iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.69677

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Intelligent Crop Recommendation System Using Machine Learning Approach

Daniel Raj K[1], Dr. T. Jasperline[2], Benitlin Subha K[3], Ponseka G[4] ,Geowin ChristoSingh R[5], Josephine Monisha R[6], Jeyapretta Emima J[7] , Barath Sanjai Lordwin DJ[8]
[2]*Department of Computer Science and Engineering, Dr. G.U.Pope College Of Engineering*
[3]*Department of Information Technology, Kings Engineering College*
[1, 4, 5, 6, 7, 8]*Department of Computer Science and Engineering, Dr. G.U.Pope College Of Engineering*

Abstract: The agricultural sector in India, despite its status as a leading producer globally, grapples with low farm productivity, resulting in diminished incomes for farmers. Addressing this challenge requires a strategic approach centered around increasing productivity, thereby enhancing farmer livelihoods. Crucially, farmers must be equipped with the knowledge of which crops are best suited to their specific plots of land to optimize yield potential. This entails consideration of various factors such as temperature, humidity, soil pH, rainfall patterns, and nutrient composition. However, many farmers lack access to this vital information, leaving them uncertain about which crops to cultivate for maximum yield and profit. Thus, the implementation of crop recommendation systems powered by machine learning algorithms presents a promising solution. By leveraging data on environmental conditions and soil properties, these systems can accurately predict suitable crop choices for individual farms, empowering farmers to make informed decisions and ultimately improve their productivity and income levels.
Keywords: Precision Agriculture, Yield Prediction, Decision Tree, Crops, SoilPH, ML, S

I. INTRODUCTION

The decision-making process for farmers regarding which crop to cultivate is often influenced by subjective factors such as intuition and short-term profit motives, along with a lack of awareness about market demand and soil suitability. Such misguided decisions can impose significant financial strain on the farmer's family and may even contribute to the alarming rate of farmer suicides reported in the media. In a country like India, where agriculture contributes approximately 20.4 percent to the Gross Value Added (GVA), the repercussions of such decisions extend beyond individual households to impact the entire regional economy. Recognizing the gravity of this issue, there is an urgent need to develop a system that can provide predictive insights to Indian farmers, enabling them to make informed choices about crop selection. To address this challenge, we propose the implementation of an intelligent system that takes into account environmental parameters such as temperature, rainfall, and geographical location, as well as soil characteristics including pH value, soil type, and nutrient concentration, to recommend the most suitable crop for cultivation.Machine learning, as a branch of artificial intelligence (AI), enables systems to learn and improve from experience autonomously, without explicit programming by a human developer. The learning process begins with the analysis of data or observations, seeking patterns that can inform future decision-making. Unlike traditional programming, where procedures are explicitly defined to process input data and produce output, machine learning algorithms adapt and refine their actions over time to enhance accuracy and effectiveness without human intervention. In contrast to conventional programs, which follow predefined logic and procedural steps, machine learning models dynamically adjust their behavior based on data patterns, allowing for more flexible and adaptable solutions to complex problems.The project involves gathering data from diverse sources, followed by applying techniques for parsing and cleansing to prepare the raw data for processing. Subsequently, subjecting the refined data to a machine learning system, along with real-time analysis, facilitates the development of an efficient crop value updating system. Utilizing an ensemble of classifiers enhances the robustness and efficiency of the model, while employing ranking techniques aids in making effective decisions. Additionally, a web application is created for user registrations and data collection, with the overarching objective of identifying a broader range of crops suitable for cultivation throughout the season. This proposed system aims to alleviate the challenges faced by farmers in crop selection and maximize agricultural yield by predicting crop outcomes based on factors such as rainfall, temperature, area, season, and soil type. The scope for an intelligent crop recommendation system utilizing a machine learning approach is extensive, offering transformative potential across various facets of agriculture. By analyzing diverse data sets encompassing soil characteristics, climate patterns, historical yields, and market trends, such a system can effectively guide farmers in selecting the most suitable crops for their specific regions and seasons, thereby maximizing productivity and profitability.

