Enhancing Smart Farming Techniques by Applying Prediction Techniques through IoT and Machine Learning

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Abstract

One of the key drivers of the Indian economy is the agricultural industry. Due to the growing population, there is a constant growth in the demand for food production. This proposed work is a farm management system that uses information and technology to identify and analyse field variability through the use of crop production techniques. In order to simplify farming, machine learning and big data technologies have arisen. The results are obtained using techniques for data mining and data analysis. To increase yield, it is possible to forecast the ideal crop for a certain location and piece of land using IoT and machine learning algorithms. The economy of many developing nations is heavily dependent on agriculture. India still employs traditional agricultural methods despite being one of the world's top producers of diverse foods in large quantities. Farmers struggle to meet the increased expectations for high-quality food production in addition to dealing with the changing weather conditions. In order to produce high-quality crops, farmers actually need to be conscious of the shifting climatic circumstances. Smart agriculture powered by IoT and machine learning would assist farmers with crop and fertiliser suggestions in addition to real-time crop monitoring. This paper's main goal is to propose an Internet of Things (IoT)-based Smart Agriculture system that would give farmers advice based on a variety of variables, including soil type, region, crop kind, and rainfall. The system would also concentrate on recommending fertilisers to farmers based on elements like the soil's amounts of nitrogen, phosphorus, and potassium. The four problem statements covered in this essay are yield prediction, price prediction, soil health, and crop disease. So that it can be analysed and offer us approximative results, the useful information about the region, crop type, rainfall, soil type, etc. is provided.

Keywords. Crop Prediction, Price Prediction, Soil health status, Disease detection, Internet of Things, Machine Learning.

1. INTRODUCTION

Agriculture is already starting to benefit significantly from machine learning (ML), which will increase its effectiveness and efficiency. In order to produce agricultural products more effectively, precision agriculture relies on the collection, processing, and analysis of data. With the aid of cutting-edge technology, data can be gathered on a contemporary farm. Agricultural ML is intended to gather particular data and employ particular algorithms to ascertain

anticipated results. It has the ability to sort through a lot of data.

The Internet of Things (IoT) is utilized in smart farming to monitor the fields. It is employed for agricultural monitoring, climate condition monitoring, and other purposes. It helps in data collection. It raises standards while lowering dangers. Farmers can access current weather information, which aids in decision-making.

It requires manual monitoring.

- Insufficient production.
- Diseases of the crop may spread easily.
- The life of top soil is killed.
- Cannot predict the yield at all.
- Weather conditions cannot be predicted.

According to Gartner, Inc., there will be 4.9 billion linked items used in 2015, an increase of 30% over 2014, and there will be 25 billion used between now and 2020. The Internet of Things (IoT) has become a powerful driver for enterprise change in all sectors of the economy and society.

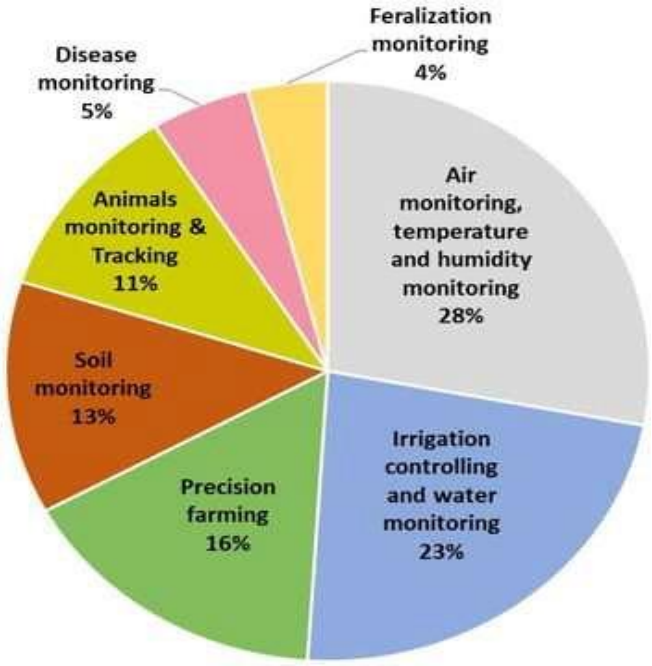

Fig.1 Issues of Traditional Systems in Agriculture [4]

Four problem statements from our project are addressed by the suggested work. As follows:

1) Yield prediction:

Before harvesting, a job called yield prediction is carried out to estimate the yield that will be obtained. It takes a long time to complete. By using information on rainfall, crop type, geography, soil type, etc., our website makes it simpler to anticipate this yield. Using the Random Forest method, it analyses and forecasts the result.

