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The Use of Artificial Intelligence to Improve Agriculture and Crop Management

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ABSTRACT

Rising global population and climate change realities dictate that agricultural productivity must beaccelerated. Results from current traditional research approaches are difficult to extrapolate to all possible fields because they are dependent on specific soil types, weather conditions, and background management combinations that are neither applicable nor translatable to all farms. Increasing food demand will challenge the agricultural sector globally over the next decades. A sustainable solution to this challenge is to increase crop yield without massive cropland area expansion. This can be achieved by identifying and adopting best management practices. To do so requires a more detailed understanding of how crop yield is impacted by climate change and growing-season weather variability. Agriculture is considered as a backbone of economy and source of employment in the developing countries like India.Agriculture contributes 15.4% in the GDPof India. Agriculture activities are broadlycategorizedintothreemajorareas:pre-harvesting,harvestingandpostharvesting. Advancement in areaof machine learning has helped improvinggains in agriculture. Machine learning isthe current technology which is benefiting farmers to minimize the losses in the farming by providing rich recommendations and insights about the crops. This paper presents an extensive survey of latest machine learning application in agriculture to alleviate the problems in the three area so fpre-harvesting ,harvesting and post-harvesting. Application of machine learning in a griculture allows more efficient and precise farming with less human man power with high quality production.

KEYWORDS: ***Machinelearning, soilmoisture, NPK level, precision agricultu*****re.**

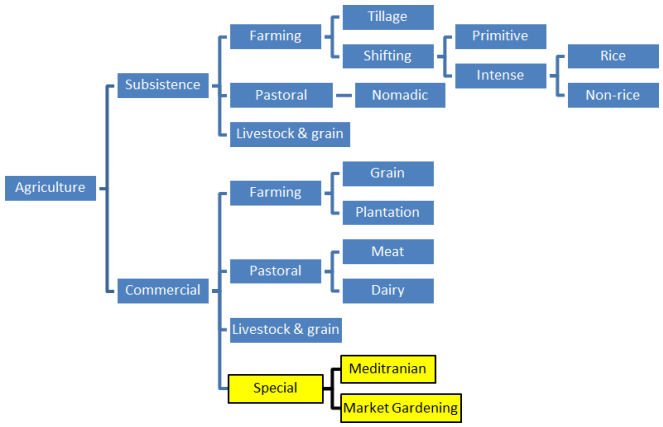
1.INTRODUCTION

Many countries like India still use the traditional way of farming, farmers are reluctant to use advanced technologies while farming because of either the lack ofknowledge, heavy cost or because they are unaware about the advantages of these technologies. Lack of knowledge of soiltypes, yields, crops, weather, and improper use of pesticides, problems in irrigation, erroneous harvesting andlack of information about market trend led to the loss of farmers or adds to additional cost. Lack of knowledge in each stage of agriculture leads to new problems or increases the old problems and add the cost to farming. Growth in the population day by day also increases the pressure on the

agriculture sector. Overall losses in the agriculture processes starting from crop selection to selling of products are very high. As per the famous saying "Information is the Power", keeping track of information about the crops, environment, and market, may help farmers to take better decisions and alleviate problems related to agriculture. Technologies like blockchain, IoT, machine learning, deep learning, cloud computing, edge computing can be used to get information and process it. Applications of computer vision, machine learning, IoT will help to raise the production, improves the quality, and ultimately increase the profitability of the farmers.

PROBLEMSTATEMENT

Crop selection and crop yield prediction are important agricultural problems. The aim of this project is to predict suitable crop based on the given climate parameters and location and also to predict the yield of that crop based on the season and area ofthe field using machine learning algorithms.



A.Classification of Agriculture types

1.1 Objectives of the project

1) To reduce the problem that occurs during the three stages of harvesting i.e. pre-harvesting, harvesting, post harvesting

2) To minimize man power withhigh quality of production.

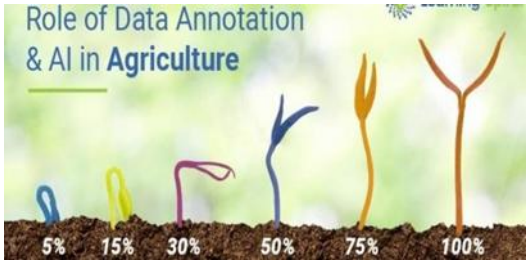
3)To use machine learningtechniques to predict crop and yield of the crop.

4)To analyse the data properly and to process the data to get better predictions.

5)To improve the performance of machine learning models.

