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Precision Agriculture – Smart Farming For Best Yield Through Machine Learning And Iot

A MOHAN[1] , Ravikiran.K[2] , B. Srinivasa S P Kumar[3] , U.HARITA[4]

[1]Department of CSE CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGYGANDIPET, HYDERABAD, INDIA

[2]Department of IT GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD, INDIA

[3]Department of M.C.A CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGYGANDIPET, HYDERABAD, INDIA

[4]Department of CSE KONERU LAKSHMAIAH EDUCATION FOUNDATION VADDESWARAM, GUNTUR, INDIA

Abstract— Agriculture is still the major occupation in countries like India. It being major source of income in several states, continues to contribute for the economic growth of India. Despite the hard work and the efforts put up by the farmers, it is observed that certain issues such as unpredictable climatic conditions, lack of fertile soil, rainfall and pests disrupt the crop productivity. Technologies like Machine Learning and Internet of Things have paved way for a smart farming through Precision Agriculture that not only promises a better yield but also helps farmers monitor the crops, assists in decision making and automate several processes in agriculture. This paper focuses and attempts to check the soil fertility and foresee the rainfall and predicts the ideal environmental characteristics for the cultivation of cereals like rice. This assures higher yield.

Keywords— Precision Agriculture, Machine Learning, IoT

I. INTRODUCTION

Agriculture plays a predominant role in India and currently there is enormous need for this domain to become smart as it has been forecasted that by 2050 the world population touches 9.5 billion and for every mouth to be fed it is necessary to improve crop yield. It is very unfortunate to note that few farmers even commit suicides when their crops fail. Precision Agriculture is a concept of managing farms through assistance and to design an effective decision support system for various farm activities. The primary goal is to optimize returns on input. Precision farming has set

high farming techniques incorporating emerging technologies such as Internet of Things and Machine Learning. These technologies improve efficiency in day to day needs o farmers assuring them to meet the worlds demands pertaining to food requirement. Fig 1 depicts the relation between smart farming, Machine learning and IoT.

Sensors are available for collecting data to analyze acidity and soil temperature, climatic conditions can be forecasted and weather patterns can be predicted. Farmers can closely monitor their crops and equipment's remotely. Vital data can be collected about soil fertility and nutrition, pests and disease in crops etc. This data collection is not the end but a well beginning, Now the next step demands so as what is to be done with the data collected and how is this data going to contribute towards smart farming? With the collected data, a lot of analysis is done considering various vital factors that improve overall crop productivity and influences crop yield.

Fig 1. Smart Farming through IoT and ML

A .Factors influencing Agriculture

It is essential to understand that there are various factors that when focused upon, contribute to the final success that is the yield. A few factors that highly influence agriculture are as follows:

Soil fertility: Soil is composed of Elements like Nitrogen, Pottasium, Phosperous, Calcium and other necessary supplemental nutrients which help in promoting crop growth. The composition of these in the soil may vary from crop to crop. The agro economic experts collect accurate samples to evaluate nutrient content and analyze if it is beneficial for the cultivation of a particular crop type or are their any deficiencies.

Climate: There is need for an ideal climate for the cultivation of crops. Factors that contribute in this context are temperature, humidity, wind, rainfall. The varying climate and unpredictable weather conditions may affect crop production

Water availability: Watering the crops or so what is also referred to as irrigation is yet another factor that contributes to crop yield. Untimely rain fall or no rain fall influences overall irrigation process. Farmers faces huge losses due to these unpredictable rains. This leads into loss of lives and results the farmers into suicide state.[4]

Pests and disease control: Pests affect the crop quality, and it is a major threat to the overall crop yield. Recognizing plant pests at an early stage of infection will highly support the farmers to prevent the spread of these insects by selecting appropriate pesticides.[3] Using image processing the pests can be detected and guided pesticide or herbicide are sprayed to control pest.

II. SMART FARMING THROUGH MACHINE LEARNING

Having identified a few areas that contribute to the overall crop quality and crop yield it is now necessary to implement smart farming with the usage of technologies like machine learning and IoT.

A generalized MLmodel should be used. The overall procedure is categorized into three major phases and depicted in Fig 3:

Phase 1: Data Collection: During this procedure, the data is collected from various sensors deployed in the field. The data collection is a continuous activity that occurs periodically.

Phase 2: Data Classification: The collected data is now classified according into well-defined categories. For Ex. Soil fertility, soil moisture, rain fall, temperature is all belonging to various categories.

Phase 3: Data Processing and Decision making: This is the most vital phase where in Machine Learning Algorithm comes into operation and the collected data is input to the algorithm and the predictions are noted and based upon the accuracy, decisions are taken.

Fig 2: A Generalized ML Model for a smart Farming

A major subpart of artificial intelligence is machine learning, that not only adapts but also improves itself by training. It exhibits a unique of working. In this approach, the model is developed by training the algorithm based on the available data, in such a way that accurate forecasts can be made. Fig 3. Depicts ML based sustainable agriculture. Although machine learning is a sub-domain of artificial intelligence, this can be further categorized into vast sub domains, among which supervised learning, and unsupervised learning are more familiar.

