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Machine Learning In Precision Agriculture: A Survey On Trends, Applications And Evaluations Over Two Decades

Mrs.Jhansi Rani,[1] B.Bharath Kumar [2]

[1] Asst. Professor, Department of MCA

[2] MCA Scholar, Department of MCA

[1,2] Chadalawada Ramanamma Engineering College, Tirupati.

Abstract- Precision agriculture represents the new age of conventional agriculture. This is made possible by the advancement of various modern technologies such as the internet of things. The unparalleled potential for data collection and analytics has resulted in an increase in multi-disciplinary research within machine learning and agriculture. However, the application of machine learning techniques to agriculture seems to be out of step with core machine learning research. This gap is further exacerbated by the inherent challenges associated with agricultural data. In this work, we conduct a systematic review of a large body of academic literature published between 2016 and 2022, on the application of machine learning techniques to agriculture and identify and discuss some of the key data issues such as class imbalance, data sparsity and high dimensionality. Further, study the impact of these data issues on various machine learning approaches within the context of agriculture. Finally, identify some of the common pitfalls in the machine learning and agriculture research including the misapplication of machine learning evaluation techniques. To this end, this survey presents a holistic view on the state of affairs in the cross-domain of machine learning and agriculture and proposes some suitable mitigation strategies to address these challenges.

I. INTRODUCTION

Precision agriculture represents the new age of conventional agriculture. This is made possible by the advancement of various modern technologies such as the internet of things. The unparalleled potential for data collection and analytics has resulted in an increase in multi-disciplinary research within machine learning and agriculture. However, the application of machine learning techniques to agriculture seems to be out of step with core machine learning research. This gap is further exacerbated by the inherent challenges associated with agricultural data. In this work, we conduct a systematic review of a large body of academic literature published between 2016 and 2022, on the application of machine learning techniques to agriculture and identify and discuss some of the key data issues such as class imbalance, data sparsity and high dimensionality. Further, study the impact of these data issues on various machine learning approaches within the context of agriculture. Finally, identify some of the common pitfalls in the machine learning and agriculture research including the misapplication of machine learning evaluation techniques. To this end, this survey presents a holistic view on

the state of affairs in the cross-domain of machine learning and agriculture and proposes some suitable mitigation strategies to address these challenges.

II. RELATEDWORKS

In Existing system, presented a feasibility study on the use of novel e-nose for the detection of basal stem rot disease in oil palm. The various odours collected via the e-nose were analysed using NN to classify trees as healthy or infected. It was found that the novel system along with the integrated ML was able to recognise infected plants at a high rate of accuracy. Prior to this approach, the manual observations of visual signs were the predominant approach, but these signs present late in the disease life cycle leaving little time for treatment. Another work monitored the presence of a toxigenic fungus in maize. The authors compared the performances of logistic regression and DT, which performed similarly. Also identified were the features which contributed most to the contamination, this enabled improved management by farmers to reduce contamination risk

In another study, investigated the suitability of KNN to classify soil type and properties based on the chemical and physical features of the soil. The current methods of collecting physical and chemical data are laborious and time consuming. This success in applying KNN has high economic value. The authors compared DT, RF, kNN to identify the best classifiers for the prediction of soil taxonomic groups. The authors found that kNN had the highest accuracy.

The Literature review plays a very important role in the research process. It is a source from here research ideas are drawn and developed into concepts and finally theories. It also provides the researchers a bird's eye view about the research done in that area so far. Depending on what is observed in the literature review, a researcher will understand where his/her research stands. Here in this literature survey, all primary, secondary and tertiary sources of information were searched. A literature survey or literature review means that researcher read and report on what the literature in the field has to say about the topic or subject. It is a study and review of relevant literature materials in relation to a topic that have been given

1. **Title :** Crop recommendation system for precision agriculture
Author : J Nisha and C Kavya

Description : 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, this problem is 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.

