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CROP YIELD PREDICTION AND EFFCIENT USE OF FERTILIZERS

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ABSTRACT

With Agricultural monitoring, in particular in developing countries, can help prevent famine and support humanitarian efforts. A central challenge is yield estimation, which is to predict crop yields before harvesting. We introduce a scalable, accurate, and inexpensive method to predict crop yields using publicly available remote sensing data. This solution if implemented at the soil health centers which have been set up by the government could help all the farmers to use minimum fertilizers, so as to maintain the soil health and also would provide them an opportunity to gain at most revenue from the same piece of land. Thus it would be a win-win for all the parties involved. This is provided with the technologies such as Machine Learning and Image Processing. Machine Learning algorithm is used for prediction analysis i.e. to suggest the best crop and also the corresponding bio-fertilizer. Image Processing provides a technological base that could be used for further developmental projects in the field of automated drone or tractors as this generates a route through the field with the least number of turns. Predictive analysis to suggest the top three more suitable crop based on the nutrition levels of the soil, temperature and also the expected revenue that this particular crop could generate. There are two ways by which this could be used. One would be the automatic way i.e. wherein the farmer just selects their location and based on the previous test that were conducted at or near that place, a suitable crop would be suggested. Second way is to manually enter the details relating to the soil and to obtain a suitable crop for the entered in value.

1. INTRODUCTION

It is estimated that 795 million people still live without an adequate food supply (FAO 2015), and that by 2050 there will be two billion more people to feed (Dodds and Bartram 2016). Ending hunger and improving food security are primary goals in the 2030 Agenda for Sustainable Development of the United Nations (United Nations 2015). A central challenge to address food security issues is yield estimation, namely being able to predict crop yields well before harvesting. Agricultural monitoring, in particular in developing countries, can improve food production and support humanitarian efforts in light of climate change and droughts (Dodds and Bartram 2016).

Existing approaches rely on survey data and other variables related to crop growth (such as weather and soil properties) to model crop yield. This approach is very successful in the United States, where data is plentiful and of relatively high quality. Comprehensive surveys of weather parameters such as the Daymet (Thornton et al. 2014) and land cover types such as the Cropland Data Layer (Boryan et al.

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2011) are publicly available and greatly facilitate the crop yield prediction task. However, information about weather, soil properties, and precise land cover data are typically not available in developing countries which have the greatest need for reliable crop yield prediction. Remote sensing, on the other hand, is a globally available and economical data source that has recently garnered much interest. It is frequently used in computational sustainability applications, such as species distribution modeling (Fink, Damoulas, and Dave 2013; Kelling et al. 2012), poverty mapping (Xie et al. 2015; Ermon et al. 2015), climate modeling (Ristovski et al. 2013), and preventing natural disasters (Boulton, Shotton, and Williams 2016). These multispectral remote sensing images, which include additional information besides the traditional visible wavelengths (RGB) and have fairly high spatial and temporal resolution, contain a wealth of information on vegetation growth and thus on agricultural outcomes. However, useful features are hard to extract since the data are high-dimensional and unstructured. In this paper, we propose an approach based on modern feature learning ideas, which have recently led to massive improvements in a range of computer vision tasks (Krizhevsky, Sutskever, and Hinton 2012; Karpathy et al. 2014).

We overcome the scarcity of training data by employing a new dimensionality reduction technique. Specifically, we treat raw images as histograms of pixel counts, and approximate the high-dimensional histogram with a mean-field assumption. Deep learning architectures are then trained on these histograms to predict crop yield. While this approach performs well, it does not explicitly account for spatio-temporal dependencies between data points. We overcome this limitation by incorporating Gaussian Process on top of deep models. We evaluate our approach on the task of predicting county-level soybean production in the United States. Experimental results show that our model outperforms competing techniques by a large margin, while remaining interpretable in terms of feature importance.

