

Literature Review of IOT and ML Applications in Agriculture

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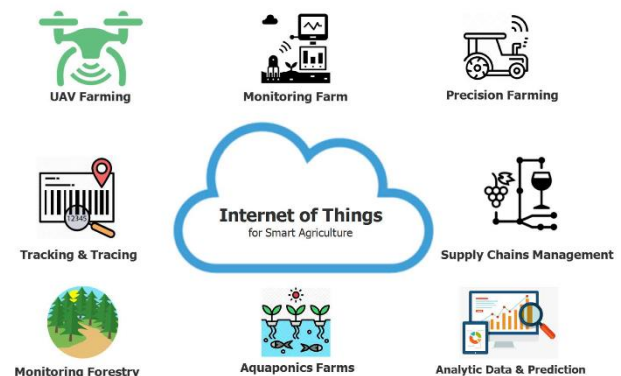
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Abstract— Agriculture is the backbone of the economy. It provides for more than just the necessities of life for people; in underdeveloped nations, it also provides work. There is a reduction in the crop yield and quality. This leads to scarcity of food. The improved technologies like Machine Learning (ML), and the Internet of Things (IOT) are applied in agriculture to overcome the challenges in agriculture. IOT devices like sensors are used in the field to collect soil parameters. Based on sensor-collected data, the ML model recommends the suitable crop for cultivation, which gives good yield and profit to the farmers. Hybrid algorithms are used to perform analysis over the dataset and provide results. In this survey, we examine the previous research work various authors have carried out on implementing IOT and ML in several agricultural principles.

Keywords— Internet of Things (IoT), Machine Learning (ML)

I. INTRODUCTION

IoT - Internet of Things. The term 'internet' is a global network of computer systems that facilitates exchange of various types of information and consisting of interconnected networks using standardized communication protocols. "The Internet of Things (IoT) refers to physical objects ("things") that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet



ML – Machine Learning. It is an area of research that enables computers to learn without explicit programming. The procedure begins with providing high-quality data to our machines, which are then trained by creating machine learning models utilising the data and various techniques. The type of data we have and the sort of task we're seeking to automate will influence the algorithms we use. ML is a programming computer to get better performance using sample data or previous data. The model will be given some parameters to analyze, and after doing so, it will be able to predict performance or gain knowledge from the data. ML applications are used in many areas like agriculture, medicine, industries. In agriculture ML is used for soil parameters prediction, weed and disease detection, crop yield prediction.

Agriculture is the backbone of the economy. In addition to meeting fundamental human needs, it provides jobs in underdeveloped nations.. Nowadays farmers suicide cases are increasing because of loss in the crop. Machine Learning (ML), and the Internet of Things (IOT) are applied in agriculture to overcome the challenges in agriculture. ML together with IOT creates revolution in agriculture. The IOT devices like sensors, microcontroller is used to get the data from soil. These sensors are attached in the field to get soil parameters. Based on the data collected and the datasets available ML model analyse the data

and suggest the best crop to cultivate in that field. ML model consists of hybrid algorithm to give accurate result. This process suggests the cost-efficient cultivation by predicting the crop that gives good profit for farmers.

Contribution

In this study, we aim to discuss some of the challenges in agriculture and also discuss the applications of IOT, ML in agriculture.

- We have surveyed existing literature works involving IOT and ML in agriculture
- We also analysed the different proposed solutions in those works.

II. LITERATURE SURVEY

A.Sharma et.al. [1] proposes using precision agriculture technology to overcome challenges in agriculture. This is also known as "smart farming," which uses machine learning (ML) technology. In this paper, the author presents machine learning applications in the field of agriculture. Based on the soil quality and weather prediction, this ML model suggests the best crop. This demonstrates how agriculture with a knowledge-based approach may increase output, quality, and revenue..

Saleem et.al. [2] suggests significant improvements in agricultural tasks have been observed due to advances in machine learning (ML) concepts. The effectiveness of machine learning algorithms over the previous ten years is presented in this summary. To perform this agriculture operation, modified versions of ML models are used. This helps take the automation in agriculture to next level.

In developing nations like India, agriculture not only provides for people's fundamental needs but also serves as the foundation of the economy and a source of jobs. There are three main divisions in agriculture: pre-harvesting, harvesting, and post-harvesting. [29] used Machine Learning technology, which is the current technology that farmers are benefiting from, to minimize agricultural losses by providing recommendations and crop insights. Application of machine learning will provide efficient and accurate farming and also enable higher quality production in all three areas. ML algorithms give remarkable results for solving agriculture problems.

Liakos KG et.al. [4] explains the use of ML in agricultural production systems is discussed in this research. Big data technologies have advanced machine learning, which is beneficial in the agriculture sector as well. ML is useful for managing soil, predicting yields, and managing crops. The farming system is changing as a result of the application of machine learning to sensor data, this offers more comprehensive suggestions and information to help farmers make decisions and take action.

Integration of machine learning algorithms and sensed data produces cost and time-effective structural prediction of soil

properties and corn yield. Different algorithms and models were developed for the prediction of soil properties and the corn yield. compare the performance of each algorithm. Study [5] suggests that the integration of machine learning algorithms and sensed data is promising for mapping soil properties and corn yield at a local scale.