2) **Price Prediction:**
   Before deciding whether to farm a certain crop kind, an evaluation of the price is made. The price that farmers will eventually be paid for their crop is unknown. By analysing historical data, our website provides assistance with this price projection.

3) **Prediction of Soil Health:**
   Knowing which crop to plant depends greatly on the health of the soil and the amount of nutrients present in it. Poor soil health has negative consequences on the crop. Our website provides the crop's N, P, and K values, making it much simpler to anticipate the soil's health. Farmers can choose which crop to cultivate based on those N-P-k levels.

4) **Disease Detection**
   The greatest threat to the crop is crop diseases. It is exceedingly challenging to detect these disorders early. The development of these illnesses threatens to have severe effects on farmers who rely on these robust crops. Simply by categorizing photographs of the leaves of a certain crop, our website aids in the diagnosis of the illness and the provision of a remedy.

2. RELATED WORK

Numerous initiatives have been taken to stop crop loss brought on by illnesses. Integrated pest management (IPM) strategies have replaced historical methods of applying insecticides widely over the past ten years [2] (Ehler, 2006). Whatever the method, the first step in effective illness management is accurate disease identification when it first manifests. The computer power, high-resolution displays, and broad built-in accessory sets of smartphones in particular, including their high-definition HD cameras, provide very innovative techniques to assisting in the identification of diseases. By 2020, it is predicted that there will be between 5 and 6 billion smartphones worldwide. Mobile broadband penetration reached 47% in 2015, a 12-fold growth from 2007, and by the end of that year, 69 percent of the world's population had access to it [3] (ITU, 2015). When HD cameras, high-performance CPUs, and widespread smartphone use are coupled, it creates a situation where, if technically possible, disease diagnosis based on automatic picture identification can be made available on a never-before-seen scale. Here, we use 54,306 photos of 14 crop species with 26 illnesses (or healthy) made publicly available by the Plant Village project to show the technical viability of a deep learning strategy [4] (Hughes and Salath, 2015).

The proposed work, which we found in the previous research papers is that everyone uses climatic factors like rainfall, sunlight and agricultural factors like soil type, nutrients possessed by the soil [5] (Nitrogen, Potassium, etc.) but the problem is we need to gather the data and then a third party does this prediction and then it is explained to the farmer and this takes a lot of effort for the farmer and he doesn’t understand the science behind these factors. To make it simple and

which can be directly used by the farmer this paper uses simple factors like which state and district is the farmer from, which crop and in what season [6-7] (as in Kharif, Rabi, etc.). In India, there are more than a hundred crops planted around the whole country. These crops are categorized for better understanding and visualization. The data for this research has been acquired from the Indian Government Repository [1]. The data consists of attributes – State, District, Crop, Season, Year, Area and Production with around 2.5 Lakh observations.

3. NOVEL MACHINE LEARNING BASED PREDICTION TECHNIQUE FOR SMART FARMING

In this paper, proposed method is about designing a website for making farming much better and effective. It deals with the 4 problem statements i.e., yield prediction, price prediction, soil health status and disease detection. The inputs are given to the website. The website classifies the data and gives the output with the help of Machine Learning algorithms Random Forest and Support Vector Machine it is shown in the figure2.Crop yield is the quantity of agricultural production harvested from a given area of land. Usually used for grains and cereals, the measurement is expressed in tones or pounds per acre. Amount of harvest per area is a measurement used by agricultural producers. On the basis of the crop's collected weight, the extrapolation for the entire farm is subsequently completed. Start-ups, governmental organizations, and academic institutions are leveraging Landsat and satellite imagery for data-driven decision-making since crop production prediction is a key use case in spatial data science. Predictive algorithms are developed with the aid of satellite picture data.