2. Title : A Flexible and Extensible Framework for Agricultural Crop Yield Prediction
Author : Manjula and J Narasimha

Description : Precision agriculture is the technology driven approach for optimizing farm management in terms of inputs and outputs besides preserving resources. Towards this end many techniques came into existence. Data mining techniques are can be used towards precision agriculture. Numerous efforts have been made to exploit remote sensing data to build various indices for assessing productivity of crops. They include

Temperature Condition Index (TCI), Vegetation Condition Index (VCI) and Normalized Difference Vegetation Index (NDVI). Crop yield prediction can help agriculture related departments and organizations to make strategic decisions. In this paper a novel framework named eXtensible Crop Yield Prediction Framework (XCYPF) is proposed that is flexible and extensible. It has provision for selection of crop, dependent and independent variables, datasets for crop yield prediction towards precision agriculture.

3. **Title :** Prediction of Crop Cultivation
Author : A Gupta and A Bakilwal

Description : Farmers have certain expectations of how much crop will get and make financial decisions based on it. In the past, farmers used to predict crops based on their own experience and observed weather conditions. Weather, pests, and harvest operation may be kept as reference for future years. Currently software can augment traditional knowledge. Keeping accurate data is an important aspect of agricultural risk management. We propose to use machine-learning techniques to develop a prediction model for crop yield production. We compare the performance of various linear and non-linear regressor models using 5-fold cross validation**.**

4. Title: Rice crop yield prediction using artificial neural networks
Author by: Arianna Dagliati.

Description: Rice crop production contributes to the food security of India, more than 40% to overall crop production. Its production is reliant on favorable climatic conditions. Variability from season to season is detrimental to the farmer's income and livelihoods. Improving the ability of farmers to predict crop productivity in under different climatic scenarios, can assist farmers and other stakeholders in making important decisions in terms of agronomy and crop choice. This study aimed to use neural networks to predict rice production yield and investigate the factors affecting the rice crop yield for various districts of Maharashtra state in India. Data were sourced from publicly available Indian Government's records for 27 districts of Maharashtra state, India. The parameters considered for the present study were precipitation, minimum temperature, average temperature, maximum temperature and reference crop evapotranspiration, area, production and yield for the Kharif season (June to November) for the years 1998 to 2002. The dataset was processed using WEKA tool. A Multilayer Perceptron Neural Network was developed. Cross validation method was used to validate the data. The results showed the accuracy of 97.5% with a sensitivity of 96.3 and specificity of 98.1. Further, mean absolute error, root mean squared error, relative absolute error and root relative squared error were calculated for the present study.

III. PROPOSED SYSTEM ARCHITECTURE

The Proposed System is as Follows:

1. The first part identifies the trends within the machine learning and agriculture (ML & Agriculture) literature and find that there has been an increase in the number of publications within the crossdomain of ML & Agriculture over the last two decades, while the type of ML techniques used has changed.

2. The second part investigates the evaluation of ML models in the agricultural setting. Methods used to assess ML models are often geared towards the measurement of classification accuracy. Classification accuracy serves the dual purpose of identifying the optimal classifier for a situation and to assess the ability of the classifier to complete a task.

3. The Third Part argue that, within the context of agriculture, other important factors such as trustworthiness through interpretability are equally important, and in some cases preferable.

4. Finally, Our work reviews the various model evaluation metrics and discusses their suitability for the ML techniques within the context of agriculture.

Advantages of Proposed system

- ✧ The system can make accurate Prediction
- ✧ This system is more performance due to data preprocessing step
- ✧ Efficient