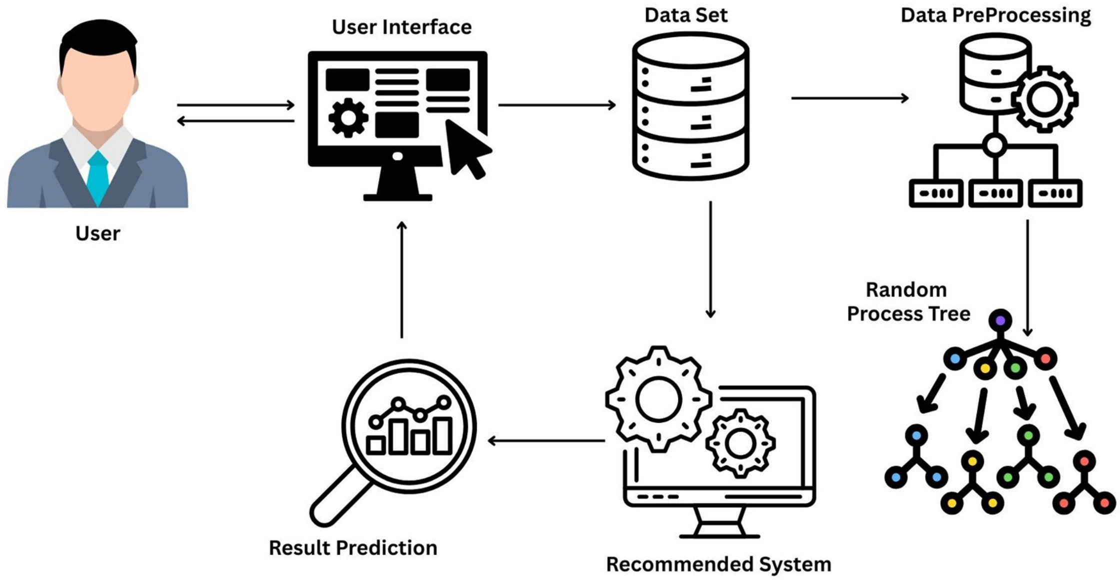


Fig.1.Architecture Diagram Of Recommended system

II. LITERATURE REVIEW

1) Title: A Review on Data Mining Techniques for Fertilizer Recommendation 2018. Authors : Jignasha M. Jethva, Nikhil Gondaliya, Vinita Shah To keep up nutrition levels in the soil in case of deficiency, fertilizers are added to soil. The standard issue existing among the Indian agriculturists choose approximate amount of fertilizers and add them manually. Excess or deficient extension of fertilizers can harm the plants life and reduce the yield. This paper gives overview of various data mining frameworks used on cultivating soil dataset for fertilizer recommendation.
2) Title: A Survey on Data Mining Techniques in Agriculture, 2015. Authors : M.C.S.Geetha Agriculture is the most critical application area especially in the developing nations like India .Use of information technology in agriculture can change the situation of decision making and farmers can yield in better way.. This paper integrates the work of several authors in a single place so it is valuable for specialists to get data of current situation of data mining systems and applications in context to farming field.
3) Title : AgroNutri Android Application,2016. Authors : S. Srija, R. Geetha Chanda, S.Lavanya, Dr. M. Kalpana Ph.D This paper communicates the idea regarding the making of AgroNutri an android application that helps in conveying the harvest particular fertilizer amount to be applied. The idea is to calculate the measure of NPK composts to be applied depend on the blanked proposal of the crop of interest. This application works depend on the product chosen by the farmer and that is taken as input, thus providing the farmers. The future scope of the AgroNutri is that GPRS can be included so that according to location nutrients are suggested.
4) Title: Machine Learning: Applications in Indian Agriculture, 2016. Authors: Karandeep Kaur Agriculture is a field that has been lacking from adaption of technologies and their advancements. Indian agriculturists should be up to the mark with the universal procedures. Machine learning is a native concept that can be applied to every field on all inputs and outputs. It has effectively settled its ability over ordinary calculations of software engineering and measurements. Machine learning calculations have improved the exactness of artificial intelligence machines including sensor based frameworks utilized in accuracy farming. This paper has evaluated the different uses of machine learning in the farming area. It additionally gives a knowledge into the inconveniences looked by Indian farmers and how they can be resolved using these procedures.
5) Title: Impacts of population growth, economic development, and technical change on global food production and consumption, 2011. Author: Uwe A. Schneider a,⇑ , Petr Havlik b, Erwin Schmid c, Hugo Valin b, Aline Mosnier b,c, Michael Obersteiner b, Hannes Bottcher b, Rastislav Skalsky´ d, Juraj Balkovicˇ d, Timm Sauer a, Steffen Fritz b Throughout the following decades humanity will request more food from less land and water assets. This investigation evaluates the food production effects of

four elective advancement situations from the Millennium Ecosystem Assessment and the Special Report on Emission Scenarios. partialy and jointly considered are land and water supply impacts from population development, and specialized change, and forests and agriculture demand request shifts from population development and economic improvement.