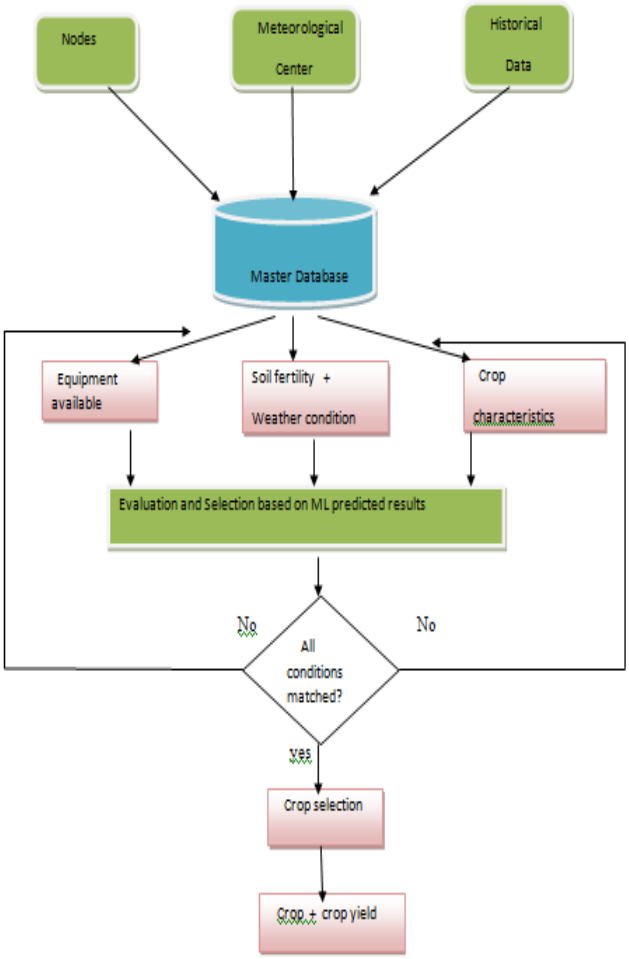

Fig 3. ML based sustainable Agriculture

A.Supervised Learning :

To throw light on this ,this is a type of learning based on a prior perception of the expected results is known. The ultimate objective here is to find inter operational relationships and approximations between the inputs and outputs of the training data. The fundamental property is that the input dataset is classified and assigned to the group based on rules and characteristics of data. However the selection of appropriate classification algorithms can be a tougher decision and can be decided on the effectiveness of the proposed mechanism

B.Unsupervised Learning:

In unsupervised learning, the models are developed by exploiting the hidden patterns in the dataset. The datasets are without any prior label, and the model tries to find the similarity between the data or generate rules such that they can be grouped. Hence unsupervised learning is mostly used in finding data patterns, primary data analytics, dimension reduction.[1]

III. ANALYSIS OF SOIL FERTILITY USING MACHINE LEARNING ALGORITHM FOR IDENTIFYING IDEAL CROP CULTIVATION AND BEST CROP YIELD

As discussed in section 1, for the best yield of any crop, various factors contribute, the most important being the fertility of the soil. A thorough study is being attempted to test the fertility

And the nutrient supplements of the soil using various machine learning algorithms. Also, rainfall prediction was done to identify the best soil and ideal environmental conditions to cultivate cereal crop like rice. For identifying the best soil, the following parameters were considered, the soil is checked for the presence of elements like Nitrogen, Potassium, Phosperous. The environmental conditions such as rainfall and humidity is also predicted using various machine learning algorithms like Linear Regression, Logistic Regression, Random forest and SVC.

The results of the prediction are depicted in Fig 4.

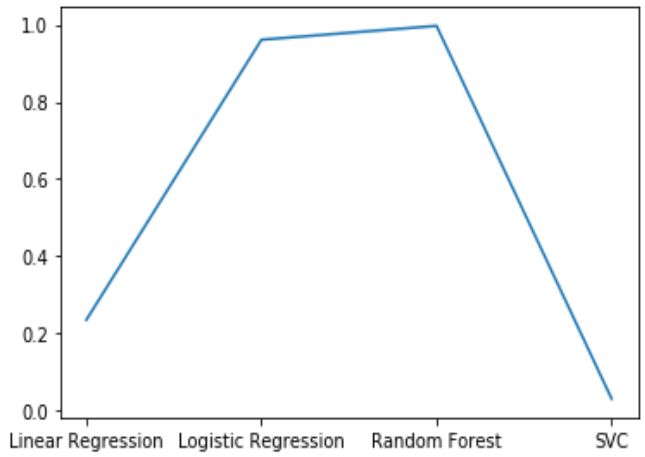

Fig 4. Ideal Rice cultivation environment as predicted by ML algorithms

Sl.No	Algorithm	Accuracy
1	Linear Regression	0.2346
2	Logistic Regression	0.961
3	Random Forest	0.997
4	SVC	0.03

It can be further observed that the random forest model could predict and produce 99.7% accurate result. Given below in table 1 are the prediction accuracy and the algorithm that predicted that

IV. CONCLUSION

As the population of our country is exponentially growing, the food and crop cultivation become a challenge to cope up with this tremendous growth in population. The unpredictable weather and environmental challenges like temperature, wind, rainfall affect the crop yield and growth. Technologies like IoT and Machine Learning have paved a way and transformed traditional farming to the next level popularly known as Precision Agriculture. Assistance is provided to the farmer to decide and opt for best practices needed for the crop cultivation. The farmers can control

their crops and equipments remotely. Automation is possible for certain like irrigation , pest control. An attempt to obtain best crop yield is being done.

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