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Advancements in Agricultural Technology: A Comprehensive Review of Machine Learning and Deep Learning Approaches for Crop Management and Disease Detection

Deepika S[1], Divya R[2], Gaganashree[3], Sameena H S[4]

Students, B.E. Department of Computer Science and Engineering[1,2,3]

Assistant Professor, Department of Computer Science and Engineering[4]

Global Academy of Technology, Bengaluru, India

Abstract: *Traditional agricultural practices often lack personalized guidance for farmers, which leads to poor crop choices, wasteful fertiliser use, and inadequate disease control. As a result, sustainability and productivity decline. In order to address these issues, this review examines the developments in agricultural technology, with a focus on the fusion of deep learning and machine learning techniques. We look at techniques like ensemble modelling, which optimises crop selection and fertiliser consumption depending on soil properties, and advanced image processing methods, which use leaf images to diagnose plant diseases accurately. Our goal in conducting this study is to provide light on how agricultural technology is developing and how it affects contemporary farming methods. We emphasise the major trends, approaches, and developments in the field of agricultural technology by examining a variety of research papers covering many elements of the subject. Our thorough analysis highlights the potential of deep learning and machine learning techniques to transform agricultural disease diagnosis, fertiliser selection, and crop management. With this investigation, we hope to add to the current conversation about using technology to solve the urgent problems facing the agriculture industry and, in the process, open the door for more effective and sustainable farming methods in the future.*

Keywords: Crop management, Machine Learning, Deep Learning, Soil-crop management, Disease detection

I. INTRODUCTION

Agriculture stands as the foundation of human civilization, providing sustenance and nourishment for centuries. However, traditional agricultural methods frequently encounter difficulties that impede maximum output and sustainability in the face of quickening technical innovation and changing environmental dynamics. A major challenge facing farmers is the lack of tailored advice, which results in poor choices being made in crucial areas like disease control, fertiliser application, and crop selection. It is impossible to overestimate the importance of agriculture in our society, yet because of antiquated practices and a dearth of specifically designed responses to contemporary problems, much of its potential is still unrealized. Within this context, the amalgamation of cutting-edge technology and data-centric methodologies presents a ray of hope, with the potential to transform farming methods and provide farmers with the necessary instruments to prosper in an ever-more intricate terrain.

With more than 1.3 billion people and a significant influence on the GDP of numerous nations, agriculture remains a significant worldwide business. There will be 9.7 billion people on the earth by 2050, according to UN estimates from the Food and Agriculture Organisation (FAO), which means that food production would need to expand by 60% to meet the growing need for food. Moreover, climate change is putting the world's agricultural productivity and food security at risk from extreme weather events, changed precipitation patterns, and rising temperatures. Given these realities, increasing agricultural output, sustainability, and efficiency is more crucial than ever. Even though they have stood the test of time, traditional farming techniques frequently lack the accuracy and flexibility required to handle the complexity of modern agriculture. Farmers often struggle to make well-informed choices about which crops to plant, how much fertiliser to use, and how to control diseases, which leads to less-than-ideal results and waste of resources.

Amidst these difficulties, technological developments present potential ways to transform farming methods and give farmers the information and resources they need to prosper in a setting that is changing quickly. In particular, data analytics, machine learning, and artificial intelligence show promise for offering individualised advice and practical insights catered to the particular needs of individual farms. This initiative's main goal is to close the gap between traditional farming methods and modern expectations by offering farmers individualised advice based on their unique requirements and situations. Our initiative uses cutting-edge technologies like machine learning and image processing to give precise, pertinent, and actionable advice across various elements of agricultural management, in contrast to conventional techniques that frequently use a one-size-fits-all methodology.

The study of several agricultural technology approaches, such as the application of ensemble methods for crop selection and fertiliser usage optimisation based on soil properties, is at the heart of our survey. We also explore the role that disease identification plays in preserving crop health and productivity, looking at how image processing methods might be applied to diagnose plant diseases accurately and efficiently from leaf images.