6) Title: A Smart Agricultural Model by Integrating Iot, Mobile and Cloud-based Big Data Analytics, 2017. Authors: S.Rajeswari, K.Suthendran, K.Rajkumar. In the cultivating field, the system models play a significant role to the enhancement of the agro-normal and money related conditions. In the proportions of benefits of the field and farm examinations to give the information and to recognize fitting and fruitful organization practices. It can recognize the organization to arrive managers and transversely over reality as long as the required soil, the board, environment, and money related information. Decision Support Systems (DSSs) use to make the information for the vermin the board, develop the officials. These systems are not using the impelled strategies to process the data. Thusly, use the adroit system thoughts to take the decisions for the issue. It expects a crucial activity in the comprehension of agronomic results, and their use as decision sincerely steady systems for farmers is extending.
7) Title: Support Vector Machine-Based Classification Scheme of Maize Crop, 2017. Authors: Suhas S Athani, CH Tejeshwar This paper says about, advancement of a mechanized framework to distinguish and group weeds from the products would be of extraordinary help and we have proposed a set-up that decreases labour. We have considered pictures of maize edits as the informational index. Separating surface highlights of the picture and applying SVM (support vector machine) to arrange whether the given picture is a weed or a yield brought about a precision of 82%. The proposed framework gives a chance to investigate more about element extraction methods.

TABLE 1: ACCURACY TABLE

S. No	Algorithms	Accuracy
1	Decision Tree	81%
2	K Nearest Neighbour	85%
3	K Nearest Neighbour with Cross Validation	88%
4	Linear Regression Model	88.26%
5	Naive Bayes	82%
6	Neural Network	89.88%
7	Support Vector Machine	78%

III. METHODOLOGY

A. Random Forest Algorithm

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model. As the name suggests, "Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset." Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output. The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting. Random Forest works in two-phase first is to create the random forest by combining N decision tree, and second is to make predictions for each tree created in the first phase. The Working process can be explained in the below steps: Step-1: Select random K data points from the training set. Step-2: Build the decision trees associated with the selected data points. Step-3: Choose the number N for decision trees that you want to build. Step-4: Repeat Step 1 & 2. Step-5: For new data points, find the predictions of each decision tree, and assign the new data points to the category that wins the majority votes.

B. Decision Tree

The Decision Tree algorithm is a supervised learning technique primarily used for classification problems, though it can also handle regression tasks. It operates by creating a tree-like structure where internal nodes represent features, branches symbolize decision rules, and leaf nodes denote outcomes. At decision nodes, decisions are made based on dataset features, leading to further branching, while leaf nodes provide final output.without additional branches. The algorithm starts with a root node and iteratively splits the dataset into subsets based on the best attribute using the Classification and Regression Tree (CART) algorithm. This iterative process continues until reaching a stage where further classification is not possible, resulting in the formation of leaf nodes. In essence, the decision tree poses questions and splits based on responses, ultimately constructing a tree structure that facilitates decision-making in classification tasks.

C. Support Vector Machine (Svm)

SVM is a supervised learning algorithm that can be used for classification tasks. It works by finding the optimal hyperplane that separates different classes in the feature space. SVMs can be applied to crop recommendation by classifying crops based on various features such as soil type, climate conditions, and historical yield data.

1) Crop Classification: SVM can help classify different regions or fields based on factors like soil type, climate conditions, and past crop yields. It learns from historical data to suggest suitable crop types for specific areas.
2) Handling Complex Relationship: SVM can capture intricate relationships between input variables (e.g., soil pH, temperature) and crop suitability, even when these relationships are non-linear.
3) Dealing with Big Data: SVM is effective with large datasets, like satellite imagery data, containing various features relevant to crop suitability assessment.
4) Noise Reduction: SVM is less affected by noisy data, allowing it to provide reliable recommendations despite imperfect or incomplete data.
5) Partial Transparency: While not as easily interpretable as decision trees, SVM can offer insight into decision-making by highlighting support vectors, aiding in understanding why certain regions are recommended for specific crops.