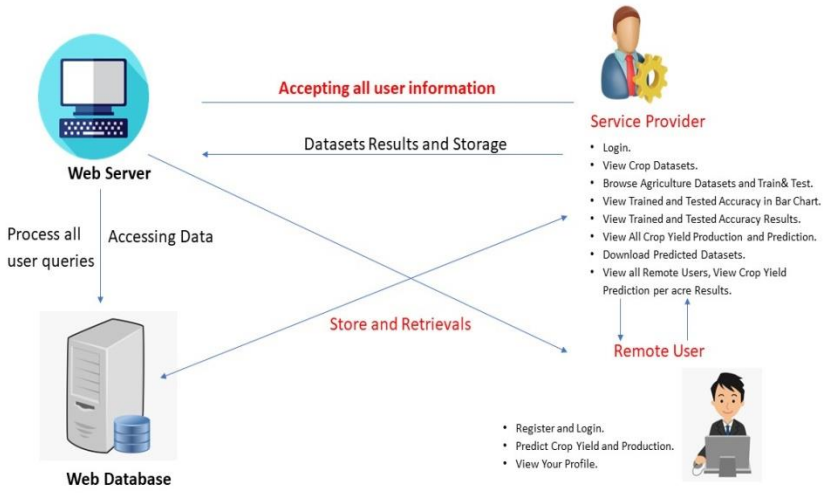

Fig.1 Architecture of proposed system

IV. RESULTS AND DISCUSSION

The output screens obtained after running and executing the system are shown from Fig.2 to Fig.5