Our initiative aims to usher in a new era of precision agriculture, where knowledgeable decision-making and technical innovation intersect to create sustainable growth and resilience in the agricultural sector, by providing farmers with individualised assistance and state-of-the-art instruments. By means of interdisciplinary cooperation and an unwavering dedication to ongoing enhancement, our objective is to unleash the complete possibilities of agriculture and establish a more optimistic and successful future for both farmers and communities.

II. HARNESSING THE POWER OF DATA-DRIVEN SOLUTIONS IN AGRICULTURAL INNOVATION

Data-driven solutions are becoming more and more important in modern agricultural operations to help farmers overcome the complicated problems they confront. The integration of cutting-edge technology like data analytics, AI, and machine learning with agricultural innovation is examined in this section. Farmers may increase production and sustainability by using data to assist their decisions about crop selection, fertiliser use, and disease control. These cutting-edge methods provide customised solutions that maximise resource efficiency and reduce environmental impact, from agricultural yield analysis to plant disease diagnostics. Few studies discuss the many ways that data-driven solutions are applied in agricultural contexts, demonstrating the industry's potential for revolutionary transformation.

2.1 Krushi Sahyog: Plant disease identification and Crop recommendation using Artificial Intelligence [1]

This paper suggests an integrated system that uses artificial intelligence (AI) in agriculture to solve problems with crop disease detection and crop suggestion. Specifically, VGG-16 and Sequential Deep Convolutional Neural Network (CNN) models are used in this technique to detect diseases. The VGG-16 model attains a 97.53% accuracy rate, which is high.

One notable feature of the content-based filtering method used for crop suggestions is its all-encompassing approach. To deliver customised suggestions, it takes into account a wide range of factors, including local topography, average annual precipitation, and climatic conditions. This guarantees that the recommendations provided by the system are appropriate for the unique requirements and circumstances of every farmer, thereby optimising output potential and reducing risks related to unfavourable environmental variables.

"Krishi Sahayog," the suggestion algorithm, takes the user's location and crop season into account. By offering precise crop choices and disease detection via a smartphone application, the technology seeks to empower farmers.

Advantages:

AI technologies are expected to provide economic benefits and increase agricultural output by addressing long-standing issues in agriculture. By addressing unbalanced datasets and data preparation issues, the method improves crop selection and disease detection reliability. The CNN VGG16 model's performance evaluation measures, which offer a thorough assessment of the system's effectiveness, include accuracy, sensitivity, specificity, false positive rate, F1 score, Matthews correlation coefficient (MCC), and kappa.

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Disadvantages:
Since the quality of the input data greatly affects the accuracy and efficacy of the system, potential problems might result from the requirement for trustworthy data sources. In order to guarantee the system's practical usefulness in actual agricultural contexts, challenges related to model interpretability and deployment may arise. These will need to be carefully considered and addressed through implementation techniques.

2.2 Usability Improvement with Crop Disease Management as a Service [2]

In our research, we discovered "e-farm with C.R.O.P," a digital platform made to give Indian farmers intelligent assistance. Crop disease detection, crop yield prediction, and crop recommendation for a given location are the main objectives of this integrated system. Through the use of multiple regression approaches for yield prediction and image processing techniques for illness identification, the Fuzzy Analytical Hierarchy Process (FAHP) algorithm in the system provides personalised suggestions.
The technology uses image processing techniques to detect crop diseases, detecting similarities and extracting features using the SIFT algorithm. Multiple regression algorithms are used to forecast crop yields based on several parameters that impact agricultural productivity. Fuzzy Analytical Hierarchy Process (FAHP) is used in crop recommendation in order to manage decision variable preferences and uncertainties.
The system has been enhanced with additional features including pesticide advice, weather updates, a discussion forum, and multilingual assistance to better serve farmers. The system tackles a number of issues that farmers confront, such as inadequate information, uneven production, and language hurdles in the agricultural industry. The suggested system seeks to empower farmers; nevertheless, there are several possible obstacles that may arise, such as data dependability, navigation concerns, and the requirement for user training.
All things considered, the "e-farm with C.R.O.P" system offers a comprehensive strategy for improving and modernising farming methods, bridging the gap between cutting-edge technology and conventional farming.
Advantages:
One of the system's main advantages is that farmers can now make better decisions and use it more easily. The user experience is improved by the addition of other features including pesticide advice, multilingual support, and weather updates.
Disadvantages:
Adoption may be hampered by problems with navigation, user training, and data dependability. The system would have more real-world influence and credibility if its technological details and empirical data from usability testing were further explored.