D. Neural Networks

Neural networks, particularly deep learning models like Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs), can be used for crop recommendation. These models can automatically learn complex patterns from large datasets and provide accurate predictions. CNNs can be used to analyze satellite imagery or other visual data, while RNNs can be used to model sequential data such as weather pattern.

E. K-Nearest Neighbors (Knn)

KNN is a simple and intuitive algorithm that can be used for both classification and regression tasks. It works by finding the k-nearest data points to a given query point and using their labels or values to make predictions. KNN can be applied to crop recommendation by finding the most similar regions or farms based on their characteristics and recommending crops that perform well in those regions.

1) Neighborly Advice: KNN is like asking your neighbors for advice on what to grow in your garden. It looks at nearby farms and suggests crops based on what's doing well in similar areas.
2) Closest Friends Matter: It pays attention to the farms closest to yours because they're the most similar. If your neighbors are growing tomatoes successfully, KNN might suggest you try them too.
3) Simple and Friendly: KNN doesn't need to be super smart or have fancy tools. It's like having a chat with your nearby farmers and getting simple, down-to-earth recommendations.
4) Numbers Count: KNN looks at the numbers—things like temperature, rainfall, and soil type—to find the best matches. The more similar the numbers are, the better the recommendation.
5) Inclusive Learning: It's always learning from new information, just like you might update your gardening plans based on what your neighbors are trying. KNN stays open to new ideas and adapts as it learns more.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

IV. IMPLEMENTATION

Exploring Data Patterns As we kickstart the implementation phase, our initial stride involves delving into data analysis. Our objective is to uncover potential relationships among the diverse attributes within the dataset.The effectiveness of any machine learning algorithm hinges upon two key factors: the richness of parameters and the quality of the training dataset. In our project, we meticulously analyzed multiple datasets sourced from reputable platforms such as the Government website - data.gov.in, and Kaggle. Our selection process prioritized parameters that promise optimal outcomes. While previous studies have predominantly focused on environmental factors or economic indicators individually, we endeavored to amalgamate both realms. By integrating environmental variables like rainfall, temperature, pH, soil nutrients, type, and location with economic metrics such as production and yield, our aim is to furnish farmers with precise and dependable crop recommendations tailored to their land.Profit analysis was performed using cost of cultivation,market price,standard price and yield data set.This was performed as a first step to know how much impact does profit as a parameter can have on crop prediction. The function below calculates the profit for each crop grown in the state and assigns a -1 value for the states with 0 or no production of the given crop.

```
for row in reader:
        ncrop=conv ( row [ 8 ] ) pcrop=conv ( row [ 9 ] ) kc rop=conv ( row [ 1 0 ] )
        i f ( narea>=ncrop and parea>=pcrop and karea >=kc rop ) :
         no months=int ( row [ 1 ] )t o t a l=row [0]+ ” , ”
        +s t r ( r a i n f a l l f i n a l [ no months−1])+” , ”
        +s t r ( tem p final[ no months −1])+” , ”+ph+”\n”
            metacrops . w r i t e l i n e s ( t o t a l )
```

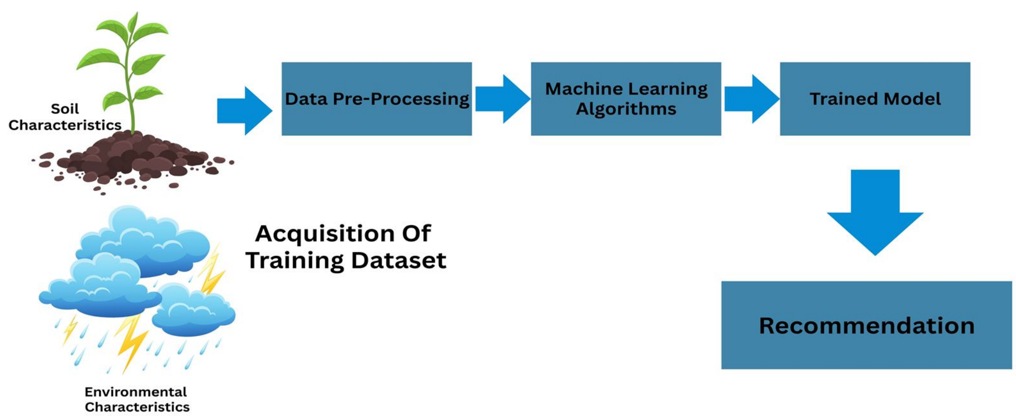


Fig.2.Pre-Processing Model Developement

To streamline the data inputted into the linear regression model, we implemented a filtering mechanism for crops based on their nutrient requirements and the soil's nutrient composition. Crops that necessitated nutrient levels exceeding those present in the soil were eliminated from consideration. This strategic approach significantly reduced training time while ensuring that only the most relevant data was utilized for model training**.**