The evolution of the Internet of Things allows us to develop less expensive systems in agriculture and be easier to control, reduces the use of resources, optimizes production efficiency and increases the quality of crops. [6] paper uses the more protocol approach to develop control processes in the Agriculture System. This approach uses sensor network to monitor and control, which aims to control the conditions that determine the proper development of a crop.

Ray et.al. [7] is about the advent of the Internet of Things has shown new directions for innovative research in agriculture. IOT devices are widely applied in various agricultural applications. These new IOT technologies and solutions are being applied in various agricultural domains. These new methodologies are applied in farming fields. These are useful for advancing agriculture. Automation and intelligence decision making are also important to achieve this project.

In the present generation, the Internet of Things is impacting every field and everyone's life by making everything intelligent. There is development in farming using IOT, by making the traditional methods more optimal but also cost-effective and reducing crop wastage. Author [8] proposed the technology to send messages on different platforms to suggest farmers. The IOT devices take live data from the fields for smart farming. This will allow farmers to take control over their crop in a new era of farming.

Anushree et.al. [9] designed a system that describes smart farming to improve production. Smart farming consists of two parts, the sensor system and a control system. The sensor system obtains the sensed result from different sensors in the field. Two Arduino boards are programmed for both systems. Programming for controlling the system is done in python. Increased quality and quantity of product are achieved by following good decision-making processes.

Farmers are not aware of the crop which suits their soil. Therefore, the work [10] is to assist farmers in validating soil quality, depending on the analysis performed based on a data mining approach. Thus, the system focuses on validating soil quality to predict the best crop suitable for cultivation according to its soil type. This work helps to maximize the crop yield and this also recommends appropriate fertilizer.

Paustian, M et.al. [11], In recent years, farmers have faced losses, so researchers in Germany want to implement precision agriculture in their country. Here, data is collected and analysed using a logistic regression model. The results show a positive influence on precision agriculture adoption. It is also critical

that it has a negative effect on the barley crop. This also requires high investment costs in technologies and minimal knowledge of farming. We can also identify which farmers do not use precision farming solutions by analysing data.

In the paper [12], the author analyses data using the sensitivity analysis method, and it is also noted that the analysis yields different results for farms of varying sizes. This also demonstrates that investment in this technology requires more capital, so farmers with larger farms can afford it and use it for many years, whereas small farmers will not use it for many years, implying that there is less profit than predicted using the sensitivity analysis method. But it also shows small farmers can also use low-level technology to improve their yields. An approach to solving this main problem is to provide financial support to them, and this support should be given until cost-effective technologies are accessible.

Precision agriculture is an emerging and promising technology. This type of agriculture has the ability to help farmers improve input, thereby lowering production costs and also increasing output. Possible increases in profits. The author [13] used a multiple case study approach to collect input and output data from six farms in order to determine the benefits and drawbacks of this type of precision agriculture. The results show that farmers benefit more from decisions taken using precision agriculture. This also requires continuous study, so it requires more technology.

[14] explains about, Agriculture is the backbone of our country, Over 58% of people in the world make their living from agriculture. But farmers are failing to pick the right crop to harvest because they use old, traditional methods. Instead of that, they can use a new precision agriculture method to pick the right one. They can choose based on soil properties or climate. This method requires many technologies, and these technologies should be continuously monitored. At first, the data is collected, and after collecting it, it will be analysed. After analysing the data, a trained model will suggest the crop to harvest. This model is trained with different datasets. Here, linear regression is used to analyse the data.

It is emphasised in [15] that precision agriculture should be implemented with caution. Before shifting from traditional to precision agriculture, farmers should have the minimum knowledge to handle tools. The main problem is convincing farmers to shift from traditional to precision agriculture. This must be done using data analysis to show them how it will increase their revenue, logistic regression is used for data analysis here. In Italy, awareness campaigns are held to educate farmers about precision agriculture.

Generally, farmers plan the next crop based on their previous experience and also with the help of their elders, but this is not working. They are failing at that method. So Bangladeshi researchers tested only six crops to see if it would work: Aus rice, Aman rice, Boro rice, potato, and yam, Jute and wheat. In

[16], a model is trained using previous data; these data were taken from the Research Center. To recommend a crop in this study, the researcher used decision tree learning and the K-nearest Neighbors Regression Algorithm. Because the model has been well trained, it is supervised learning, and it will recommend the best crop based on the trained data set. With this method, farmers can plan which crop to grow based on season and investment.

Hugo Valin et.al. [17], Food consumption is increasing. So, farmers are shifting from modern to other methods and also using more chemicals to grow crops faster, but in fact they are affecting the soil. So, they are facing losses. It is assumed that regional projections and sector changes are very different from one model to another for a given scenario. It is also observed that there will be 60% more demand than now. There are some assumptions about climate change in this. It also demonstrates how 10 global economic models contribute to the model's analysis. Climate change is also affecting calorie availability. A linear expenditure system and the Global Trade Analysis Project are used to analyze the data.