2.3 Healthy Harvest: Crop Prediction And Disease Detection System[3]

Integrating Machine Learning and Deep Learning approaches, the paper's methodology presents a complete strategy to modernise conventional farming practices. It suggests creating a Web application that would act as a centralised hub for the distribution of agricultural knowledge, with an emphasis on disease detection and suggestions for crops and fertiliser. With this project, farmers will be able to successfully manage crop diseases and maximise crop productivity, two major difficulties that they confront.
The Web-App's recommendation algorithm uses a variety of data sources, such as soil factors, meteorological information, and past crop performance information. The recommendation model is trained using sophisticated algorithms like naive Bayes classifiers and decision trees, which account for variables like rainfall patterns, pH levels, and N-K-P levels. Through the analysis of these factors, the system seeks to offer customised crop selection suggestions, therefore improving agricultural sustainability and production.
The research suggests using neural network models or Support Vector Machine (SVM) to simplify the adoption of image classification approaches in the field of illness diagnosis. To help the platform detect and categorise illnesses more precisely, farmers are urged to provide pictures of impacted plants. By taking a proactive stance, the negative effects of diseases on agricultural output and quality can be lessened by prompt intervention and management techniques.

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It shows how to empower farmers, enhance agricultural decision-making, and add to the overall modernization of the Indian agriculture sector through a comprehensive and technologically sophisticated strategy. The future of effective and sustainable agricultural methods is very promising with the integration of machine learning and deep learning techniques, notwithstanding some obstacles.

Advantages:

Enhanced productivity and production thanks to individualised fertiliser recommendations. timely and precise disease detection in relation to agricultural problems.

Disadvantages:

Accurate picture categorization and the requirement for a strong and well-maintained database are two possible obstacles. Users may need to have consistent access to the internet.

2.4 Plant Disease Detection and Crop Recommendation Using CNN and Machine Learning[4]

The proposed study addresses the pressing issues caused by common crop diseases and poor soil quality, which have a substantial influence on crop yield in terms of both quality and quantity. The study presents an innovative system that uses Convolutional Neural Network (CNN) for accurate disease detection and Machine Learning (ML), specifically leveraging the Support Vector Classifier (SVC) algorithm for crop recommendation, in recognition of the critical importance of early disease diagnosis and effective crop selection.

The dataset is prepared with meticulous attention to detail, drawn from the extensive Plant Village Dataset, and it includes precise naming and identification of a wide variety of plant species in order to create a reliable database. The CNN undergoes extensive training on the illness dataset, and then thorough testing is conducted to ensure that the system reaches a high degree of accuracy and confidence in disease diagnosis. The SVC algorithm's higher performance over other classifiers, including KNN, Logistic Regression, Random Forest, and Decision Trees, supports its use for crop recommendation.

With its expert mapping of crop and soil databases, the integrated model offers farmers insightful information on the best crops to plant depending on the nutrient levels in the soil. By enabling farmers to make knowledgeable choices about crop selection, this capability eventually maximises productivity. Though the approach is well established in the study, additional in-depth investigation into the benefits, drawbacks, and usefulness of the model in actual farming situations might be achieved in subsequent work.

Furthermore, a full examination of the social, economic, and environmental effects of putting such a system into place will greatly advance knowledge of its importance in the context of agriculture. It is imperative that stakeholders grasp the wider, more comprehensive implications of this technology beyond its technical features in order to properly appreciate its potential advantages and difficulties in reshaping agriculture in the future.