A. Machine Learning Approach

1) Linear Regression Model

Linear regression is a linear approach to modeling the relationship between a scalar response (or dependent variable) and one or more explanatory variables (or independent variables). Linear regression is used for finding linear relationship between target and one or more predictors. It fits a linear model with coefficients w = (w1, . . . , wp) to minimize the residual sum of squares between the observed targets in the dataset, and the targets predicted by the linear approximation. Linear regression is used for finding linear relationship between target and one or more predictors. After the preprocessing was done.

we trained our liner regression which would return y-pred value for each crop based on a straight line fit between rainfall, temprature, ph and production. The implementation is given below.At the end we have sorted the crops based on the y-ored value returned by the linear regression model using quick sort giving the crop with the best score first in the list

2) Neural Network

Neural networks are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns. They interpret sensory data through a kind of machine perception, labeling or clustering raw input. The patterns they recognize are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated. Neural networks help us cluster and classify. Our implementation of the neural network was facilitated with the help of keras module.We implemented a sequential model with 3 input layers and 15 out put layers which gave the sustainability of each 15 crops given the input in terms of state,month and soil.

```
model = S e q u e n ti al ( )
Model.add(Dense(15input_dim=3,init=uniform,
activation=”sigmoid”) )sgd = SGD( lr =0.01)
model.compile(loss=” binarycrossentropy ”,optimizer=sgd , metrics=[”accuracy ”])
model . fit(train-Data.values,trainLabels.values,epochs=500, batch size=10, verbose=1)
```

V. RESULTS & CONCLUSION

For the purposes of this project we have used three popular algorithms: Linear regression, Logistic regression and Neural network. All the algorithms are based on supervised learning.Our overall system is divided into three modules

1) Profit analysis
2) Crop recommender
3) Crop Sustainability predictor

This system assists farmers in selecting the optimal crop by offering insights that are typically overlooked, thereby reducing the risk of crop failure and enhancing productivity. It also helps in preventing losses. The system can be expanded to the web, making it accessible to millions of farmers nationwide. We achieved an accuracy rate of 89.88% from the neural network and 88.26% from the linear regression model. Future enhancements involve integrating the crop recommendation system with a yield predictor subsystem, providing farmers with production estimates for the recommended crops. This solution offers farmers the opportunity to enhance agricultural productivity, mitigate soil degradation, and decrease fertilizer usage by suggesting suitable crops based on diverse attributes. It provides a holistic prediction by factoring in geographical, environmental, and economic factors.

```
for row in r e a d e r :
c rop=row [ 0 ]
metadata=d a t a s e t . l o c [ d a t a s e t [ ’ Crop ’ ] == c rop ]
X = metadata . i l o c [ : , : −2]. v al u e s#r a i n f a l l , temp , Ph Y = metadata . i l o c [ : ,
4 ] . v al u e s#P r o duc t i on
X t rain , X te s t , Y t rain , Y t e s t = t r a i n t e s t s p l i t (X, Y, t e s t s i z e = 0 . 1 , random s ta te = 0 )
#p r i n t ( Y t r a i n )
 r e g r e s s o r = Li n e a r R e g r e s si o n ( ) r e g r e s s o r . f i
 t ( X t rain , Y t rai n )
X lo cba s ed = l o c b a s e d . l o c [ [ n ] ] . v al u e s X lo cba s ed = X lo
cba s ed [ : , 1 : 4 ]
Y pred=r e g r e s s o r . p r e d i c t ( X lo cba s ed )
pr int ( Y pred ) i f Y
pred >0:
    crop Y p red . append (round( Y pred [ 0 ] , 3 ) )
    crop name . append
   (crop ) pr int ( crop name )
   acuracy = r e g r e s s o r . s c o r e ( X te s t , Y t e s t )
    pr int ( ”ACCURACY SCORE:−” , accu rac y ∗  100 , ’%’ )
   sortedcrops=quicksort(crop name,cropYpred,0 ,len (crop Y p red )−1) c s v f i l e . c l o s e return s
   o r t e d c r o p s
```