As the population is growing, there will be a demand for food as well. to comprehend the relationship between food prices and food demand based on availability, as well as the income they earn It also shows important impacts of food price rises among poor people, and [18] says that a better understanding of this will provide good food in the future. For this study, they have taken data from 1980–2011 to understand food consumption and the rise in food prices.

To analyze the data, they have used specified parameters to understand the situation with the help of meta-regression.

It reviewed estimates of adoption of certain PA technologies for certain crops in surveys conducted using standard random sampling procedures and examined how estimates using other sampling methods can differ from one another. The author [19] validate this using three adoptions as follows first, the speedy adoption of some precision agriculture technologies worldwide second, the slow adoption of variable rate technology and third, the very limited use of precision agriculture on non-mechanized farms in the developing world. It also implies that AI bots will do the job in the future.

India is a developing country in which most of the people depend on agriculture. As the population grows, we must produce more food to meet people's needs. The author [20] have used the k-nearest neighbor algorithm and the Naive Bayes algorithm to analyze the data. Since soil plays a crucial role in farming, this is done in Uttarakhand, where soil properties are analyzed and crop recommendations are made based on them. It is also used to better detect crops suitable for a particular soil type.

The paper [21] is about, the northern region of our country desperately needs more water supplies., drought is the major disaster of the development of agriculture in this area, and the water supply crisis is becoming more and more now a days. It

is our responsibility to take care of water supply crisis. We have some modules to get the information data of the crop some of them are information management module, data acquisition module and so on ...these modules get the perfect data of the crop which helps for the cultivation of crops.

Vellidis et.al. [22] In many agricultural regions of the world, irrigation has become crucial for crop production. soil moisture sensing device is installed in soil to monitor soil condition and provides soil moisture measurements to the web-page . based on data collected from sensor we know the soil moisture content in the soil. With that data we know which crop should be grown in the fields. The combination of electronics and sensors put at each field area is referred to as a "smart sensor node.". This sensor helps in the production of crop.

Kim, et.al.[23],Water management is the primary application everywhere, and irrigation is a critical component of many agricultural systems.. Hardwiring the system over long distances could not be practicable, and producers might not find it acceptable because it might interfere with their regular farming activities. Sensor plays a major role in irrigation based on the sensor data the irrigation data is decided

Lea-Cox et.al. [24], so many soil based sensors are used to know the soil quality, moisture and so on. The fertility of the soil can be also known by these sensors here the sensors get the data from the crops, that crop data or information is used for crop production and cultivation. Data may vary from season to season depends on season changes. In conclusion we are making some progress to control irrigation and greenhouse environment.

Smith et.al. [25], we get to know how soil classification is done based on IOT and machine learning. By measuring the soil water retention curve and extracting features from the SWRC model. In this we find information of soils and water retention characteristics were obtained from the UNSODA database Based on the soil test results the is analyzed that which crop should grow in which season for the increase of production. This is done by using some sensors.

To overcome the problem of choosing the suitable crops based on the soil conditions, and geographical location and to regulate the suicides, quitting the agriculture field and moving towards urban areas for livelihood caused due to the above mentioned problem, this research work [26] has proposed a method to help the farmers in crop selection by considering all the parameters like sowing season, soil, and geographical location. To assist the concerned problem, they Built a model that gives a right prediction of crop sustainability in a given state for the particular soil properties and also weather and provide guidance of the best suitable crops in that soil, so that the farmer does not award with any loss

Most of the research papers related to crop selection proposed solutions to select the crops that maximises the yield rate of the crop, productivity. What if there were more than one way to use

the limited amount of land available to sow crops at once? then choosing a crop is a challenge. [27], has given solution for this by proposing a method called crop selection method (CSM) to solve the crop selection problem. Publishers have studied the different subsets of crop influencing factors by different prediction models.

S. Pudumalar et.al. [28], Most of the countries still follows traditional agricultural. In recent times the trends in agriculture have significantly evolved due to globalization. Many new technologies have been developed to regain the quality of crops. states the usage of agricultural data with data mining and visual data mining methods are depicted. In order to learn useful information about yield and input application, this research shrinks the high-dimensional agricultural data to a more manageable size (like fertilizers).

SUMMARY

From the above papers, it has been observed that machine learning models plays pivotal role in predicting the suitable crops. Some of the above research papers have spoken about IOT devices which intern helps to collect the precise information regarding the soil quality. The papers also encountered the solution for deciding one crop if two choices for sowing at the same time. Papers also suggest that the government should also take the responsibility by barring some of the expenses faced by the farmers.

CONCLUSION

By surveying all these papers, it is concluded that how the IOT and ML can be pivotal in improving agricultural practices. It has shown various research papers and drew the conclusion on which model will be well suitable for choosing the best crop for the given for the given soil type. Through this productivity of the formers can be increased and proportionately can contribute to the country economy. In this paper, hybrid algorithm has been used to get the accurate output regarding which crops are appropriate for the given soil type. By this perfect crop will be suggested for the farmers which maximises their productivity.

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