Advantages:

The system can provide customised crop suggestions based on soil nutrient levels thanks to the use of machine learning algorithms, especially the Support Vector Classifier (SVC) algorithm, which maximises output and fosters agricultural production. Convolutional neural networks (CNNs) are integrated to provide precise disease diagnosis, prompt monitoring and intervention, and reduced crop losses. The painstaking compilation of the dataset, which was drawn from the extensive Plant Village Dataset, guarantees the creation of a trustworthy database, boosting the validity and precision of crop recommendations and disease diagnostics. The integrated model helps farmers make well-informed decisions about crop selection by offering insightful information about appropriate crops based on soil nutrient levels. This eventually improves farmers' productivity and profitability.

Disadvantages:

Despite the research stresses how carefully the dataset was prepared, maintaining the dataset's quality and dependability is still essential for precise illness detection and crop suggestion. Problems like inconsistent or biassed data might make the system less effective. Notwithstanding the theoretical advantages of the system, its practical application in actual agricultural situations may be constrained by elements like infrastructure, internet connectivity, and technology accessibility in rural regions, where agriculture is mostly practiced. Results from sophisticated algorithms, such as CNN and SVC, might be difficult to interpret since farmers need clear and concise explanations before they can believe and apply the system's suggestions.

2.5 Empirical Study of Crop-disease Detection and Crop-yield Analysis Systems: A Statistical View[5]

In order to shed light on the performance and applicability of these algorithms for a range of agricultural applications, the research study sets out on a thorough analysis into the numerous algorithms used in crop imaging. The approach used compares statistical metrics, such as accuracy and error rates, against several algorithms in an organised manner. The study attempts to give a nuanced knowledge of the strengths and limitations inherent in each algorithm by an in-depth investigation of statistical intricacies, therefore aiding academics and practitioners in making well-informed judgements.

Through the provision of insights into the statistical performance of different algorithms, the study provides stakeholders with important information to enhance agricultural yield analysis and crop disease detection systems. But difficulties in interpreting statistical results might arise, therefore it's important to carefully evaluate any biases and limits related to the statistical measurements that were selected.

To further enhance the context and importance of the empirical study, a comprehensive literature review of current crop-disease detection and crop-yield analysis systems would be beneficial, along with a discussion on the development of these technologies.

Overall, by establishing a statistical basis for upcoming research projects and technical developments in crop imaging and analysis, it makes a substantial contribution to the rapidly developing field of precision agriculture. The study lays the groundwork for the creation of more precise and effective crop management systems, which will ultimately promote sustainable agricultural practices, by clarifying the statistical performance of various algorithms.

Advantages:

When choosing algorithms for crop-related applications, researchers and practitioners can make well-informed selections thanks to the methodical comparison of statistical characteristics. Through an awareness of the advantages and disadvantages of each algorithm, interested parties may select the best course of action for their unique agricultural requirements. The empirical study provides a statistical basis for performance evaluation, which simplifies the algorithm selection procedure. By simplifying, researchers and practitioners may focus on adopting successful solutions instead of undertaking lengthy trial-and-error studies, saving time and money..

Disadvantages:

Although the statistical analysis, the intricacy of the data and methods involved may make it difficult to grasp the results. The statistical results must be properly interpreted by researchers and practitioners to prevent misunderstandings and guarantee the validity of their conclusions. The selected statistical measurements or procedures may introduce biases or limits into the article. These biases raise questions about the validity and consistency of the study's results, emphasising the significance of assessing the empirical data critically. Although the empirical study offers insightful information on algorithm performance, it might not give a complete picture of the larger crop-disease detection and crop-yield analysis system landscape. The importance of the study's findings might be increased and further context could be provided by a more in-depth literature analysis and discussion of the development of these technologies.

2.6 Leverage Points for Governing Agricultural Soils: A Review of Empirical Studies of European Farmers' Decision-Making [6]

A thorough analysis of the factors influencing farmers' decision-making processes in the framework of agricultural soil governance in European nations is conducted by the writers. They conduct a thorough assessment of the literature covering forty years, examining empirical research from a range of disciplines to gain understanding of farmers' decision-making processes.