REFERENCES

[1] S. P. Mohanty, U. Choppali and E. Kougianos, "Everything You Wanted to Know About Smart Cities: The Internet of Things is the Backbone," IEEE Consumer Electronics Magazine, vol. 5, no. 3, pp. 60-70, July 2016. doi: 10.1109/MCE.2016.2556879

[2] A. R. Patil and D. Patil, "Crop Recommendation System Using Machine Learning Algorithms," 2020 International Conference on Communication and Signal Processing (ICCSP), Chennai, India, 2020, pp. 0878-0882. doi: 10.1109/ICCSP48568.2020.9182108

[3] S. Sharma and V. P. Singh, "Crop Recommendation System Using Machine Learning: A Review," 2021 5th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2021, pp. 1006-1011. doi: 10.1109/ICICCS51141.2021.9432247

[4] S. Chatterjee, A. Sarkar and M. Das, "Crop Recommendation System Using Machine Learning for Agricultural Sector," 2021 4th International Conference on Intelligent Sustainable Systems (ICISS), Palladam, India, 2021, pp. 1526-1530. doi: 10.1109/ICISS49785.2021.9616827

[5] K. A. Patil and N. R. Kale, "A Model for Smart Agriculture Using IoT," 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC), Jalgaon, India, 2016, pp. 543-545. doi: 10.1109/ICGTSPICC.2016.7955300

[6] T. Singh, A. Yadav and R. Tripathi, "A Crop Recommendation System Using Machine Learning," 2020 9th International Conference on System Modeling and Advancement in Research Trends (SMART), Moradabad, India, 2020, pp. 180-183. doi: 10.1109/SMART50582.2020.9337127

[7] P. Patel and N. Patel, "Crop Yield Prediction Using Machine Learning Techniques," 2021 International Conference on Emerging Smart Computing and Informatics (ESCI), Pune, India, 2021, pp. 245-249. doi: 10.1109/ESCI50559.2021.9396910

[8] P. A. Adnan, M. Hasan, T. Islam, and M. M. Rahman, "Machine Learning Based Soil Analysis and Crop Suggestion Using IoT," 2021 International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2), Rajshahi, Bangladesh, 2021, pp. 1-4. doi: 10.1109/IC4ME251882.2021.9380403

[9] B. P. Reddy and A. B. Nandimath, "IoT and Machine Learning Based Crop Recommendation System," 2020 IEEE International Conference on Advances and Developments in Electrical and Electronics Engineering (ICADEE), Coimbatore, India, 2020, pp. 1-6. doi: 10.1109/ICADEE49888.2020.9276850

[10] M. Singh, S. Rani and M. Kamal, "Crop Recommendation System to Maximize Crop Yield Using Machine Learning Technique," 2019 International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 2019, pp. 614-617. doi: 10.1109/ICSSIT46314.2019.8987940

[11] R. Kumar and M. L. Garg, "Data Mining Techniques in Crop Yield Prediction and Crop Suitability," 2018 2nd International Conference on Micro-Electronics and Telecommunication Engineering (ICMETE), Ghaziabad, India, 2018, pp. 255-258. doi: 10.1109/ICMETE.2018.00062

[12] G. V. Kumar and B. Chatterjee, "Smart Agriculture Using Machine Learning," 2021 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), Greater Noida, India, 2021, pp. 738-742. doi: 10.1109/ICCCIS51004.2021.9397120

[13] M. C. Sujatha, K. Vani, and V. M. Nandhini, "Prediction of Crop Yield Using Regression and Decision Tree Algorithms," International Journal of Computer Sciences and Engineering, vol. 7, no. 6, pp. 239-243, 2019.

[14] A. Kale and S. R. Gengaje, "Smart Farming: A Crop Recommendation System Using Machine Learning," International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 6, pp. 2138-2143, June 2020.

[15] A. Sharma and A. K. Suryawanshi, "IoT and Machine Learning in Agriculture: Crop Prediction Model," Journal of Emerging Technologies and Innovative Research, vol. 7, no. 6, pp. 56-61, June 2020.