2. LITERATURE SURVEY

Primary investigation is carried out under the following stages, such as Understanding the existing approaches, Understanding the requirements, developing an abstract for the system. In this paper the authors proposed crop recommendation based on data mining concepts such as crop and recommendation and prediction of soil and climate condition. Here they have used the assembling technique and a comparative study of soil classification. The proposed framework will coordinate the information got from archive, climate office and by applying machine learning calculation, Multiple Linear Regression, an expectation of most reasonable yields as indicated by current natural conditions is made. This furnishes an agriculturist with assortment of alternatives of harvests that can be developed. This exploration goes for examination of soil dataset utilizing information mining procedures. It centers around characterization of soil utilizing different calculations accessible. Another essential design is to foresee untested traits utilizing relapse procedure, and usage of computerized soil test grouping [1].

Agriculture plays a crucial role in the life of an economy. It is the backbone for developing countries like India as more than 70% of population depends on agriculture. To increase crop production many factors are responsible like soil, weather, rain, fertilizers and pesticides. They have used soil

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parameters to increase crop production because it is an essential key factor of agriculture. To maintain nutrient levels in the soil in case of deficiency, fertilizers are added to soil. The common problem existing among the Indian farmers is that they choose approximate amount of fertilizers and add them manually. Excess or insufficient addition of fertilizer can harm the plant life and reduce the yield. The paper provides review of various data mining techniques used on agriculture soil dataset for fertilizer recommendation. Mainly focused on various soil parameters like Fe, S, Zn, Cu, N and Ph value etc. In this survey, authors also describe some Agriculture problems that can be solved by using data mining techniques such as Agriculture, Soil Fertility, Fertilizer Recommendation, Data Mining, Clustering, Classification, Neural Network. Algorithms used here are K-mean in Agriculture, K-nearest neighbor in Agriculture, SVMs in Agriculture, Decision Tree in Agriculture [2].

Data mining is the practice of examining and deriving purposeful information from the data. Data mining finds its application in various fields like finance, retail, medicine, agriculture etc. Data mining in agriculture is used for analyzing the various biotic and abiotic factors. Agriculture in India plays a predominant role in economy and employment. The common problem existing among the Indian farmers are they don’t choose the right crop based on their soil requirements. Due to this they face a serious setback in productivity. This problem of the farmers has been addressed through precision agriculture. Precision agriculture is a modern farming technique that uses research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their site specific parameters. This reduces the wrong choice on a crop and increase in productivity. In this paper, the problem has been solved by proposing a recommendation system through an ensemble model with majority voting technique using Random tree, CHAID, K-Nearest Neighbor and Naive Bayes as learners to recommend a crop for the site specific parameters with high accuracy and efficiency [3].

3. EXISTING SYSTEM

The Systems Development Life Cycle (SDLC), or Software Development Life Cycle in systems engineering, information systems and software engineering, is the process of creating or altering systems, and the models and methodologies that people use to develop these systems. In software engineering the SDLC concept underpins many kinds of software development methodologies. Remote sensing data has been widely used for predicting crop yield in the remote sensing community (Bolton and Friedl 2013; Johnson 2014). However, all existing approaches we are aware of rely on hand-crafted features, on the assumption that they can capture most of the information related to vegetation growth contained in high dimensional images. Some widely used features include Normalized Difference Vegetation Index (NDVI) (Quarmby et al. 1993; Johnson 2014), two-band Enhanced Vegetation Index (EVI2) (Bolton and Friedl 2013) and Normalized Difference Water Index (NDWI) (Satir and Berberoglu 2016).

Disadvantages

While a significant effort has been devoted to feature engineering, existing features are fairly crude indexes which depend on a small number (usually two) of the available image bands. Second, high-order moments of the features are rarely explored in existing approaches. In most settings, ground truth average yield data is provided over a region as the regression output, while features are given as input for all the locations within that region. Most works either calculate the mean (first moment) of the features over the region of interest (Johnson 2014) or do sampling (Kuwata and Shibasaki 2015).

4. PROPOSED SYSTEM

Inspired by recent successes in computer vision and speech recognition and in contrast to existing approaches, we are the first to use modern representation learning ideas from AI to automatically discover relevant features from raw data. Our experimental results suggest that our learned features are much more effective, and that bands that are typically ignored could play an important role.