They employ a strong conceptual framework that connects behavioral features, the social-institutional environment, economic limitations, and decision-making characteristics with objective farm and farmer attributes. After examining 87 European research, they conclude that although incentives and financial limitations are important, pro-environmental attitudes, goodness of fit, and prior experiences also have a big impact on decision-making processes.

The authors use the Web of Science platform to find relevant articles by combining keywords, and then they use exclusion criteria based on abstracts to narrow down their selection. They also perform a bibliometric analysis with

VOS viewer to show patterns in the literature, which improves comprehension of important trends and future paths for study.

Summarizes the body of information on European farmers' decision-making in relation to agricultural soil governance, which makes a substantial contribution. Establishing a basis for forthcoming investigations and stressing the significance of taking into account both financial and non-financial aspects in successful soil management plans.

Advantages:

This report presents an insightful synthesis of empirical studies that shed light on the various elements impacting farmers' decisions about soil management throughout Europe. Through the use of a strong conceptual framework, the writers proficiently arrange and evaluate the data, augmenting the comprehension of the intricacies entailed in agricultural soil governance. This thorough analysis provides a basis for further study aiming at enhancing soil management techniques and advances the field's research agenda..

Disadvantages:

The reviewed literature's heterogeneity as well as its geographical limitations to the EU and its surrounding nations. It is acknowledged that the subjective character of factor classification and the possibility of bias in the selection process could affect how broadly applicable the results are.

2.7 GrowFarm – Crop, Fertilizer and Disease Prediction using Machine Learning [7]

An all-encompassing machine learning system for agricultural disease, fertilizer, and crop prediction. Analyzing soil characteristics and climate parameters is the main goal in order to help farmers make informed decisions.

The system makes accurate predictions of crop recommendations and fertilizer suggestions based on various factors like nitrogen, phosphorus, potassium, and others by utilizing multiple categorization strategies, such as Decision Tree, Random Forest, Naive Bayes, Support Vector Machine, and Logistic Regression. Plant disease diagnosis is additionally aided by image analysis employing the ResNet algorithm.

The methodology involves creating a user-friendly website with a simple and cost-effective interface, enabling farmers to access valuable information on crops, fertilizers, and disease detection. This aims to make farming more efficient, increase crop yields, and enhance customer satisfaction.

Regular dataset updates, IoT integration for automatic soil component inspection, real-time agricultural market rates, and multilingual support are recommended as areas for future work. GrowFarm, which uses machine learning to enhance agricultural decision-making, is a comprehensive approach to smart farming overall.

Advantages:

In addition to lowering losses and offering a consolidated platform for agricultural information, the system may increase agricultural output. The incorporation of machine learning methods for picture analysis and prediction gives conventional farming operations a useful new angle. The website is accessible to a broad audience thanks to its user-friendly interface, which increases its usefulness and adoption among farmers.

Disadvantages:

Reliable and current datasets are necessary to guarantee the correctness of predictions and suggestions, which could provide difficulties or drawbacks. Particularly in remote places, adoption may be hampered by the need for technological infrastructure, such as internet access and equipment for uploading images. Initiatives and training programs aimed at educating farmers about the technology and its advantages may be necessary to guarantee user acceptance and uptake..

2.8 Vegetable Plant Disease Detection And Fertilizer Recommender System [8]

Presents a novel method for recommending fertilizer and detecting disease in vegetable plants using artificial intelligence (AI) and convolutional neural networks (CNN). In order to identify different plant illnesses, the system uses a CNN model that was trained on pre-processed plant picture datasets. It has an accuracy of more than 95% in disease identification. Additionally, a fertilizer recommender module is created that makes recommendations for the optimal fertilizer depending on the kind of soil, other environmental factors, and the recognized plant disease..

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Using the user-friendly design of the system, farmers may submit photographs of their plants and get real-time disease diagnosis and fertilizer suggestions. Given that the suggested method outperforms current methods in terms of accuracy and speed, practical applications can benefit from using it..

