, soil temperature and soil composition on the health of the plant. This article proposes a new approach to a multi-agent information gathering for conscious monitoring of agriculture by WMSN. Sensor nodes collect data and update the knowledge base with information on soil parameters such as soil moisture, soil temperature and soil composition. They consist of two components, a sensor and a monitoring node, and two monitoring nodes. The sensor nodes can be updated with knowledge of the soil and the health status of the plant and its environment. When the information is in range, a message is sent to the sensor node via the cluster head, which is done with multi-hop technology. The sensor nodes form clusters depending on the communication area and when they detect information, they compare it with thresholds.

The arable land is divided into several areas where the fertility of the soil is almost uniform from area to area, and in some area’s fertility varies considerably. Duncan's new multiple-range comparison method is compared on several levels, and we introduce a new method for accurately assessing the number of clusters (fuzzy - c, which means clustering). The sensitivity analysis shows that NICCV is insensitive to exponents and blurred weighting, but shows a strong sensitivity to the numbers in clusters [6].

In [7] researchers used SVM to process soil patterns and classify them into different soil classes. The study was conducted in West Guwahati, Assam, India, with the help of the National Institute of Environmental Science and Technology and the Department of Earth Sciences at the University of North Carolina. To collect samples, they used an Android device with a 13MP camera, and the device was specifically used as a model that farmers can easily apply to real life. Fifty soil samples were taken from different regions as part of the study. For training, they used a combination of different types of soil such as soil type, soil moisture, water quality, temperature and humidity. Image pre-processing, segmentation and feature extraction were performed to get the feature vectors from the images. They then proposed three different models for classifying soil classes: the first model used three soil classifications and the second model used two soil classifications. Overall, these models have good accuracy and take less time than conventional hydrometer tests, but there is a small sample size and some limitations due to the small size of the sample and the large number of samples.

TABLE 1. OTHER POPULAR RESEARCHES THAT USE MACHINE LEARNING AND IOT IN AGRICULTURE

Author/Researcher	Proposed Methodology	Purpose	Accuracy
Goldstein et al [8]	IoT Device and ML techniques (Linear Regression, gradient boosted regression Tree and boosted tree classifier)	Automated Irrigation System	95%
Hussain [9]	Multilayer Perceptron and Naïve Bayes	Seed classification	99.5%.
Zhong & Zhao [10]	Regression and multi-label classification	Apple leaf disease Identification	93.71%
Maione, Batista, Campiglia, Barbosa [11]	Multilayer Perceptron, Support Vector Machine and Random Forest	Classification of Rice region based on their chemical component	93.83%
Goap, Sharma, Shukla, & Rama Krishna [12]	IoT device with sensor, Support Vector Regression and K mean Clustering Technique	Automated Irrigation System	96%

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There are tools and devices that were developed by many companies [1], [13]. These tools allow farmers to use machine learning to improve crop growth and help farmers understand the impact of climate change, soil conditions, and other factors on crop yields. The company is launching a bridge device that integrates sensors and provides a customizable programming interface for applications that can be used by partners. Farming is moving from agricultural technology to digital agricultural technology through the use of artificial intelligence, data analysis and machine learning and IoT. Other issues have raised the need for sustainable intensification, with the aim of increasing production from existing agricultural land while minimising environmental damage, thereby preserving the country's ability to continue producing food and also contributing to the preservation of biodiversity. These include operating materials that can become pollutants if used inefficiently, as well as environmentally harmful agricultural machinery. Solutions will also be found in the form of data analyses that show the increasing pressures of climate change and other environmental problems such as water pollution and soil erosion.

Companies develop and program autonomous robots that perform tasks such as harvesting. They use computer vision and deep-learning algorithms to process data captured by drones and software - based technologies that monitor plant and soil health. Predictive analytics and machine learning are designed to track and predict the impact of weather conditions on crop yields, plant health and other aspects of agriculture [14].

Cloudera [15] provides today's industries around the world with the most advanced technologies in data analysis, ML, and AI. Customers are increasingly using their IoT data, including movement and dormant data, to create a host of new business opportunities for their businesses and customers. We make this possible by helping companies leverage IoT to drive operational efficiency, introduce new products and services, improve the customer experience and develop completely new business models. The first step is to collect information on the condition of the farm and its environment, as well as on the health and well-being of farmers. IoT-powered devices collect data that farmers previously had not had access to, enabling them to work more accurately, make better decisions and have a clearer picture of what is happening on a farm. Once the data is stored, it is processed and can be used to develop machine learning that finds patterns in this data. IoT systems based on the data analysis of the previous step use artificial intelligence and machine learning to find the best solution to the problem. With these different technologies, we are getting closer to life in the Jetsons, where different autonomous machines can learn to do their daily tasks efficiently. The concept of smart cities involves the use of technology and data analysis to optimize the use of technology to improve the quality of life of residents. Artificial intelligence applications that are part of a smart city include smart buildings, smart streets and smart transport systems.

Agritech [16] a company, uses data analysis and blockchain to obtain references and authenticity for the use of data in the production of agricultural products such as seeds, fertilizers and pesticides. Secondly, agricultural technology companies carry out predictive analysis (i.e., weather forecast, sowing times, irrigation plans, etc.). They use machine learning and deep learning algorithms, as well as artificial intelligence to monitor crop yields, plant health, soil health and other aspects of agriculture.

V. Conclusion

This manuscript provides review of IoT and Machine Learning in agriculture. These technologies are used in a different area such as soil classification, disease identification and classification and automated irrigation system. Although ML and IoT are used in all domain, in agriculture these are mostly used in automated irrigation and classification of disease. The use of automated system is helpful in increasing the yield production that's just not improve the income of farmers, but also help to accommodate the food demand.

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