Advantages

- Farmers can know which crop is feasible based on their soil type.
- Chances if increasing income for farmers based on analysis.

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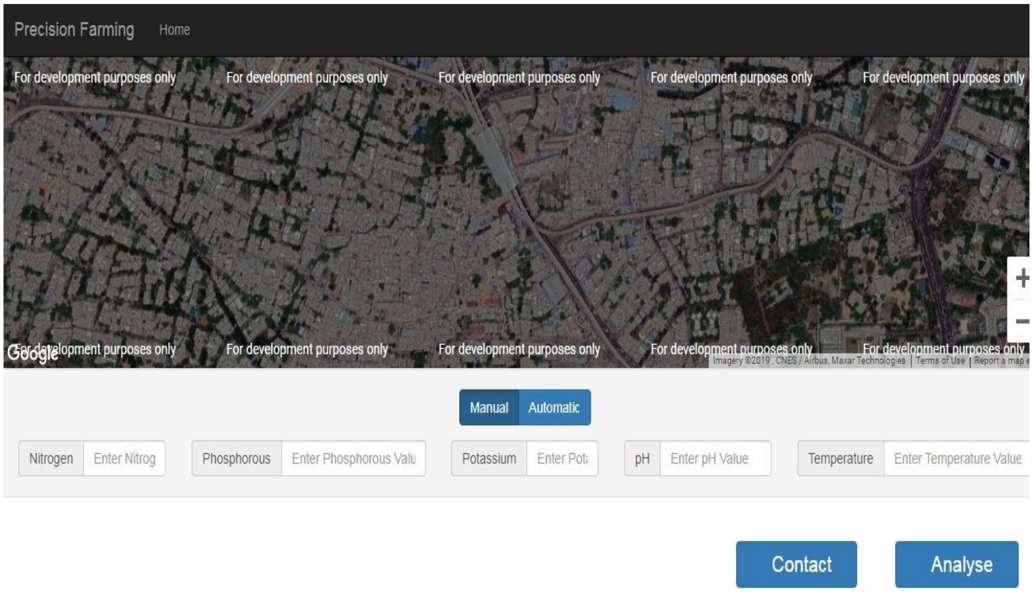
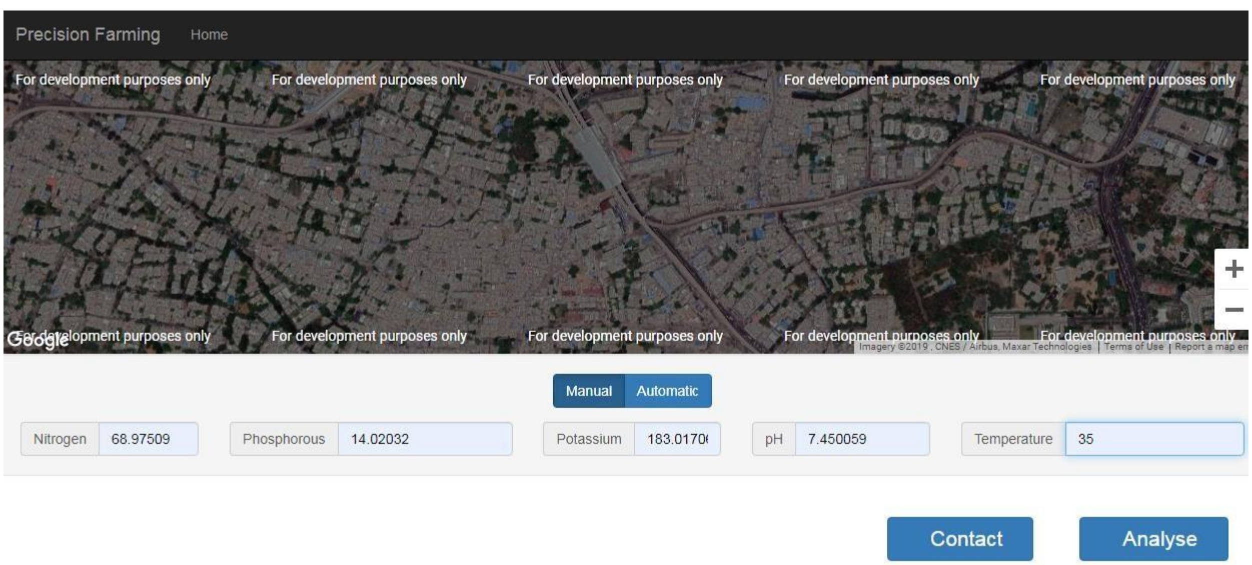
RESULTS