The authors stress the possible effect on lowering the use of pesticides and fertilizers and encouraging ecologically friendly farming methods. The system's compatibility with modern agricultural technologies, such as robots and drones, allows for automatic plant disease detection and fertilizer recommendation..

The study recognizes the value of disease and vegetable plant datasets—like the PlantVillage dataset—in the development of machine learning algorithms for efficient disease diagnosis.

Promising innovations that could improve agriculture's productivity, profitability, and sustainability are being offered. It is advised that more investigation and advancement be undertaken in order to resolve any possible drawbacks and improve the system's practicality.

Advantages:

Train the CNN model on a smaller dataset through the use of transfer learning, which increases efficiency and lowers resource needs. Given that it has been trained on a broad variety of plant species, the system's adaptability makes it suitable for use with a wide range of crops, thereby enhancing its usefulness. Evaluating the system thoroughly using metrics like recall, accuracy, and precision guarantees that it works well in real-world farming situations. Identifying nutritional deficiencies, recommending fertilizer, and providing a comprehensive solution for plant health management all help to increase agricultural yields and promote sustainability..

Disadvantages:

It is advised to increase the dataset used to train the CNN model in order to improve accuracy and performance even more, albeit this may take a substantial amount of time and money. The system's capacity for intricate data processing and prediction may be improved by using cutting-edge deep learning techniques like long short-term memory (LSTM) networks. It may be difficult to put into reality because to issues including user uptake, ongoing dataset upgrades, and integration with current agricultural methods. These issues call for careful planning and stakeholder participation.

2.9 Leveraging the Benefits of Soil-Crop, Fertilizer, and Disease Prediction[9]

Discusses how important the agriculture industry is to the country's growth in terms of jobs, social progress, and economy. In order to assist farmers with crop and fertilizer forecast, it suggests a machine learning-based approach that takes into account certain soil parameters and climatic boundaries. The Crop Recommendations System and Fertilizer Recommendation System are made more effective by using different classification strategies.

The process is multi-step. In order to fill in missing values and scale or alter the data, the dataset must first be imported and pre-processed. Hidden patterns are found through exploratory data analysis. Following the division of the data into training and testing sets, a number of classification models are used, including Random Forest, Decision Tree, Naive Bayes, Support Vector Machine, and Logistic Regression and others. A comparison of these models' accuracy shows that Random Forest and Naive Bayes have the highest accuracy rates.

In order to predict crop sustainability, the goal and scope include creating a trustworthy crop recommendation system based on soil composition and climatic data. By advising appropriate crops for each farmer's region and offering advice on crop maintenance and disease detection using picture analysis, the system seeks to reduce losses for all farmers.

The study emphasizes how important it is to use machine learning to anticipate diseases, fertilizers, and soil-crop conditions in the context of India's agricultural industry. With further improvements targeted at enhancing its performance and usability, the suggested system shows encouraging accuracy rates and useful applications.

Advantages:

Farmers may make educated decisions using the system without having to invest a lot of money or time, since it provides a cost-effective and practical solution. Farmers with differing degrees of technology literacy may utilize the system due to its user-friendly interface and design, which guarantees broad acceptance and usefulness. The system improves decision-making and agricultural management methods by providing accurate forecasts for crops and fertilizers through the use of machine learning algorithms and classification approaches.

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Disadvantages:

The representativeness and quality of the datasets used for training have a major impact on how well the machine learning-based system performs. The dependability and credibility of the system may be compromised by erroneous or biased data, which might result in incorrect forecasts and suggestions. A major problem is ensuring that high-quality, current information are always available, particularly in dynamic agricultural areas where variables like soil composition and climatic conditions can change over time.

2.10 Artificial Intelligence (AI) for Agricultural Sector [10]

The writers talk about how agricultural methods have changed throughout time and how new technology have emerged, with a special emphasis on India's agricultural sector. The study emphasizes how important agriculture is to India's economy and the difficulties caused by things like erratic water supplies. By taking into account a variety of land factors and climatic conditions, the proposed Intelligent Agriculture initiative seeks to harness innovation to boost agricultural output.