1.2. DATA ANNOTATION

Data Annotation is a very important task for machine learning because data scientists need to use clean, annotated, organized data sets to train machine learning and AI models. Our whole Data annotation and data labeling work is performed by well-trained and experienced professionals. ML algorithms can continuously beimproved and hence increase prediction efficiency, and ML can be applied in different fields including agriculture. Machine learning tools allow learning of useful and ML techniques can play a critical role in forecasting pest attack incidences, giving farmers an opportunity to prepare control measures well in advance.



B. Data Annotation

Building algorithms

The data were labeled or classified into two agro-ecologies (highlands and lowlands), and this suggested the implementation of supervised linear and nonlinear class of ML algorithms [51].The algorithms selected were linear algorithms (logistic regression (LR)) and linear discriminant analysis (LDA) as well as nonlinear algorithms [K-nearest neighbor (KNN), classification and regression trees (CART), Gaussian naive Bayes (NB) and support vector machine (SVM)]. The main analysis was done in Python version 3 using the sklearn package.

Description of the algorithms:

While performing agriculture tasks the steps as below is generally followed by farmers.

Step 1: Selection of Crop

Step 2: Land Preparation

Step 3: Seed Spreading

Step 4: Irrigation & fertilizing

Step 5: Crop Maintenance [use of pesticides, crop pruning etc.]

Step 6: Garnering

Step 7: Post-Harvesting activities

1.3 Crop Quality

The accurate detection and classification of crop quality characteristics can increase product price and reduce waste. In comparison with the human experts, machines can make use of seemingly meaningless data and interconnections to reveal new qualities playing role in the overall quality of the crops and to detect them.

Figure C The accurate detection and classification of crop quality playing role in the overall quality of the crops

A.CHALLENGES AND LIMITATIONS IN PREDICTION OF SOIL PROPERTIES AND WEATHER PATTERN:

1. Varying geographical conditions poses a challenge for universal design of the prediction algorithms.

2. Soil parameters prediction is highly dependent on the sample selection philosophy.

3. Dataset selection and filtering is achallenge for researchers with non- computing background.

B. CROP YIELD PREDICTION:

The application of AI techniques in prediction of crop yield is a mammoth task and lack of availability of a universal model makes designing of the algorithm challenging. The most promising algorithms for crop yield prediction are regression algorithms, and neural networks. Advantages of using ML in crop yield prediction: 1.Complex dataset – crop yield prediction involves enormous dataset composing of satellite data and/or historic data. Faster and accurate predictions can be made by utilizing the AI techniques such as regression algorithms (SVR, RF) Neural networks (CNN).

2. Parameter variation – the crop yield depends on a lot of parameters, like climatic factors, soil quality, NDVI, altitude, air parameters. The AI based prediction systems handle the parameters dependency efficiently.

3. Accurate prediction – prediction of parameters using ML exhibit low error indices such as RMSE, and R2 which are standard measures of accuracy for statistical analysis.

C.IoT APPLICATIONS IN PRECISION AGRICULTURE

Precision agriculture refers to a system with minimizing direct involvement of the caretaker/farmer except when there is an urgent need or an emergency i.e. when there is a failure in the system. IoT helps in maintaining the defined standards of parameters needed for day to day work inagriculture. The parameters can be measured using the required sensors and can be uploaded to an IoT cloud for remote monitoring so that the direct involvement of farmers is minimized. The IoT cloud can be used for control purposes also, say for example in detecting and avoiding animal intrusion in the agriculture field. Sensors are an integral part of IoT for precision agriculture without which the monitoring and controlling becomes next to impossible.

CONCLUSION

Agricultural experiments repeated every year in hundreds of locations across the India generate a vast amount of crop yield and management datasets which are useful for broad inferences. Agriculture is considered an important pillar of the world's economy and also satisfies one of the basic need of human being i.e. food. Such datasets have, to date, remained disconnected from each other, and are difficult to combine, standardize, and properly analyze. In the presented work, we overcame these issues by developing large databases and by leveraging the power of ML algorithms. We argue that our algorithms can advance agricultural research and aid in revealing a currently hidden yield potential in each individual farm across the task. Figure 1.3 shows the trend search of keywords “IoT in agriculture” and “sensor in agriculture” on google in the last 10 years. Apart from monitoring and controlling, IoT in

agriculture is also used as data storage technology. Parameters like properties of soil, crop yield, seasonal behavior data, temperature changes, etc can be stored on the IoT cloud which will be helpful in analyses, prediction, and deciding on estimated crop production India.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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