A Survey On Smart Agriculture Crop Yield Prediction Using Machine Learning Deep Learning And Cloud Computing

Abhijeet D.Salwe
Student
Computer Science Department
Rajarshi Shahu College of Engineering, Buldana,India

Prof.Lokesh S.Khedekar
Assist.Professor
Computer Science Department
Rajarshi Shahu College of Engineering,Buldhana,India

Abstract— **Crop cultivation is one of the oldest activities of civilization. For a long time, crop production was carried out based on knowledge passed from generation to generation. Accurate prediction of crop yield supported by scientific and domain-relevant insights, is useful to improve agricultural breeding, provide monitoring across diverse climatic conditions and thereby protect against climatic challenges to crop production. The Indian economy, dominatingly, depends upon farming along with agro-industry things. The soil ingredients (like Nitrogen, Phosphorous, Potassium), crop rotation, soil clamminess, atmospheric and surface temperature, precipitation, etc, play an efficient role in cultivation. The present evidence related to this field includes a model which is incorporated with ML algorithms (Random Forest, Decision Tree, Artificial Neural Network) to determine best crop. In this paper applying machine and deep learning techniques and along with the prediction of crop, a clear information is achieved regarding the amounts of soil ingredients needed with their expenses separately. It provides a better accuracy than the existing model. It analyzes the given data and help the farmers in predicting a crop which in return help in gaining profits. The climatic and soil conditions of land are taken into consideration to predict a proper yield.**

Keyword: **Agriculture, Deep Learning Machine Learning Crop,CloudComputing etc**

I Introduction

Agriculture is one of the most fundamental human activities. Agriculture is the key sector for any developing India. As our farming capacity has expanded, usage of resources such as land, fertilizer, and water have grown exponentially.Farming is the backbone for the advancement of the nation. India is called as an Agricultural country for its remarkable agricultural lands and its other resources. In recent days, the temperature and soil moisture factors affect the growth of agriculture such as productivity,diseases, and yield production.The main goal of agricultural planning is to achieve maximum yield rate of crops by using limited number of land resources. Many machine learning algorithms can help in improving the production of crop yield rate. Whenever there is loss in unfavourable conditions we can apply crop selecting method and reduce the losses. And it can be used to gain crop yield rate in favourable conditions. This maximising of yield rate helps in improving countries economy. We have some of the factors that influence the crop yield rate. They are seed quality and crop selection. We need test the quality of the seeds before sowing. As we know that good quality of seeds helps in getting more yield rate. And selection of crops depends upon two things that is favourable and unfavourable conditions. This can also be improved by using hybridisation methods. Many researches are carried out to improve agricultural planning. The goal is to get the maximum yield of crops. Many classification methods are also applied to get maximum yield of crops. Machine learning techniques can be used to improve the yield rate of crops. The method of crop selection is applied to improve crop production.Crop yield is essential in quantitative and financial evaluation at the field level for determining strategic plans in agricultural commodities for import-export policies and doubling farmer's incomes. Crop yield predictions are carried out to estimate higher crop yield through the use of machine learning and deep algorithms and cloud computing which are one of the challenging issues in the agricultural sector

II Literature Survey

Smart Farming

Smart Farming is an emerging concept that refers to managing farms using modern Information and Communication Technologies to increase the quantity and quality of products while optimizing the human labor required.

Among the technologies available for present-day farmers are:

Sensors: soil, water, light, humidity, temperature management

Software: specialized software solutions that target specific farm types

Connectivity: cellular, Wi-Fi, etc.

Location: GPS, Satellite, etc.

Robotics: Autonomous tractors, processing facilities, etc.

Data analytics: standalone analytics solutions, data pipelines for downstream solutions, etc.

Fig 1 Smart Farming

Problem Statement

Problem 1

Crop yield prediction is an important agricultural problem. The Agricultural yield primarily depends on weather conditions (rain, temperature, etc), pesticides. Accurate information about history of crop yield is important for making decisions related to agricultural risk management and future predictions.