The project's methodology entails using knowledge research methodologies to create an Android application. This program is meant to estimate rainfall, diagnose soil shortages in terms of fertilizer ingredients, detect leaf diseases, and predict ideal crops based on current weather and soil conditions. Reputable organizations, such as the Indian Meteorology Department (IMD), provide the data used in the program, which includes variables like temperature, precipitation, and soil properties.

Demonstrates the revolutionary potential of intelligent agriculture in India and positions it as a major agricultural industry enabler of the artificial intelligence era. The approach is centered on developing Android applications, utilizing information from reliable sources such as IMD, and applying knowledge research methods. Although the benefits appear promising, resolving any obstacles is necessary for a thorough assessment of the suggested strategy and its consequences for Indian agriculture.

Advantages:

Through data-driven decision support on crop selection, disease detection, rainfall forecasting, and fertilizer needs, the system seeks to improve agricultural yields, which in turn will boost profitability and build farmer confidence.

Disadvantages:

For the system to be successfully deployed and adopted, it may be necessary to take into account elements like data accuracy, implementation costs, the needs for the technology infrastructure, and user acceptability.

IV. ANALYSIS TABLE

The following table gives the analysis of techniques and methods used in research papers on Crop Management and Disease detection.

Sr. No	Paper Title	Authors	Method
1	Krushi Sahyog: Plant disease identification and Crop recommendation using Artificial Intelligence	Narayani Patil et.al	Implemented Deep Convolutional Neural Network (CNN) models - Sequential and VGG-16. Achieved accuracy of 97.53% with VGG-16.
2	Usability Improvement with Crop Disease Management as a Service	Komal Raikar et.al	Image processing techniques used for diagnosing crop diseases.SIFT algorithm employed for feature extractionand similarity matching.Multiple regression technique utilized for predicting crop yield.Fuzzy Analytical Hierarchy Process (FAHP) used for decision-making on the best crop.
3	GrowFarm – Crop, Fertilizer and Disease Prediction using Machine	Suresh Singh Rajpurohit et.al	Machine Learning (Decision Tree, Random Forest, Naive Bayes, SVM, Logistic Regression)

	Learning		- Image Processing (ResNet for disease detection)
4	Vegetable Plant Disease Detection And Fertilizer Recommender System	Prof.Suhas Chavan et.al	Convolutional Neural Networks (CNN), Image preprocessing and segmentation , Ailment detection , Fertilizer recommendation using a decision tree algorithm
5	Leveraging the Benefits of Soil-Crop, Fertilizer, and Disease Prediction	Jaafer Al-Saraireh and Ala Masarweh	Machine Learning Algorithms - Decision Tree, Random Forest, Naive Bayes, Support Vector Machine, Logistic Regression
6	Leverage Points for Governing Agricultural Soils	Bartosz Bartkowski et.al	Data collected from empirical literature spanning. The analysis includes 87 studies from various disciplines.
7	Artificial Intelligence for Agricultural Sector	Krishna Mridha et.al	employs Android app development with knowledge research techniques to create an application for predicting optimal crops and detecting leaf diseases based on current weather and soil conditions. Additionally, the app forecasts rainfall and identifies soil deficiencies in terms of fertilizer elements.
8	Empirical Study of Crop-disease Detection and Crop-yield Analysis Systems : A Statistical View	Akshay Dhande et.al	The methodology employed involves a systematic comparison of statistical parameters, encompassing error rates and accuracy, among different algorithms.
9	Plant Disease Detection and Crop Recommendation Using CNN and Machine Learning	Raj Kumar et.al	CNN employed for disease detection. Support Vector Classifier (SVC) used for crop recommendation. Comparison of various classifiers (KNN, Logistic Regression, Random Forest, Decision Trees) for performance evaluation.
10	Healthy Harvest: Crop Prediction And Disease Detection System	Sambhav Bhansali et.al	Prediction using image processing steps. Mentioned focus on reviewing different algorithms for crop-growth. adoption of image classification techniques, facilitated by Support Vector Machine (SVM) or neural network models.