Main page



Enter required values for manual analysis:



View Predicted values:

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Precision Farming Home

Tomato Cultivation Guide Revenue/Hectare: Rs426000

Climatic Requirements

Tomato is a warm season crop, it requires warm and cool climate. The plants cannot withstand frost and high humidity. Also light intensity affects pigmentation, fruit colour, fruit set. The plant is highly affected by adverse climatic conditions. It requires different climatic range for seed germination, seedling growth, flower and fruit set, and fruit quality. Temperature below $10^{0}C$ and above $38^{0}C$ adversely affects plant tissues thereby slow down physiological activities. It thrives well in temperature $10^{0}C$ to $30^{0}C$ with optimum range of temperature is $21\text{-}24^{0}C$. The mean temperature below $16^{0}C$ and above $27^{0}C$ are not desirable. The plant doesn't withstand frost, it requires low to medium rainfall, and does well under average monthly temperature of 21 to $23^{0}C$. Avoid water stress and long dry period as it causes cracking of fruits. Bright sunshine at the time of fruit set helps to develop dark red coloured fruits.

Temperature Requirement:

Temperature Requirement

Sr. No.	Stages	Temperature (^{0}C)		
		Minimum	Suitable	Maximum
1.	Seed germination	11	16-29	34
2.	Seedling growth	18	21-24	32
3.	Fruit set (day) (night)	10	15-17	30
		18	20-24	30
4.	Red colour development	10	20-24	30

Fertilizers:

Fertilizers

As the fruit production and quality depends upon nutrient availability and fertilizer application so balance fertilizer are applied as per requirement. The nitrogen in adequate quantity increases fruit quality, fruit size, color and taste. It also helps in increasing desirable acidic flavor. Adequate amount of potassium is also required for growth, yield and quality. Mono Ammonium Phosphate (MAP) may be used as a starter fertilizer to supply adequate phosphorus during germination and seedling stages. Calcium availability is also very important to control soil pH and nutrient availability. Sandy soils will require a higher rate of fertilizer, and more frequent applications of these fertilizers due to increased leaching of essential nutrients. The seedlings are sprayed with starter solution of micronutrient. Before planting farm yard manure @ 50 ton per hectares should be incorporated. Normally tomato crop requires 120kg Nitrogen (N), 50kg Phosphorus (P_2O_5), and 50kg Potash (K_2O). Nitrogen should be given in split doses. Half nitrogen and full P_2O_5 is given at the time of transplanting and remaining nitrogen is given after 30 days and 60 days of transplanting.

Soil and tissue analyses should be taken throughout the growing and production season to insure essential nutrients are in their proper amounts and ratios. Tissue analysis of a nutritionally sufficient plant will show the following nutrient status:

	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sulphur
%	4.0-5.6	0.30-0.60	3.0-4.5	1.25-3.2	0.4-0.65	0.65-1.4
	ppm	Manganese	Iron	Boron	Copper	Zinc
		30-400	30-300	20-60	5-15	30-90

In the present situation it has been realized that the use of inorganic fertilizers should be integrated with renewable and environmental friendly organic fertilizers, crop residues and green manures.

5. CONCLUSION

Crop yield prediction and efficient use of the fertilizer is successfully predicted and also found the efficient algorithm from both the algorithm and obtained the most efficient output of the yield. Performance of Machine Learning algorithms such as Random Forest , SVM and KNN is help to overcoming the problems faced by the farmers. It provides feedback to the farmers regarding the effective grow of the crop and the maximum yield. This makes the farmers to take the right decision for right crop such that the agricultural sector developed by innovative ideas.

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