Problem 2

Farmers are facing challenges to sustain cultivation of crops due to lack of rainfall and they are rarely addressed because of growing economic competition, rising population and governmental agencies long term plans. To improve agricultural production and growth, agriculturist should investigate every opportunity to meet global demands. Farmers should assess suitability between lands and crops either to expand agricultural lands or to improve production. Many researchers are attracted by the investigation of land and crop suitability to utilize latest technologies like remote sensing, geographical information systems etc.

Smart Farming Application

Crop Management

The crop management category involves versatile aspects that originated from the combination of farming techniques in the direction of managing the biological, chemical and physical crop environment with the aim of reaching both quantitative and qualitative targets [5]. Using advanced approaches to manage crops, such as yield prediction, disease detection, weed detection, crop recognition, and crop quality, contributes to the increase of productivity and, consequently, the financial income. The above aspects constitute key goals of precision agriculture.

Yield Prediction

Fig 2 crop yield prediction

In general, yield prediction is one of the most important and challenging topics in modern agriculture. An accurate model can help, for instance, the farm owners to take informed management decisions on what to grow towards matching the crop to the existing market's demands [8]. However, this is not a trivial task; it consists of various steps. Yield prediction can be determined by several factors such as environment, management practices, crop genotypic and phenotypic characteristics, and their interactions. Hence, it necessitates a fundamental comprehension of the relationship between these interactive factors and yield. In turn, identifying such kinds of relationships mandates comprehensive datasets along with powerful algorithms such as ML techniques [5].

Disease Detection

Crop diseases constitute a major threat in agricultural production systems that deteriorate yield quality and quantity at production, storage, and transportation level. At farm level, reports on yield losses, due to plant diseases, are very common [9]. Furthermore, crop diseases pose significant risks to food security at a global scale. Timely identification of plant diseases is a key aspect for efficient management. Plant diseases may be provoked by various kinds of bacteria, fungi, pests, viruses, and other agents.

Water Management

The agricultural sector constitutes the main consumer of available fresh water on a global scale, as plant growth largely relies on water availability. Taking into account the rapid depletion rate of a lot of aquifers with negligible recharge, more effective water management is needed for the purpose of better conserving water in terms of accomplishing a sustainable crop production [5].

Machine Learning

Machine learning (ML) is a subfield of artificial intelligence that uses computer algorithms to transform raw data from the real world into valuable models. ML techniques include Support Vector Machines (SVM), Decision Trees, Bayesian learning, K-Means clustering, association rule learning, regression, neural networks, and many others [2]. The machine learning-based crop yield prediction method consists of some phases, namely data collection, data preprocessing, data partition and data analysis **Fig 3**.

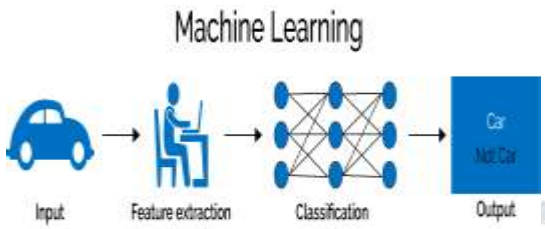

Fig 3 Machine Learning

Deep Learning

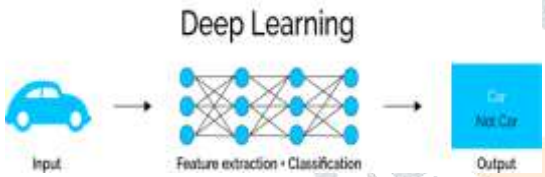

Fig 4 Deep Learning

Deep learning has already been successfully used in the development of decision support systems in various domains. Therefore, there is an incentive to apply it in other important domains such as agriculture.Fertilizers, electricity, chemicals, human labor, and water are the components of total energy consumption in agriculture. Yield estimates are critical for food security, crop management, irrigation scheduling, and estimating labor requirements for harvesting and storage. Therefore, estimating product yield can reduce energy consumption. Two deep learning models, Long Short-Term Memory and Gated Recurrent Units, have been developed for the analysis of time-series data such as agricultural datasets.**Fig 4** shows Deep learning (DL) is a subfield of machine learning. DL algorithms can be used throughout the cultivation and harvesting cycle in agriculture and are receiving considerable attention in developing such decision-making systems. The idea is to feed large artificial neural networks with increasingly large amounts of data, extract features from them automatically, and make decisions based on these data [2]. Deep here refers to the number of hidden layers of the neural network. The performance of the model improves as the network becomes deeper .