V. CONCLUSION

The study conducted a comprehensive literature review of several articles published between 2017 and 2023 offering profound insights into the transformative role of machine learning and deep learning techniques in reshaping agricultural practices, particularly in the realms of crop management and disease detection. This comprehensive review has shed light on the transformative potential of machine learning and deep learning approaches in revolutionizing crop management and disease detection in agriculture. Through the analysis of a diverse range of research papers, we have explored the advancements in agricultural technology, from crop recommendation systems to disease diagnosis techniques. By leveraging data-driven solutions, farmers can make informed decisions that optimize productivity, minimize resource wastage, and promote sustainability. Even while these technology advancements present exciting possibilities, there are still issues that need to be resolved, including data accuracy, implementation costs, and the requirement for technological infrastructure. To ensure that agricultural technology is widely adopted and that its full potential is realised, multidisciplinary cooperation and ongoing research are important. In the end, we can create an agricultural sector that is more resilient, efficient, and sustainable and that serves the requirements of both the current and future generations by embracing innovation and utilising data.

REFERENCES

[1]. N. Patil, S. Kelkar, M. Ranawat and M. Vijayalakshmi, "Krushi Sahyog: Plant disease identification and Crop recommendation using Artificial Intelligence," 2021 2nd International Conference for Emerging Technology (INCET), Belagavi, India, 2021, pp. 1-6, doi: 10.1109/INCET51464.2021.9456114.

[2]. K. Raikar, S. Gawade and V. Turkar, "Usability improvement with crop disease management as a service," 2017 International Conference on Recent Innovations in Signal processing and Embedded Systems (RISE), Bhopal, India, 2017, pp. 577-582, doi: 10.1109/RISE.2017.8378221.

[3]. Suresh Singh Rajpurohit, SowmenParui, Rakshita Bhole . "GrowFarm – Crop, Fertilizer and Disease Prediction using Machine Learning ." 2023 International Journal of Intelligent Systems and Applications in Engineering 12.1 (2024): 467-473.

[4]. Prof.SuhasChavan ,PrajaktaSaswade, Yash Pokale, Aditya Kadu,Harshal Puranik Priya, "Vegetable Plant Disease Detection And Fertilizer Recommender System .“2023 nternational Journal of Current Science (IJCSPUB) 12.1 (2022): 2250-1770.

[5]. Yuvraj Rakheja, Suyash, Nipun Sharma, Kajol Dahiya, " Leveraging AI for Crop Recommendation and Disease Detection in Indian Agriculture .“ International Research Journal of Modernization in Engineering Technology and science 3.06 (2023).

[6]. K. Mridha and S. M. A. Hasan, "Artificial Intelligence (AI) for Agricultural Sector," 2021 International Conference on Control, Automation, Power and Signal Processing (CAPS), Jabalpur, India, 2021, pp. 1-6, doi: 10.1109/CAPS52117.2021.9730581.

[7]. Bartkowski, B., & Bartke, S. (2018). Leverage Points for Governing Agricultural Soils: A Review ofEmpirical Studies of European Farmers’ Decision-Making. Sustainability, 10, 3179.doi.org/10.3390/su10093179.

[8]. Dhande and R. Malik, "Empirical Study of Crop-disease Detection and Crop-yield Analysis Systems: A Statistical View," 2022 International Conference on Emerging Smart Computing and InformaticsPune, India, 2022, pp. 1-4, doi: 10.1109/ESCI53509.2022.9758284.

[9]. R. Kumar, N. Shukla and Princee, "Plant Disease Detection and Crop Recommendation Using CNN and Machine Learning," 2022 International Mobile and Embedded Technology Conference (MECON),Noida, India, 2022, pp. 168-172, doi: 10.1109/MECON53876.2022.9752173.

[10]. S. Bhansali, P. Shah, J. Shah, P. Vyas and P. Thakre, "Healthy Harvest: Crop Prediction And Disease Detection System," 2022 IEEE 7th International conference for Convergence in Technology(I2CT),Mumbai, India, 2022, pp. 1-5, doi: 10.1109/I2CT54291.2022.9825446.