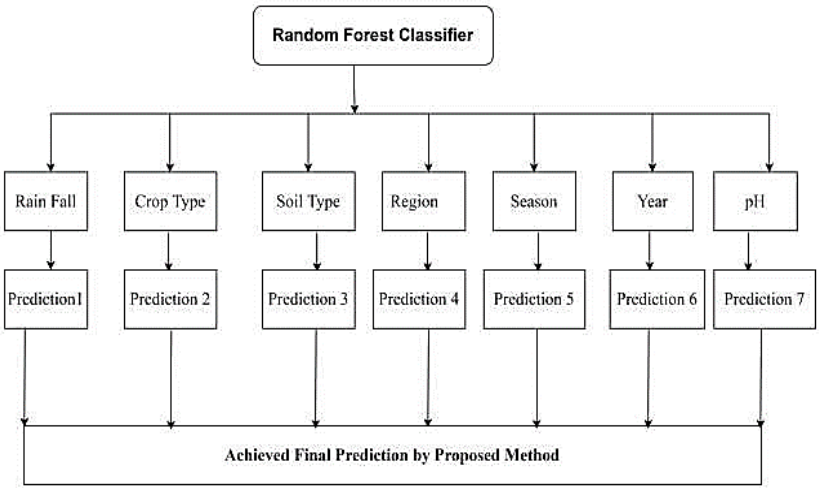

Fig.2 Architecture for different prediction

Prediction of Crop Yield Using AI and ML

Some of the reasons for the decreased rate of agricultural production include the climate and its unpredictability. Thus, accurate weather forecasting is crucial for better crop management. Other sectors that are connected to agriculture include

the sugar industry, which is dependent on sugarcane farmers.

Therefore, agricultural production prediction using machine learning or AI also aids them in organising their business' logistics. As a result, there are many ways that AI and related IoT devices are used in agriculture.

Let's examine the advantages of crop yield prediction using AI/ML.

- Crop monitoring for better production
- Resource and field mapping
- Remote monitoring of farm regions and
- Predictive analytics for data-driven decision-making

Weather predictions

When it comes to forecasting crop yields, there are many different factors. Studying weather information, satellite images, soil conditions, and potential pest attacks are a few of these. These factors come together to provide a comprehensive picture of the ideal window of time for crop production. To deal with any unforeseen issues, there are additional what-if scenarios and alternate action plans.

Therefore, crop output forecasting is crucial to the global food production system. Making informed decisions is made feasible with greater data at hand. The information on crop yield forecast is also helpful to government organizations so they can plan for the security of the nation's food supply.

- **Yield prediction:** We give inputs of crop, state, season, year, area and rainfall. It predicts the yield in Quintal.
- **Price prediction:** We give the inputs of state, crop and year. It predicts the price.
- **Soil Health prediction:** Inputs of crop, temperature, humidity, rainfall and pH are given. It gives optimal N- P-K values of the soil.
- **Disease detection:** We give the images of the leaves. It detects the disease and gives the cure.

Prediction of Soil Health

The basic goal of soil management in farming is to increase crop productivity by enhancing and maintaining dynamic soil characteristics. Particularly in emerging nations like India, population pressure, land constraints, and the deterioration of traditional soil management techniques have resulted in a decline in soil fertility. Crop health is a crucial element in the high productivity agricultural methods used today.

Crop Disease Prediction

Plant disease is characterised as a condition of localised or systemic aberrant physiological functioning of a plant as a result of ongoing, protracted "irritation" brought on by organisms (infectious or biotic disease agents). Insects and parasitic plants, as well as harmful organisms like fungi, bacteria, viruses, and protozoa, are the principal causes of infectious plant illnesses.

4. CONCLUSION AND FUTURE ENHANCEMENTS

One of the key industries in our nation's economic development is the agricultural industry. The issues with traditional farming techniques are eliminated by this strategy, which also improves and simplifies farming. The suggested approach uses ML techniques to enhance crop planning decisions utilising IoT and ML algorithms based on various metrics. Utilizing it is pretty simple. It gathers the data, examines it, and makes predictions. The farmers can make better decisions thanks to this system. It provides the output promptly. It lessens the issue of manual and ongoing farm monitoring. Farmers can greatly benefit from it by boosting their output, effectiveness, and crop quality.

The future of urban farming must take into account a variety of elements, including the changing climate, natural disasters, community resilience, and socioeconomic aspects of farming, in addition to the projected trend of declining agricultural supplies. An indoor vertically scalable climate-controlled structure that integrates renewable energy, biodiversity, and resource management could be the face of farming in the future. This structure would also eliminate waste by turning waste into resources in a circular economy.

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