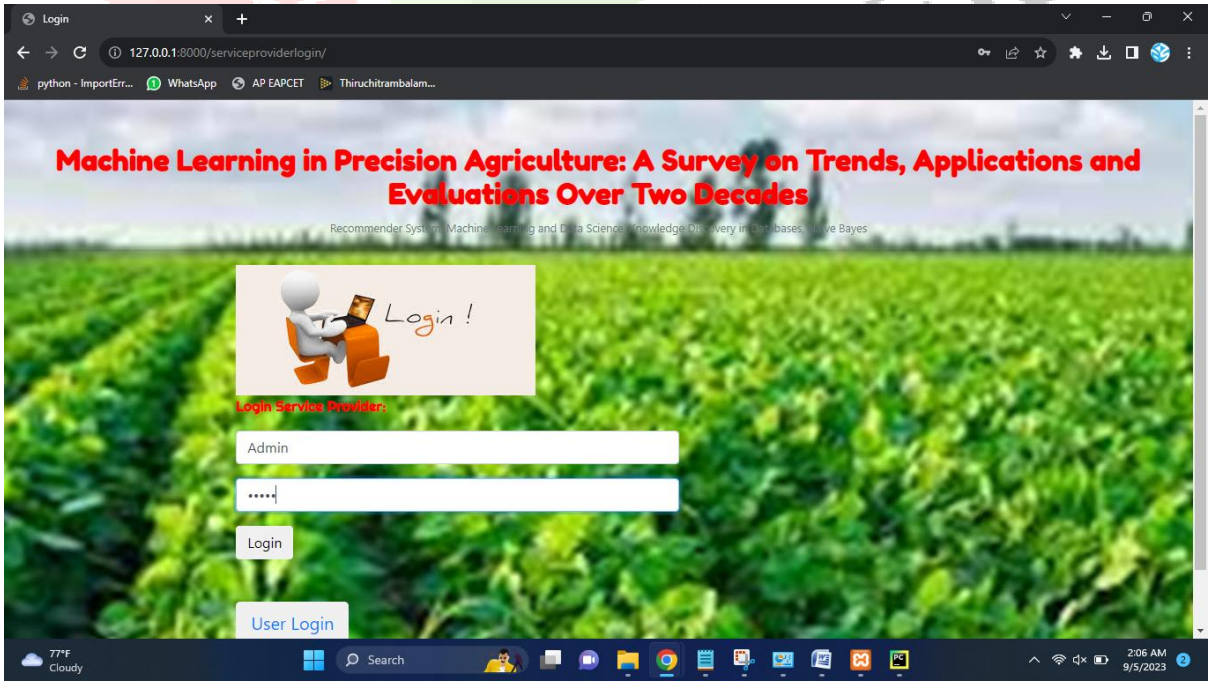

Fig.2 service provider login

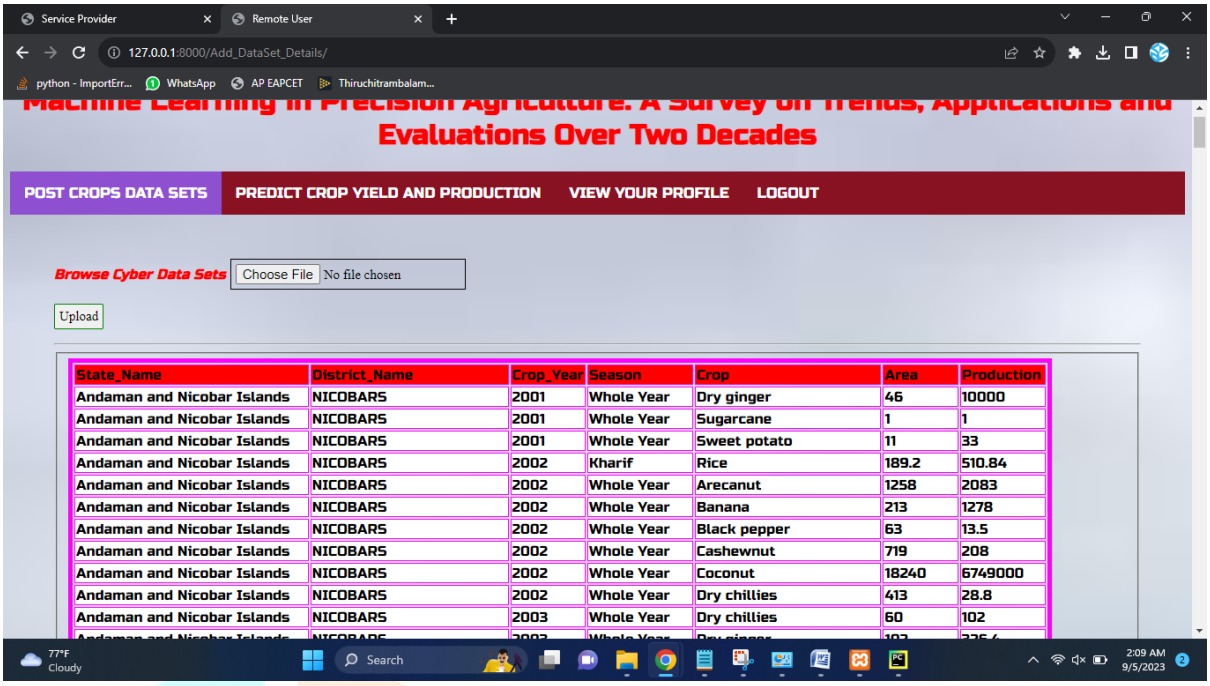

Fig.3 dataset details

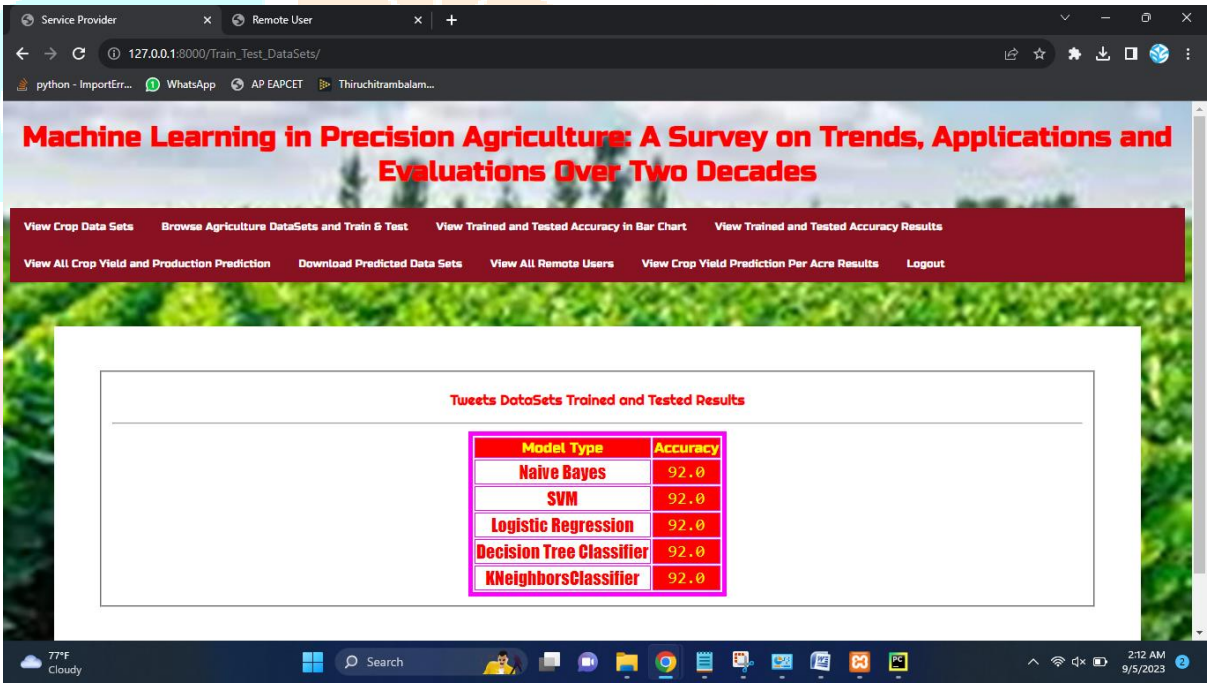

Fig.4 Training and testing accuracy

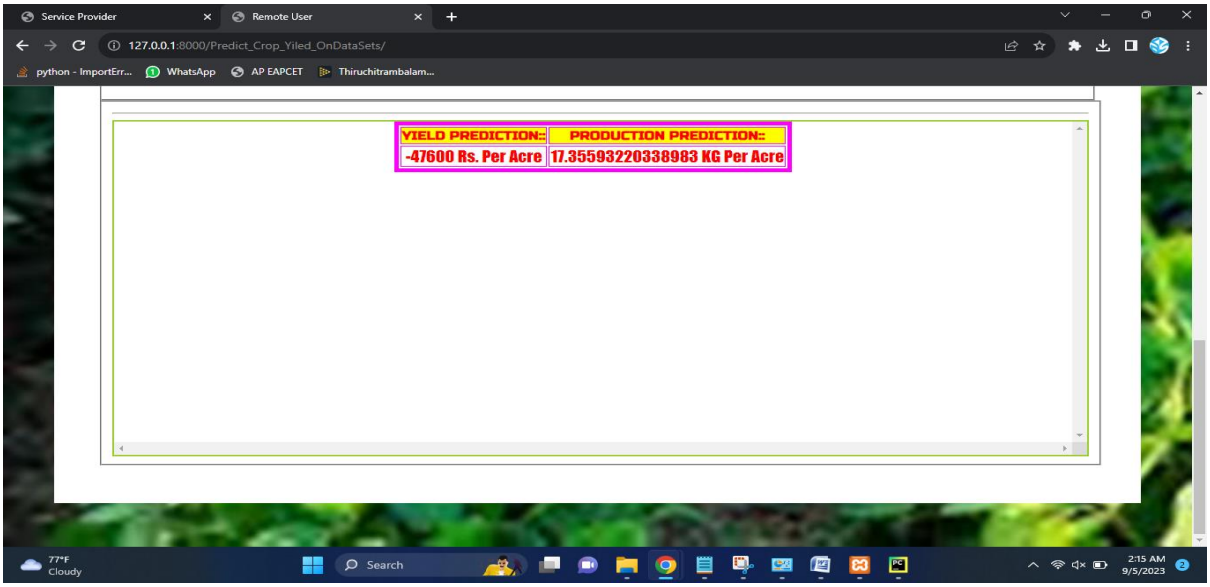

Fig.5 Prediction result

V. FUTURE SCOPE AND CONCLUSION

On the application of machine learning techniques to agriculture and identify and discuss some of the key data issues such as class imbalance, data sparsity and high dimensionality. Further, study the impact of these data issues on various machine learning approaches within the context of agriculture. Finally, identify some of the common pitfalls in the machine learning and agriculture research including the misapplication of machine learning evaluation techniques.

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