WIRELESS SENSOR NETWORKS IN PRECISION AGRICULTURE

Wireless sensor networks (WSNs) can be utilized to supply farmers with a lot of useful information for their crop production and quality decisions that has an enormous potential in agriculture. Thus, a number of WSNs have been found to different uses in agriculture, such as in climate and nutrient data monitoring, crop health forecasting as well as crop production monitoring [9]. Irrigation planning can be predicted using WSNs have a broad impact on the prediction of irrigation planning by considering different factors including weather conditions (such as temperature and humidity) and soil moisture. In prediction algorithms, a combination of AI and WSN can be used in agriculture fields for real time monitoring and intelligent farming decisions making. An Internet of Things (IoT) sensor network which consists of a soil moisture sensor, an electrochemical sensor, and an optical sensor measures the field data continuously that can be used as training data in ML and DL algorithms.

Cloud Computing

Fig 5 Cloud computing

Cloud computing is the delivery of on-demand computing services -- from applications to storage and processing power -- typically over the internet and on a pay-as-you-go basis. Storing and securing huge amounts of data that is accessible only by authorized users, having ability to use applications on the Internet that store and protect data while providing a service. Used in Web services. to integrate photos, maps, and GPS information to create a mash up in customer Web browsers. Cloud computing used in the development of smart agriculture by helping the farmers with the specific tasks like: Crop related , Information , Soil information, Monitoring growth, Farmer's data ,E-commerce, Expert consultation ,etc. The role of cloud computing is Store all the agriculture related information in a centralized cloud, which will be available to all the users at anytime, anywhere , Management of all data related to land, location, area.There are three major players in the public cloud platforms arena - Amazon Web Services (AWS), Microsoft's Azure, and Google Cloud Platform. The top cloud computing companies are addressing a large and growing market.The immense growth of the cloud infrastructure leads to the deployment of several machine learning as a service (MLaaS) in which the training and the

development of machine learning models are ultimately performed in the cloud providers' environment. Farmers can also use the cloud to access information from predictive analysis, whereby they can have an accurate prediction on products that are in demand by different markets and adjust production accordingly. They are also able to have insight on weather conditions and other parameters affecting production[1].

ROLE OF SAAS-BASED CLOUD SOFTWARE IN SMART FARMING

Data Collection

One of the biggest applications of cloud software in agriculture is for data collection and retrievement. Cloud software store tonnes of data relating to weather cycles, crop patterns, soil quality, harvesting and satellite imagery to provide insights with sharp accuracy and speed. All the data related to farm is stored in cloud and hence readily accessible. So if in future, crops are infected with the same symptoms as 10 years ago, the data can be used to find the remedy used at that time.

Data Processing/Analysis

Database management in cloud software tie up all the loose ends of every type of data available with respect to farm to enable higher level of decision-making. Meteorological data, market data, farm data, GIS and water availability - all the data from past and present is analysed thoroughly before giving optimum value of seeding, water and pesticide requirements for a farm. The systems also have an alert system whenever discrepancies in crop growth are detected. Hence these systems work efficiently in case of pest attack informing farmers with actionable data.

III CONCLUSION

The Survey paper has discussed about role of machine learning, Deep learning and cloud computing in the field of agriculture. This survey paper study the benefits of Machine learning, Deep learning and cloud computing by using emerging technologies in the smart farming. This paper gives a brief assistance for the farmers in increasing agriculture yield growth and take efficient care in agriculture.

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