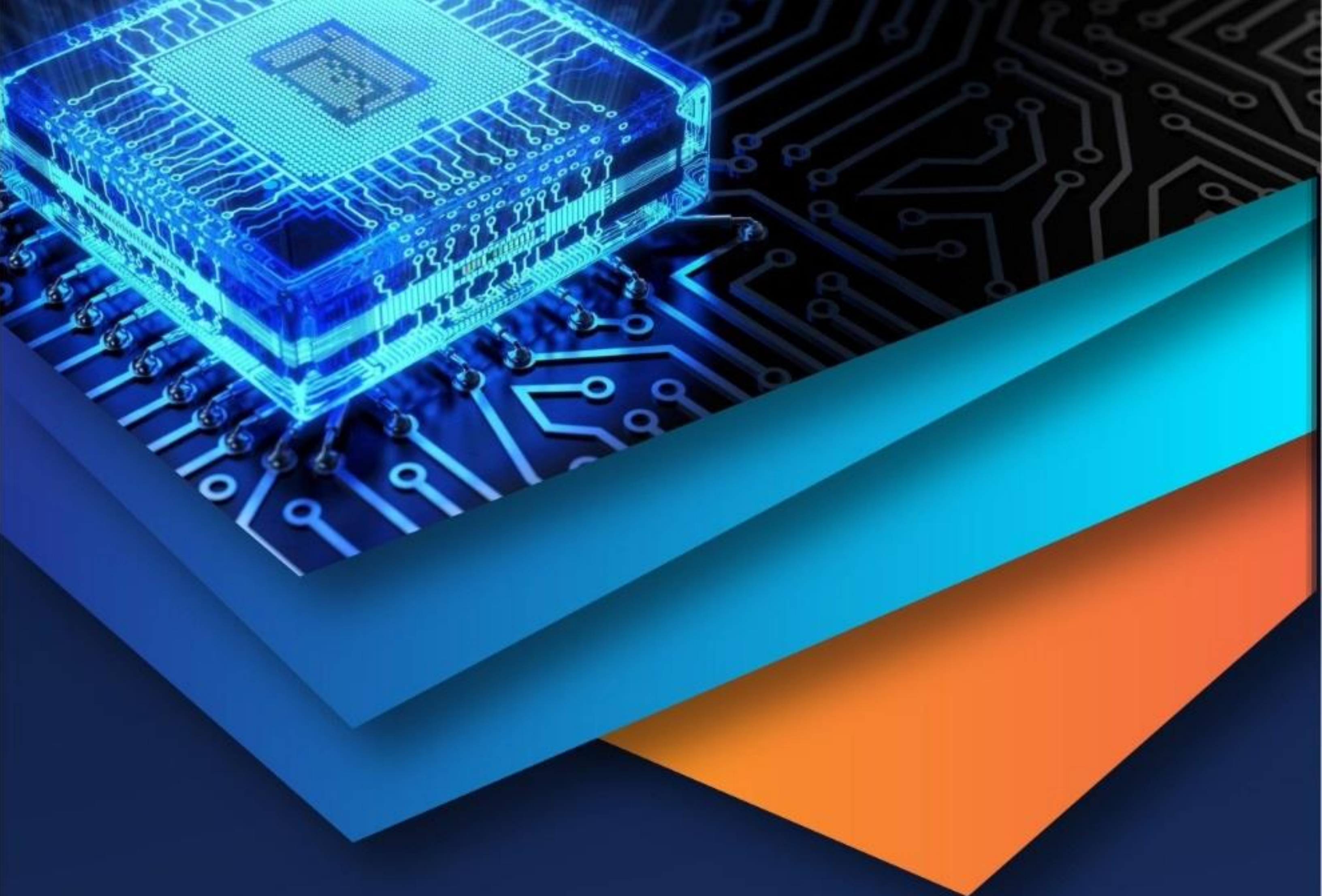
[16] R. Singh, S. Saini and A. Girdhar, "Machine Learning Based Crop Recommendation System Using Soil and Environmental Parameters," International Journal of Scientific & Engineering Research, vol. 10, no. 4, pp. 1446-1450, April 2019.

[17] "Crop Recommendation Dataset," Kaggle, 2020. [Online]. Available: https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset

[18] "Weather Data Archive," Indian Meteorological Department, 2021. [Online]. Available: https://mausam.imd.gov.in/

[19] P. Pandey, R. K. Mishra and D. P. Yadav, "Smart Farming Using Decision Tree Algorithm," 2021 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 2021, pp. 1-5. doi: 10.1109/ICCCI50826.2021.9402432

[20] V. D. Jadhav and P. D. Patil, "Crop Prediction System Using Machine Learning Algorithms," 2020 IEEE Pune Section International Conference (PuneCon), Pune, India, 2020, pp. 1-4. doi: 10.1109/PuneCon50868.2020.9362364



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY