AGRONEXA: A FARM EQUIPMENT RENTAL PORTAL WITH ML BASED EQUIPMENT RECOMMENDATION SYSTEM

A PROJECT REPORT

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ABSTRACT

Agriculture, the backbone of many economies, faces the dual challenges of increasing food production to meet growing global demand while ensuring the sustainability of farming practices. In the context of India, where agriculture is a way of life for millions, the need for innovation in the sector is more critical than ever. The Farm Equipment Rental Portal, known as "AgroNexa," emerges as a transformative solution to address these challenges.

AgroNexa is an online platform that bridges the gap between traditional farming practices and cutting-edge technology. It offers an extensive range of farm equipment available for rent, providing farmers with cost-effective and convenient access to machinery that can boost productivity. This portal leverages the power of digital connectivity to connect equipment owners with farmers seeking specific tools for their agricultural tasks.

One of AgroNexa's distinguishing features is its incorporation of a crop recommendation system. By analyzing local environmental conditions and historical crop data, the platform assists farmers in making informed decisions about the crops they should cultivate. This feature not only optimizes resource allocation but also contributes to sustainable farming practices.

With the fusion of modern technology and agriculture, AgroNexa is poised to revolutionize the farming landscape, elevating the livelihoods of farmers and ensuring food security for the future.AgroNexa is a revolutionary online platform designed to empower the agricultural community by seamlessly integrating farm equipment rental services with an intelligent crop recommendation system. This platform leverages the power of machine learning, specifically the recommendation system, to provide farmers with personalized crop suggestions based on factors such as soil nutrient content, seasonal variations, and credit availability. AgroNexa goes a step further by not only suggesting crops but also recommending the exact equipment needed for successful cultivation, enhancing the overall farming experience. This sophisticated yet user-friendly portal not only simplifies the decision-making process for crop selection but also ensures that farmers have easy access to the right tools required for their agricultural journey. AgroNexa is more than just a rental service; it's a comprehensive solution that fosters efficiency and productivity in the world of agriculture, bridging the gap between traditional farming practices and cutting-edge technology.

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INTRODUCTION

1.1. GENERAL:

Machine learning is a subset of artificial intelligence that empowers computers to learn from data and make predictions or decisions without explicit programming. It's a rapidly evolving field that has transformed various industries and continues to shape the future of technology. At its core, machine learning relies on algorithms and statistical models to recognize patterns, gain insights, and make data-driven predictions. These algorithms can be broadly categorized into three types:

Supervised Learning: In supervised learning, a model is trained on a labeled dataset, where the algorithm learns to map input data to correct output. It's used for tasks like image recognition, language translation, and spam email detection.

Unsupervised Learning: In unsupervised learning, the model works with unlabeled data to discover hidden patterns or group similar data points. Common applications include clustering and dimensionality reduction.

Reinforcement Learning: Reinforcement learning involves training a model through interaction with an environment. The model learns to take actions to maximize a reward over time. It's used in autonomous vehicles, robotics, and gaming.

1.2. MACHINE LEARNING AND ACCURACY PREDICTION:

Predicting dataset accuracy using machine learning algorithms is a common task in the field of data science and machine learning. To do this, you would typically need a labeled dataset with historical accuracy values and various features that might affect accuracy. Here's a simplified process for using machine learning algorithms to predict dataset accuracy:

Steps Include:

1. Data Collection
2. Data Preprocessing
3. Feature Selection/Engineering
4. Model Selection
5. Model Training
6. Model Evaluation
7. Hyperparameter Tuning
8. Model Deployment
9. Monitoring and Maintenance
10. Interpretability

1.3. RECOMMENDATION SYSTEM DESIGN:

Designing a recommendation system using machine learning (ML) algorithms involves a systematic approach to providing personalized recommendations to users. Here are the steps involved in building a recommendation system:

Data Collection:

Gather historical data on user interactions with items. This data may include user ratings, purchase history, page views, or any other relevant user-item interactions.

Data Preprocessing:

Clean the data, handle missing values, and ensure data quality.

Transform and encode data as needed, such as converting user and item IDs to numerical values.

Data Splitting:

Split the dataset into training and testing sets to evaluate model performance.

Feature Engineering:

Extract relevant features from the data that can help in making recommendations. This could include user demographics, item attributes, and contextual data.

Selecting an Algorithm:

Choose a recommendation algorithm that fits the problem, such as collaborative filtering, content-based filtering, matrix factorization, or deep learning models like neural collaborative filtering.

Model Training:

Train the selected recommendation model using the training dataset. The model learns the patterns and relationships between users and items.

Model Evaluation:

Evaluate the model's performance using appropriate metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), or precision and recall. Adjust hyperparameters to optimize performance.

Cross-Validation:

Implement cross-validation techniques to ensure the model's robustness and generalizability.

Hyperparameter Tuning:

Fine-tune model hyperparameters to achieve the best possible performance. Techniques like grid search or random search can be used.

Model Validation:

Validate the model's performance on the testing dataset to ensure it can make accurate recommendations for new, unseen data.

Deployment:

Deploy the trained recommendation model into a production environment. This could be integrated into a website, mobile app, or other platforms where recommendations are needed

1.4. SCOPE OF THE PROJECT:

The scope of this initiative is defined by the following key components:

I. FARM EQUIPMENT RENTAL PORTAL

User-Friendly Interface: The portal will feature an intuitive user interface to facilitate easy navigation for farmers and users. User feedback will be actively collected to enhance usability.

Equipment Catalog: The platform will maintain an extensive catalog of farm equipment available for rent. This will encompass a wide range of equipment, including tractors, plows, harvesters, and more.

User Registration and Authentication: Users will be required to create accounts and undergo an authentication process to ensure the security and reliability of transactions.

Equipment Listings: Farmers and equipment owners can list their equipment for rent, including detailed descriptions, rental terms, and pricing.

Rental Management: Users can browse equipment listings, make rental requests, and manage their rentals through the portal. Rental agreements will be facilitated online

II. CROP RECOMMENDATION SYSTEM

Data-Driven Insights: The Crop Recommendation System will analyze a variety of factors, including soil conditions, climate, and market demand, to provide data-driven crop recommendations.

User Input: Farmers will input specific information about their farming conditions, such as soil type, location, and preferences, to receive tailored crop recommendations.

Crop Information: The system will provide detailed information about recommended crops, including cultivation practices, market trends, and potential yields.

III. CONTINUOUS ENHANCEMENT

Ongoing Development: The project scope includes a commitment to ongoing development and enhancement of the portal and recommendation system.

Scalability: The platform will be designed with scalability in mind to accommodate future growth and an increasing number of users.

CHAPTER 2

LITERATURE SURVEY

[1] P. Saindane, S. Bugtani, Y. Hiranandani, V. Jagtap and K. Rajpal, "SwasthPhasal: An E-farming Web Portal," 2022 Second International Conference on Advanced Technologies in Intelligent Control, Environment, Computing & Communication Engineering (ICATIECE), Bangalore, India, 2022, pp. 1-5

Agriculture has been the backbone of India's economy for centuries. Despite the increasing demand for edible grains, the contribution of agriculture to India's GDP has dwindled. Many farmers live in dire poverty, struggling with loans and inadequate access to essential resources. Our portal addresses these challenges by providing affordable crop seeds, fertilizers, and the option to rent farming equipment. In an age of cutting-edge technology, the farming sector has been left behind, with farmers often at the mercy of third-party retailers. Agro marketing offers a secure and accessible solution, enabling farmers to purchase products online and access valuable information, government programs, and cultivation techniques. The platform also provides weather forecasts, agro health advice, and a supportive community for efficient and sustainable farming practices.

[2] R. Sneha Iyer, R. Shruthi, K. Shruthhi and R. Madhumathi, "Spry Farm: A Portal for Connecting Farmers and End Users," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 429-433

Agriculture is considered to be the backbone of India. There are many people who are involved in farming mostly belong to the lower class and are stuck in poverty. The emergence of middlemen in the Indian agricultural marketing sector can be traced back to as early as bartender system times. The interference of middlemen has led to poor lifestyle for the farmers since time immemorial. The development of a portal will serve as a way for the farmers to sell their products across the country. The portal helps the farmers in registering themselves easily and selling their produce. The farmers can gain more profit than usual by using the web portal since it forms a direct connect to the customers.
Removing the intervention of the middlemen. The total sale and the earned profit for the sold products, and customer needs are better known by the farmers through the portal. This would overall give a clear idea to the farmer as to what the customer requirements are and to how to grow only the required crops and needed investments for the same as alike. The max-prior algorithm used helps in allocating the highest requirement customer to the farmers to gain better profit. It also helps the farmers in selling their produce quicker. Thus, by this portal the farmers gain more profit hence increasing the country's economy.

[3] R. Marimuthu, M. Alamelu, A. Suresh and S. Kanagaraj, "Design and development of a persuasive technology method to encourage smart farming," 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), Dhaka, Bangladesh, 2017, pp. 165-169

Information systems on Agriculture can be a boon to any country, but for the farmers of India, particularly Tamilnadu, this can be the one which saves farmer's lives. But the farmers are to be given a big push towards using technology for their needs since the trust factor on technology among farmers is very low. This paper discusses about a persuasive technology method (PTM) developed to change the mindset of the farmers towards technology supported farming. The ICT system developed hass a website component and a mobile app component. The mobile app is linked to the website with details of marketing and farming accessory like dairy, organic products and farm machineries. Based on the requirement, the farmer can learn about the crops, marketing his products and by products or getting support for the field operations.

[4] M. Kumari, V. Kumar and V. Agarwal, "Multidisciplinary Real-Time Model for Krishi Seva," 2021 5th International Conference on Information Systems and Computer Networks (ISCON), Mathura, India, 2021, pp. 1-4

In India, Farmers contribute more than 17% to the Indian GDP but they are not getting what they deserve. Krishi - Seva is an online portal where farmers can check their soil rating and expected crop production, can directly communicate to consumers, can have a contract with third-party (exporters), and also can consult with the farming experts whoever they want. This platform is implemented using HTML, CSS, JavaScript, and used PHP for the backend. During this project, we used the Scrum framework of the Agile Development Model. This paper shows the requirement of such a platform so that farmers can get more attention based on Rating.

[5] D. Pinto, R. Alves, P. Matos and D. Pousa, "e-SmallFarmer - A solution for small farming," 2020 IEEE International Workshop on Metrology for Agriculture and Forestry (MetroAgriFor), Trento, Italy, 2020, pp. 104-108

The emergence of concepts such as Internet of Things, Cloud Computing has been adding improvements in different sectors of human life activity. The agricultural sector is no exception, and it begins to appear the first systems that use these new concepts, as is the case of, use of drones and associated technology applied to fighting pests or the use of sensor networks to monitor productions.

However, the technological gap between urban and rural areas is becoming ever wider, and the arrival of these new concepts in rural areas is taking place very slowly. In order to accelerate this technological transformation, it's necessary to find tools that reduce these differences, leveraging these rural regions in terms of technology and, at the same time, providing access to new markets. In this article is proposed, a solution to the problem of the lack of production flow, allowing producers in low-density regions to access markets that until now would be impossible to reach, while providing an solution to the problem of shortage of labour and the increase in abandoned land in Portugal.

[6] D. Singh, A. Pande, S. Kulkarni, S. Kimbahune, T. Hanwate and A. Sawarkar, "Innovation for crop quality certification using ICT," 2015 7th International Conference on Communication Systems and Networks (COMSNETS), Bangalore, India, 2015, pp. 1-6,

The focus of Indian agriculture so far has been on meeting the national demand, however it is going through a steady transformation phase to address the global requirement and is being driven by consumers and markets. According to APEDA Agriexchange portal, every year our country suffers more than 17000 Cr losses because consignments get rejected [1]. There is a growing concern for the food quality and scrutiny of the food supply chain [2] due to increased use of pesticides and its impact on health [3]. As a result, awareness of the importance of safe food is rapidly increasing among the consumers worldwide.
These mostly involve audit and documentation processes, in English, with Site Inspectors and Auditors visiting the field and recording their observations on paper. Hence the scalability is a challenge and the adoption is low.

[7] S. S, S. S R, V. L R and M. R, "Agro World: A Naive Bayes based System for Providing Agriculture as a Service," 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2022, pp. 1871-1875

A portal that provides all the necessary details for the farmers which includes the crop and its yield prediction, a discussion forum, news display and a platform for buying seeds, equipment, manures required for farming are discussed. The Naive Bayes algorithm used for the prediction of crop and its yield, efficiently determines the crop to be sowed in a particular season and also predicts the amount of produce. The Apriori algorithm gives accurate recommendations in the ecommerce section based on the farmer's previous purchases. This portal provides an efficient and reliable system for Agriculture as a Service (AaaS).

[8] M. Jadhav, N. Kolambe, S. Jain and S. Chaudhari, "Farming Made Easy using Machine Learning," 2021 2nd International Conference for Emerging Technology (INCET), Belagavi, India, 2021, pp. 1-5

Agriculture is the primary mainstay of the economy in our country. In recent years because of uncertain trends in climate and other fluctuations in the price trends, the price of the crop has varied to a larger level. Farmers remain oblivious of these uncertainties, which spoils the crops and causes massive loss. They are unaware of the crop type which would benefit them most. Due to their limited knowledge of different crop diseases and their specific remedies, crops get damaged. This system is handy, easy-to-use. It provides accurate results in predicting the price of the crop. This framework utilizes Machine Learning's Decision Tree Regression Algorithm to predict crop price. The attributes considered for prediction are rainfall, wholesale price index, month, and year. Consequently, the system gives an advance forecast to the farmers' which grows the speed of profit to them and consequently the country's economy.

[9] N. G., S. R., S. K. and S. D. N. S., "Agro Bidding - A Smart Dynamic System for Enhancement of Farmer's Lifestyle," 2019 International Conference on Smart Structures and Systems (ICSSS), Chennai, India, 2019, pp. 1-4

Online auction system is a web based application, in which seller can sell the goods. It is a popular method for buying and selling products. It is developed with the objective of making the auction system reliable, easier and faster. The objective of the online auction system is that the user can have better choice for their investment. Also it is time saving and through this system user can invest in their own selected firm. The application allows consumers to bid for the farm produce, thus eradicating middle man and benefiting both farmers and consumers. In this the admin will post the image and details of the product. The buyer can select the product and bid accordingly. The bidding will have a specific time duration, which will be set by the seller. At the end of time limit, product will be sold to the highest bidder. Our main aim is to provide a software environment for farmers to gain maximum profit.

[10] V. Lešić et al., "Rapid Plant Development Modelling System for Predictive Agriculture Based on Artificial Intelligence," 2021 16th International Conference on Telecommunications (ConTEL), Zagreb, Croatia, 2021, pp. 173-180

Actual and upcoming climate changes will evidently have the largest impact on agriculture crops cultivation in terms of reduced harvest, increased costs, and necessary deviation from the traditional farming. The aggravating factor for the successful applications of precision and predictive agriculture is the lack of big data, due to slow, year-round cycles of crops, as a prerequisite for further analysis and modelling. The goal of the system we propose is to enable rapid collection of data with respect to various climate conditions, which are artificially created and permuted in the encapsulated design, and correlated with plant development identifiers. The design is equipped with a large number of sensors and connected to the central database in a computer cloud.

Such accumulated data is exploited to develop mathematical models of wheat in different growth stages by applying the concepts of artificial intelligence and utilize them for prediction of crop development and harvest.

[11] N. Krishnan, R. Surendran and M. Nathan, "Crop tracker - A web application to sell or buy crops and predict crop price using machine learning," 6th Smart Cities Symposium (SCS 2022), Hybrid Conference, Bahrain, 2022, pp. 152-156

Proposed System consists of the progressive web application which will help the farmers and retailers to Buy or Sell their Crops. In our system, we also predicting the price of the crops to know the current and future market price. This will help the farmers to predict which crops will give more profit in the future and also, they can set the on fair price to sell their crops. Our System helps to eliminate the mediators and help the farmers to get the full profit. This System also aims to provide uninterrupted location service for Transportation and 24x7 Customer support. For delivering the crops, offline maps are available in the driver portal by which they can see the location even in poor signal areas.

[12] R. Talreja, R. Chouksey and S. Verma, "A Study of Blockchain Technology in Farmer's Portal," 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2020, pp. 828-833

Considering the features of blockchain such as immutability and maintaining the footage of transaction details, this paper highlights the usage of blockchain technology with farmer's portal that keep the footage of selling and buying information of crops. The proposed solution uses the python as a programming language in integration with the blockchain system that will benefit the farmers or vendors and individuals by preserving the contract of trade. An interface for the farmers is designed using a python programming language in addition with blockchain technology, which is used to store the information related to seller, buyer, selling and buying an item and total value transacted.

[13] G. Egger, P. Sacco, D. Chaltsev and F. Mazzetto, "farMAS: Multi-Agent based farm activity planning and execution system," 2021 IEEE International Workshop on Metrology for Agriculture and Forestry (MetroAgriFor), Trento-Bolzano, Italy, 2021, pp. 411-415

Based on a conceptual model and ontology of a farm, this paper describes a multi-agent architecture for operations management activities (both planning and execution). The approach focusses on the identification of the relevant actors, their roles and the relationship between actors and defines the interactions to support the implementation of an experimental simulator.

Cooperative interaction is ensured by governing decision policies, and by considering the farmers expertise in strategical and tactical decisions.The adoption of farMAS is expected to make farming operations more sustainable by helping to use resources efficiently even in particular challenging situations like extreme weather phenomena, the introduction of new, stress-tolerant crop varieties, more controlled use of pesticides, employment of advanced sensing technologies, sharing of farming equipment, the processing of the data obtained with the latter, and the near real-time reaction to it.

[14] U. S. Rajani, A. Sathyan, A. Mohan and A. A. Kadar, "Design architecture of autonomous precision farming system," 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Kerala, India, 2017, pp. 415-419

Precision farming technology is a valuable management concept that aids accurate soil parameter monitoring & control. Automation allows farmers to apply optimal amount of water and fertilizers at the field locations upon requirement. This paper describes the design and development of an Autonomous Precision Farming System (APFS) for agriculture automation. It is a low power, user friendly system which helps the farmers to plan irrigation and fertilization based on environmental and soil conditions. The system can intelligently operate pumps. The graphical TFT touch screen provides responsive user interface. The farmers can configure the device for getting alerts of critical field parameters or hazardous conditions. These alerts can be conveyed to the farmer in the form of preprogrammed text Messages to his mobile phone through SMS.

[15] J. Park, Soon-Duck Kwon and K. H. Law, "A data-driven approach for cooperative wind farm control," 2016 American Control Conference (ACC), Boston, MA, USA, 2016, pp. 525-530

This paper discusses a data-driven, cooperative control strategy to maximize wind farm power production. Conventionally, every wind turbine in a wind farm is operated to maximize its own power production without taking into account the interactions among the wind turbines in a wind farm. As an alternative, we propose a cooperative wind farm control strategy that determines and executes the optimum coordinated control actions that maximize the total wind farm power production. Wind tunnel experiments using 6 scaled wind turbine models are conducted to assess (1) the effectiveness of the cooperative control strategy in improving the power production, and (2) the efficiency of the BA algorithm in determining the optimum control actions of the wind turbines using only the input control actions and the output power measurement data.

CHAPTER 3

SYSTEM ANALYSIS

3.1. EXISTING SYSTEM:

Traditionally, farmers have relied on purchasing their own equipment to carry out various farming activities. However, this practice has both advantages and disadvantages. The emergence of farm equipment rental portals has provided an alternative approach to acquiring the necessary machinery for agricultural operations. In this analysis, we will explore the traditional practice of buying farming equipment, its advantages, and disadvantages in comparison to utilizing a farm equipment rental portal.

Advantages of Traditional Farmer Equipment Purchase:

1. Ownership and Control:

One of the primary advantages of owning farming equipment is the sense of ownership and control. Farmers have the liberty to use the equipment as and when needed without any restrictions. This ownership can lead to a stronger sense of self-reliance.

2. Long-Term Investment:

Investing in farming equipment can be seen as a long-term investment. Over time, the equipment can pay for itself in terms of savings on rental costs and increased productivity. Farmers may also have the option to sell the equipment in the future.

3. Immediate Availability:

Owned equipment is readily available whenever required, without the need to coordinate with rental providers or worry about equipment availability during peak seasons.

4. Familiarity and Maintenance:

Farmers tend to be more familiar with their equipment, which can simplify operation and maintenance. They may have established routines for equipment care and repair, reducing downtime.

Disadvantages of Traditional Farmer Equipment Purchase:

1. High Initial Costs:

The most significant drawback of purchasing farming equipment is the high initial cost. Many farmers, especially small-scale ones, struggle to afford the substantial investment required to buy machinery.

2. Maintenance Expenses:

Equipment ownership comes with ongoing maintenance costs. Regular maintenance, repairs, and parts replacement can be financially burdensome and time-consuming.

3. Depreciation:

Farm equipment depreciates over time, which affects its resale value. Farmers may not recoup their initial investment when selling used machinery.

4. Limited Usage:

The full potential of owned equipment is often not utilized throughout the year. Seasonal variations in farming activities can result in underutilized assets, making the investment less cost-effective.

3.2. PROPOSED SYSTEM:

The proposed system of an Equipment Rental Portal serves as a modern solution to address the challenges and limitations associated with the traditional process of purchasing farming equipment. This innovative platform leverages technology to offer farmers a convenient and cost-effective alternative, allowing them to rent the equipment they need for their agricultural operations.

Key Features of the Proposed System:

1. Equipment Variety:

The Equipment Rental Portal offers a diverse range of farming machinery, ensuring that farmers have access to the specific tools required for their tasks. From tractors and ploughs to seeders and harvesters, the portal provides a comprehensive selection to cater to various farming needs.

2. Cost-Effective Rental Options:

One of the primary benefits of the proposed system is its cost-efficiency. Farmers can rent equipment for specific tasks or seasons without the burden of high initial purchase costs. This flexibility is particularly advantageous for small-scale farmers who may have limited capital.

3. Accessibility and Convenience:

The portal is accessible through the internet, making it easy for farmers to browse equipment options and reserve what they need from the comfort of their homes. This convenience eliminates the need for time-consuming visits to equipment dealers or rental agencies.

4. Maintenance and Support:

The proposed system often includes maintenance and support services provided by the rental provider. This feature relieves farmers of the responsibility of equipment upkeep, ensuring that the machinery is in optimal working condition.

5. Reduced Financial Risk:

By avoiding the significant upfront costs of equipment purchase, farmers can reduce financial risk. This approach also mitigates concerns related to equipment depreciation and resale value.

3.3. ADVANTAGES OF PROPOSED SYSTEM:

Cost-Efficiency: The primary advantage of the proposed system is its cost-efficiency. Renting equipment reduces the financial burden on farmers, making it an accessible option, especially for those with limited budgets.

Access to Specialized Equipment: The system offers access to a wide array of specialized farming equipment, allowing farmers to choose the most suitable machinery for their specific tasks.

Reduced Maintenance Responsibility: Rental providers typically handle maintenance and repairs, alleviating farmers from the time and cost associated with equipment upkeep.

Flexibility and Adaptability: The system offers flexibility in equipment selection, enabling farmers to adapt to changing needs and agricultural seasons.

3.4. DISADVANTAGES OF THE PROPOSED SYSTEM:

Availability Constraints: During peak seasons, equipment availability may be limited, leading to scheduling conflicts and potential delays in farming activities.

Lack of Ownership: Farmers do not have ownership or control over the equipment they rent, potentially leading to a sense of dependency on rental providers.

3.5. SYSTEM SPECIFICATIONS:

3.5.1 Hardware Requirements:

1. Hard Disk: 40GB and above
2. RAM: 512MB and above
3. Processor: Pentium and above

3.5.2. Software Requirements:

1. Windows operating system XP and above
2. Google Colaboratory
3. Python 3.6 and above
4. Visual Studio Code/Jupyter notebook

3.6. LANGUAGE SPECIFICATIONS:

3.6.1. PYTHON:

Python is a high-level, versatile programming language known for its simplicity and readability. Created by Guido van Rossum and released in the early 1990s, Python has gained widespread popularity due to its ease of use and a vast community of developers.

Python's syntax emphasizes readability, making it an ideal choice for both beginners and experienced programmers. It uses indentation to define code blocks, rather than relying on curly braces or keywords, enhancing code clarity.

Python supports a wide range of libraries and frameworks for diverse applications, from web development (Django, Flask) and data analysis (NumPy, pandas) to machine learning (TensorFlow, PyTorch). It also integrates well with other languages, such as C and C++, for performance-critical tasks.

Python's interpreted nature allows for rapid development and testing, making it an efficient choice for prototyping and scripting. It's a cross-platform language, enabling code to run on various operating systems without modification.

3.6.2. HTML:

HTML, or Hypertext Markup Language, is the foundation of the World Wide Web. It's a standard markup language used to create web pages by structuring and presenting content. HTML consists of a series of elements or tags that define the structure and layout of a web page. These tags specify headings, paragraphs, links, images, and more.

A basic HTML document includes essential elements like <html>, which encapsulates the entire page; <head>, containing metadata; and <body>, where the visible content resides. Tags are typically used in pairs, with an opening tag (e.g.,) and a closing tag ( ). Attributes within tags provide additional information, like specifying an image source or setting a hyperlink.

3.6.3. CSS:

CSS, or Cascading Style Sheets, is a vital web technology that complements HTML. It controls the visual presentation and layout of web pages, allowing developers to define how content is displayed on a website. CSS separates the structure and content (handled by HTML) from the design and appearance, offering a more efficient and flexible approach to web design.

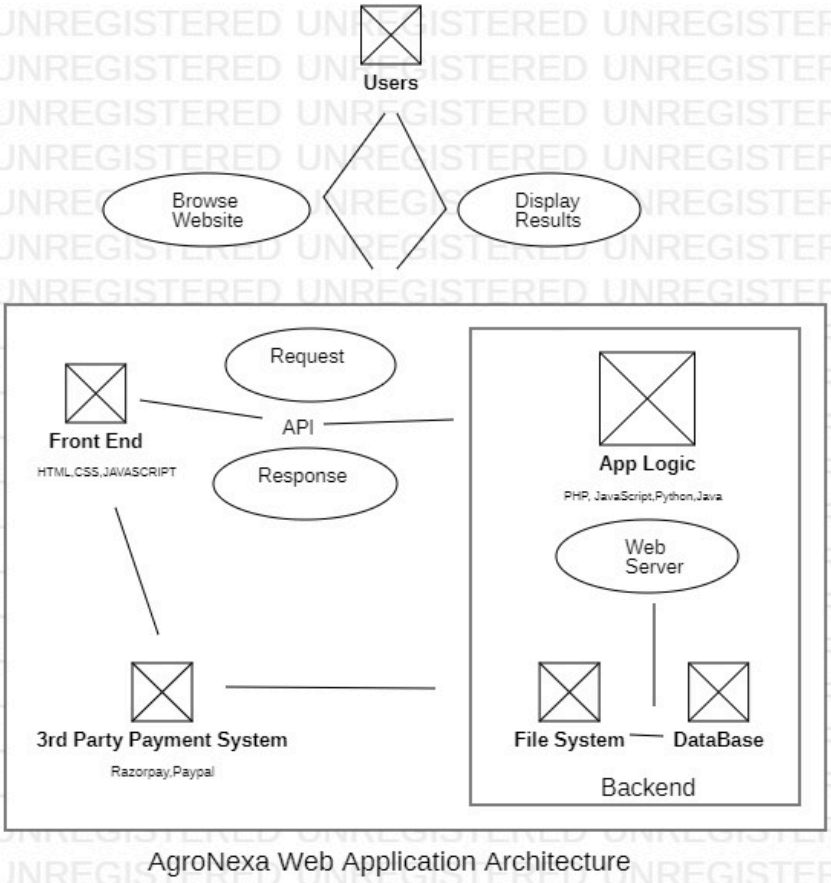
With CSS, designers can specify various styling attributes such as fonts, colors, spacing, and positioning for HTML elements. This separation of content and style simplifies web development, as changes to the design can be made globally by modifying the CSS file, impacting all pages that reference it.

CHAPTER 4

SYSTEM ARCHITECTURE

4.1 ARCHITECTURE DIAGRAM:

Figure 4.1.1 displays the overall architecture of the entire application as a whole and is necessary step towards development of a web application. Below diagram depicts a User who interacts with website through two actions “Browse website” and “Display results”. The front end of website receives user input and does a API call to backend of web application to display results. The backend app logic fetches data from file system and database and returns it in response call. A 3rd party payment system in implemented to handle payment process.



AgroNexa Web Application Architecture

Figure 4.1.1

4.2. FRONTEND ARCHITECTURE:

Figure 4.2.1 displays the architecture of frontend of the web application. The main components are subdivided into 4 parts, the Home page frontend part responsible for Home Page Display service, the Recommendation System frontend part responsible for Recommendation Page Display service, the Listings frontend Display service responsible for Listings service and the Login frontend Display service responsible for Login service.

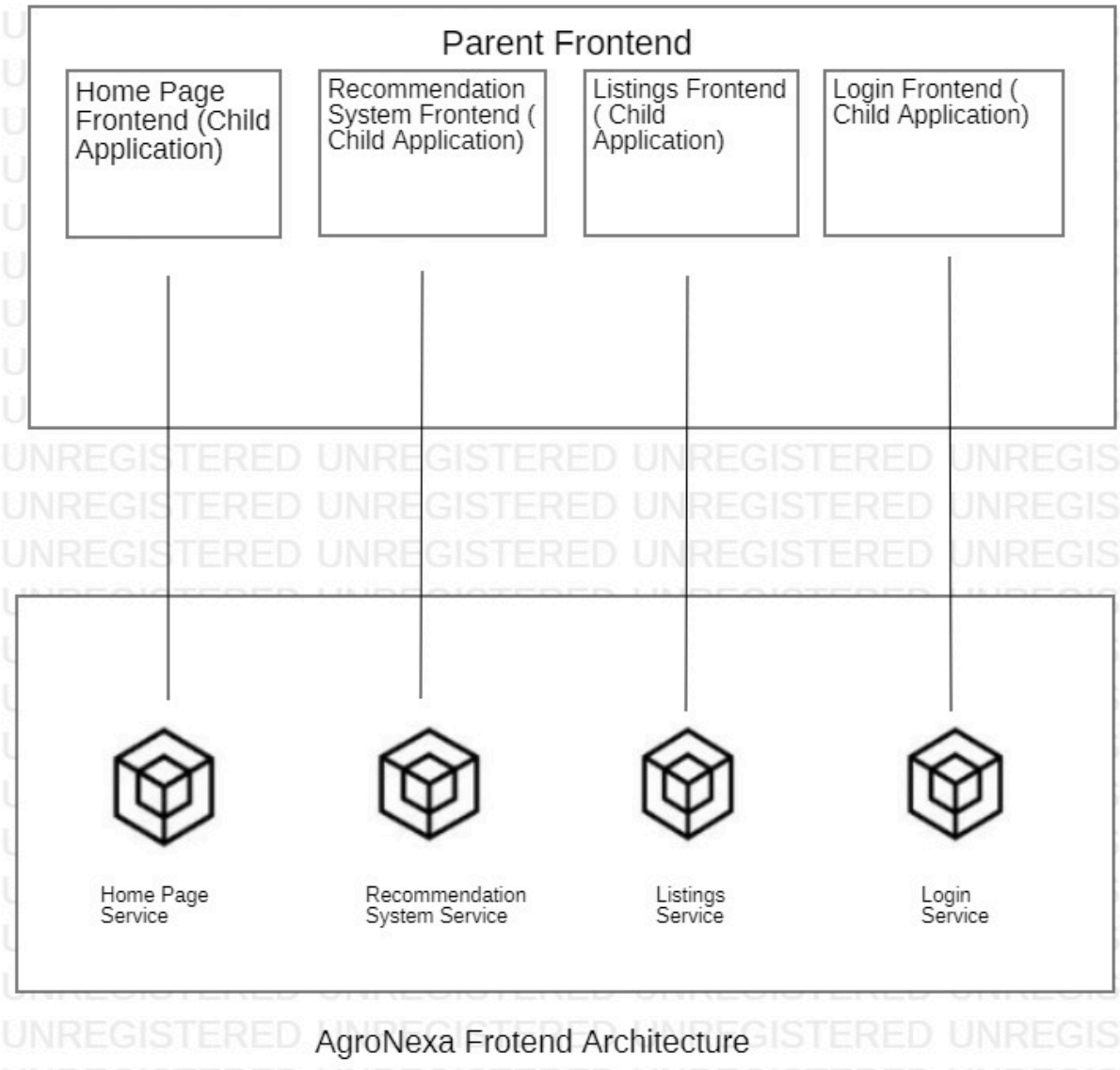
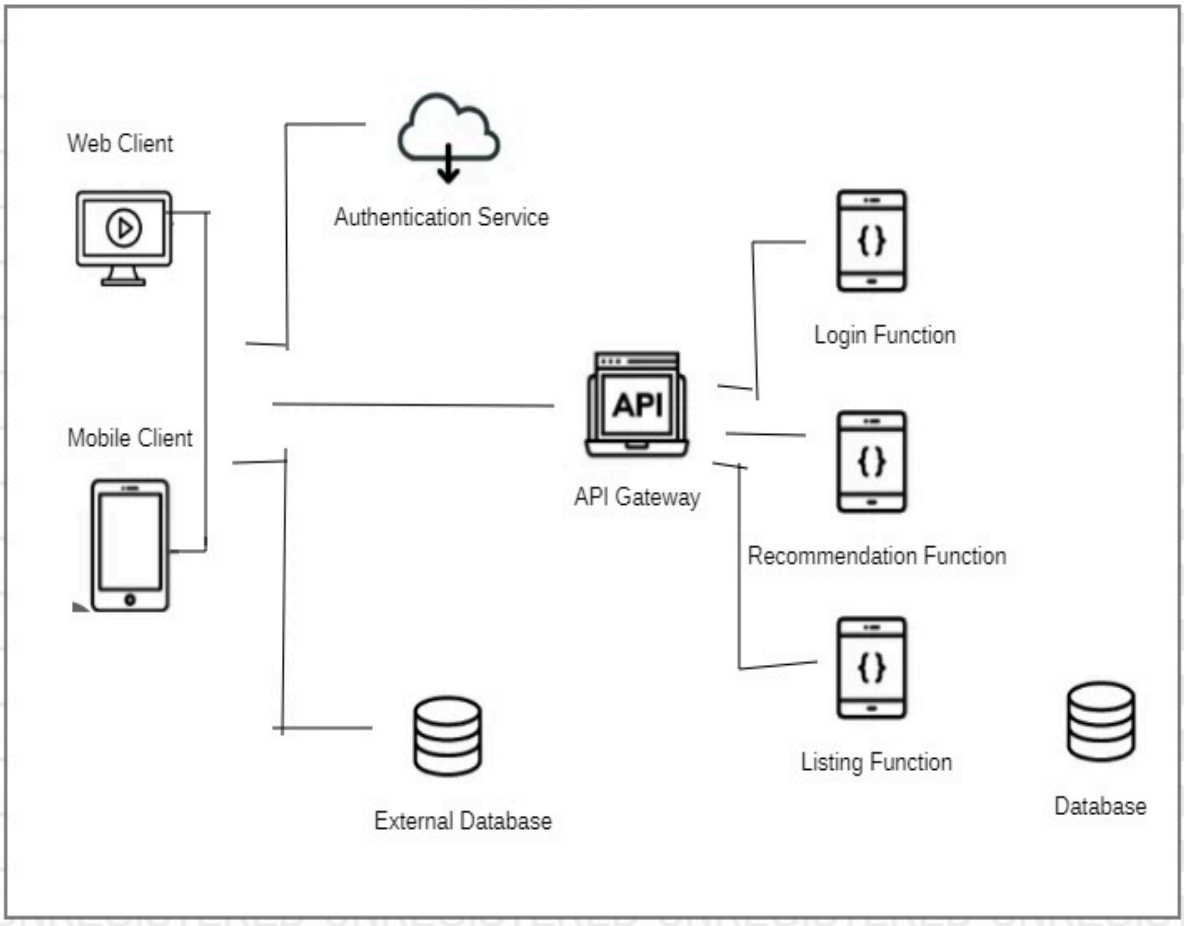


Figure 4.2.1

4.3. BACKEND ARCHITECTURE:

Figure 4.3.1 displays the architecture of backend of the web application. The web client / mobile client is associated with authentication service, the Api gateway, external database with handles login, access and operations service. The Login function, Recommendation function and Listings function is activated as per API request and is associated with internal database for storing key information.



AgroNexa Backend Architecture Diagram

Figure 4.3.1

4.4. USE CASE DIAGRAM:

Figure 4.4.1 displays USER CASE diagram for given application. There are two types of users, the “Customer” and the “Admin”. The customer’s use cases comprise of browsing websites, searching listings, posting ad, renting equipment, pay rental, creating account and using recommendation system. The admin use cases comprises of Adding new users, manage user access, manage listings, Update listings and Managing authorization.

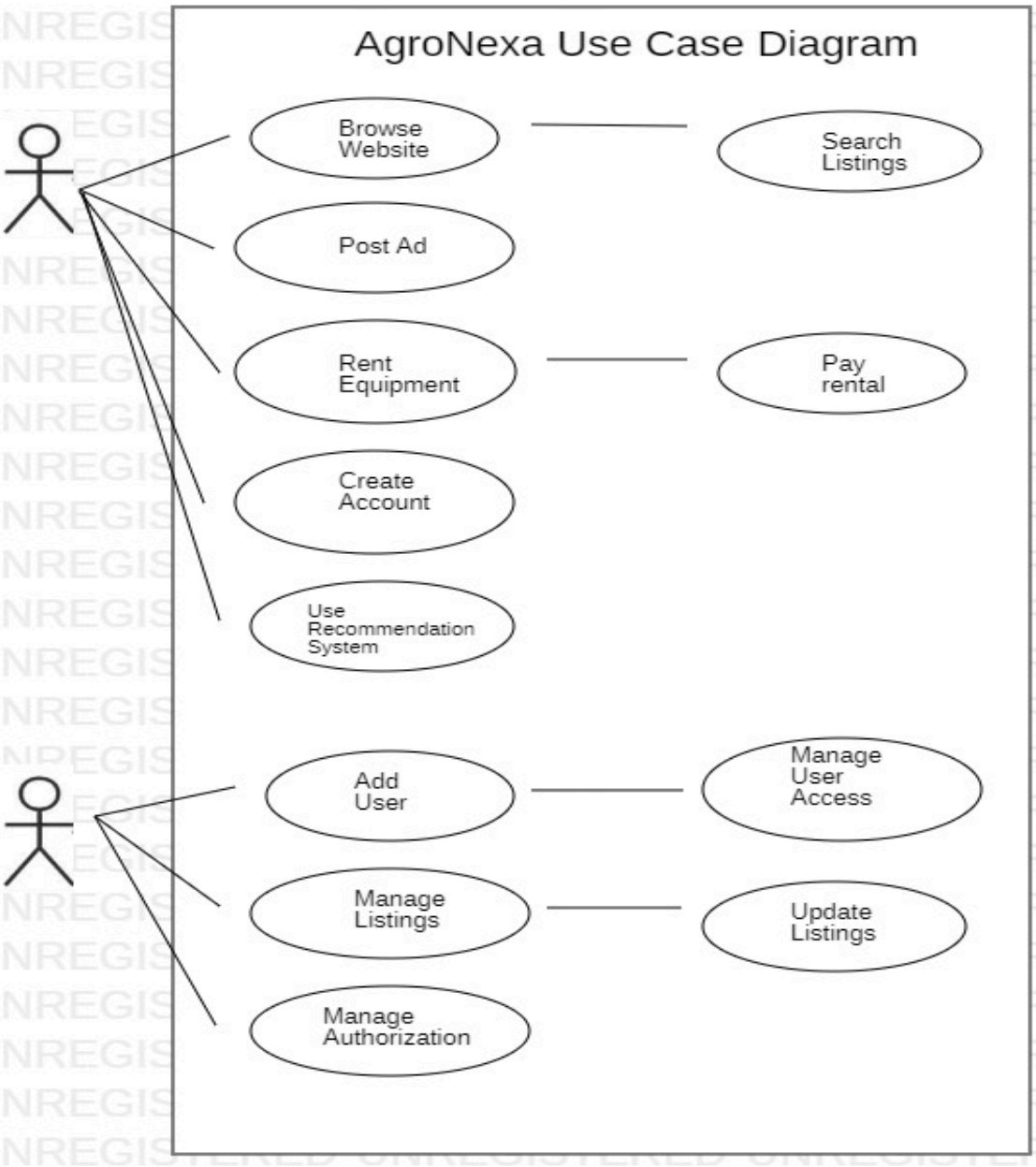


Figure 4.4.1

4.5. FLOWCHART DIAGRAM:

Figure 4.5.1 displays the flowchart for the web application. Its starts from accessing Homepage, then user can go to Login page or Recommendation page directly or the listings page. From recommendation page the user is taken to listings page to display listings, he can then click rent and will be taken to rent equipment page to select renting options and then taken to pay rent page to pay the rental amount. From login page he can also access Post ad page to post his own listings for rent.

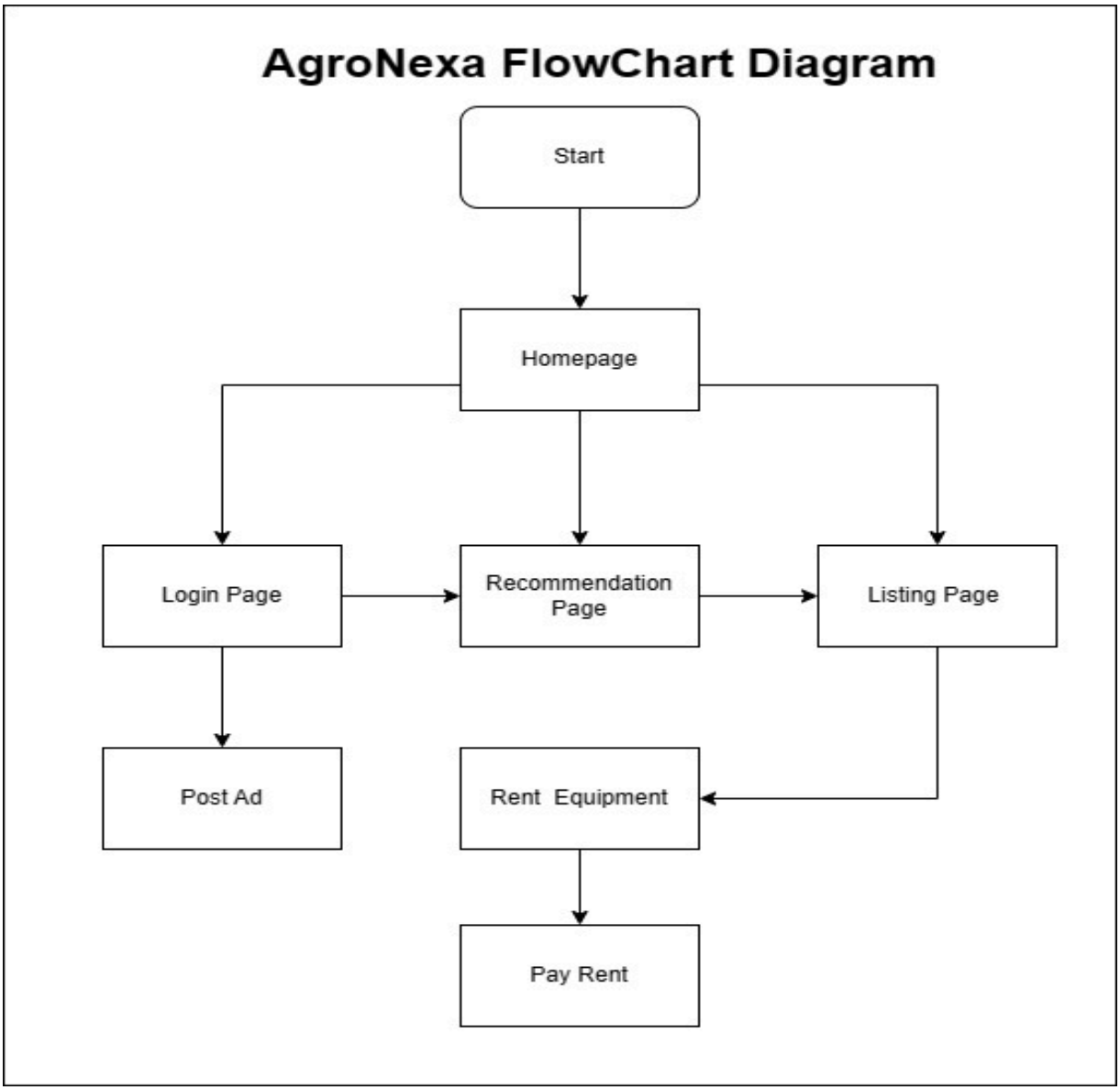


Figure 4.5.1

CHAPTER 5

MODULE DESCRIPTION

5.1. DATASET:

About Dataset

Precision agriculture is in trend nowadays. It helps the farmers to get informed decision about the farming strategy. Here, I present you a dataset which would allow the users to build a predictive model to recommend the most suitable crops to grow in a particular farm based on various parameters.

Context

This dataset was build by augmenting datasets of rainfall, climate and fertilizer data available for India.

Data fields

- N - ratio of Nitrogen content in soil
- P - ratio of Phosphorous content in soil
- K - ratio of Potassium content in soil
- temperature - temperature in degree Celsius
- humidity - relative humidity in %
- pH - pH value of the soil
- rainfall - rainfall in mm

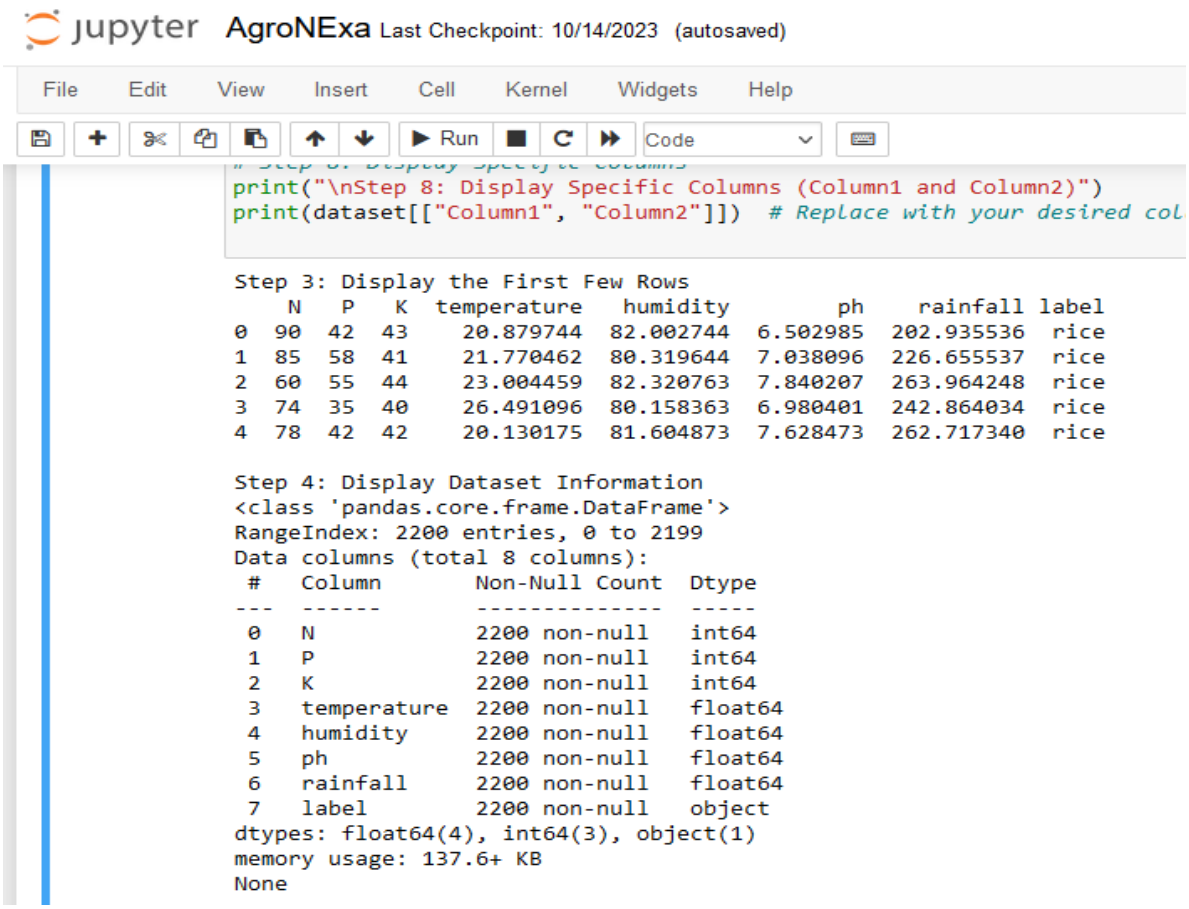


Figure 5.1.1

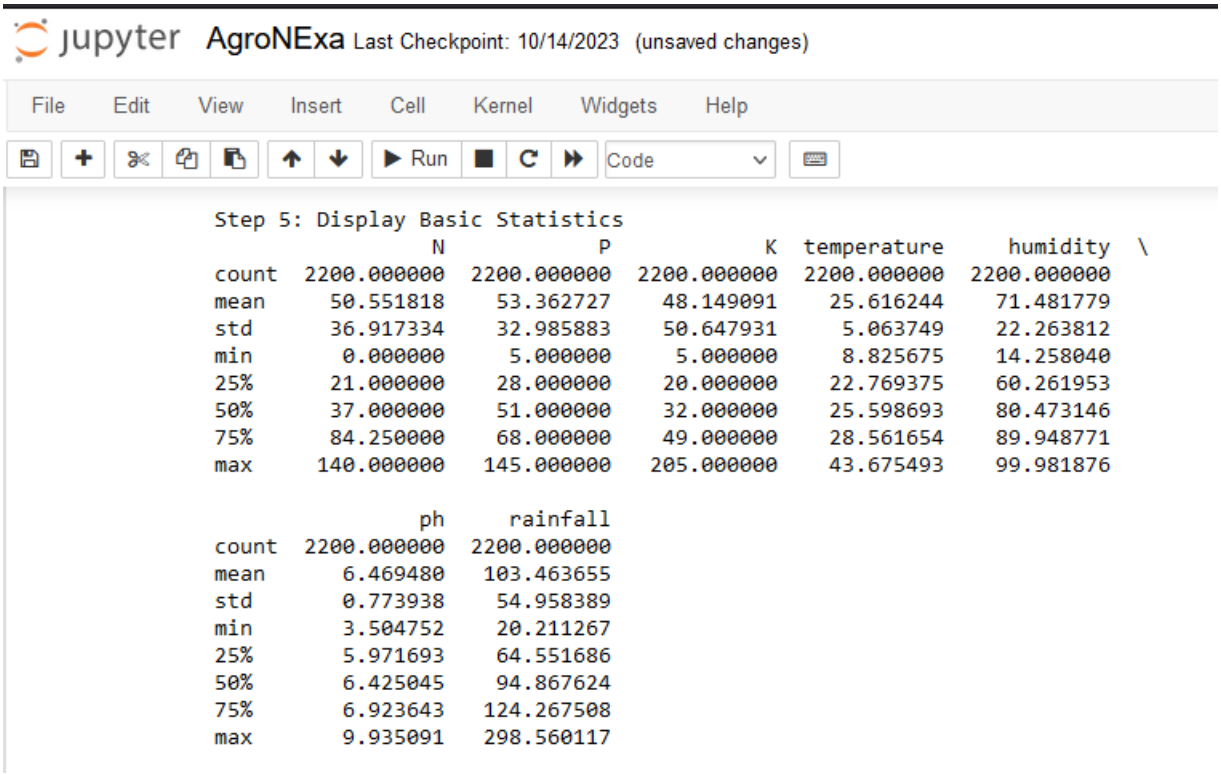


Figure 5.1.2

5.2. ALGORITHMS:

5.2.1. NAÏVE BAYES

The Naive Bayes algorithm is a machine learning technique used for classification tasks. It's based on Bayes' theorem, which calculates the probability of an event given prior knowledge of conditions related to that event. Naive Bayes simplifies this by assuming that features are independent, even if they may not be in reality. Despite this simplification, it often performs remarkably well in text classification, spam filtering, and sentiment analysis. Naive Bayes is computationally efficient, requires relatively small amounts of data for training, and can provide quick predictions, making it a popular choice for a wide range of applications in natural language processing and machine learning.

Code:

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score

# Load the dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']
```

Split data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

Initialize and train the Naive Bayes classifier

nb_classifier = GaussianNB()

nb_classifier.fit(X_train, y_train)

Predict on the test set

y_pred = nb_classifier.predict(X_test)

Calculate accuracy

accuracy = accuracy_score(y_test, y_pred)

print(f'Accuracy: {accuracy * 100:.2f}%')

In [8]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score

# Load the dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize and train the Naive Bayes classifier
nb_classifier = GaussianNB()
nb_classifier.fit(X_train, y_train)

# Predict on the test set
y_pred = nb_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 98.86%
```

Figure 5.2.1.1

5.2.2. SVM

Support Vector Machine (SVM) is a powerful machine learning algorithm used for classification and regression tasks. It works by finding the optimal hyperplane that best separates data points into different classes. SVM aims to maximize the margin, which is the distance between the hyperplane and the nearest data points of each class. This approach not only results in accurate classification but also offers robustness to outliers. SVM can handle both linear and non-linear data by using various kernel functions. It's widely used in image recognition, text classification, and bioinformatics, among other fields, due to its ability to handle complex data and provide high accuracy.

Code:

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score


# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']
```

Split data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

Initialize and train the SVM classifier

svm_classifier = SVC(kernel='linear', C=1) # You can experiment with different kernels and C values

svm_classifier.fit(X_train, y_train)

Predict on the test set

y_pred = svm_classifier.predict(X_test)

Calculate accuracy

accuracy = accuracy_score(y_test, y_pred)

print(f'Accuracy: {accuracy * 100:.2f}%')

In [9]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize and train the SVM classifier
svm_classifier = SVC(kernel='linear', C=1)  # You can experiment with different kernels and C values
svm_classifier.fit(X_train, y_train)

# Predict on the test set
y_pred = svm_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 97.73%
```

Figure 5.2.2.1

5.2.3. K-NEAREST NEIGHBOR

K-Nearest Neighbors (KNN) is a machine learning algorithm used for classification and regression tasks. It operates on the principle of similarity, where an object is classified based on the majority class of its K nearest neighbors in the feature space. KNN is a non-parametric, instance-based learning method, meaning it doesn't make underlying assumptions about the data distribution. It's versatile and can handle both classification and regression problems. However, its performance may be sensitive to the choice of K and the distance metric. KNN is simple to understand and implement, making it a popular choice for various applications in pattern recognition and recommendation systems.

Code:

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

Initialize and train the k-NN classifier with k=5 (you can adjust this parameter)

knn_classifier = KNeighborsClassifier(n_neighbors=5)

knn_classifier.fit(X_train, y_train)

Predict on the test set

y_pred = knn_classifier.predict(X_test)

Calculate accuracy

accuracy = accuracy_score(y_test, y_pred)

print(f'Accuracy: {accuracy * 100:.2f}%')

In [11]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize and train the k-NN classifier with k=5 (you can adjust this parameter)
knn_classifier = KNeighborsClassifier(n_neighbors=5)
knn_classifier.fit(X_train, y_train)

# Predict on the test set
y_pred = knn_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 88.18%
```

Figure 5.2.3.1

5.2.4. RANDOM FOREST:

Random Forest is a versatile machine learning ensemble method used for classification and regression tasks. It constructs multiple decision trees during training and combines their outputs to make predictions. Each tree is trained on a random subset of the data and features, which helps reduce overfitting and increases accuracy. Random Forest is robust, handles high-dimensional data, and provides feature importance rankings. It's widely used for tasks such as image classification, anomaly detection, and recommendation systems. Its ability to handle complex data and maintain predictive accuracy makes it a popular choice in many applications, including data science and predictive modeling.

Code:

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']
```

Split data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

Initialize and train the Random Forest classifier

rf_classifier = RandomForestClassifier(n_estimators=100, random_state=42) # You can adjust the number of estimators

rf_classifier.fit(X_train, y_train)

Predict on the test set

y_pred = rf_classifier.predict(X_test)

Calculate accuracy

accuracy = accuracy_score(y_test, y_pred)

print(f'Accuracy: {accuracy * 100:.2f}%')

In [10]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize and train the Random Forest classifier
rf_classifier = RandomForestClassifier(n_estimators=100, random_state=42)  # You can adjust t
rf_classifier.fit(X_train, y_train)

# Predict on the test set
y_pred = rf_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 99.32%
```

Figure 5.2.4.1

5.2.5. ADABOOST:

AdaBoost, short for Adaptive Boosting, is a popular ensemble machine learning algorithm. It works by combining the outputs of multiple weak learners, typically decision trees, to create a strong classifier. AdaBoost assigns different weights to data points and focuses on the samples that are misclassified in each iteration, allowing it to give more attention to challenging examples. The final prediction is a weighted sum of the individual learners' outputs. AdaBoost is particularly effective in improving classification accuracy and is used in face detection, text classification, and other applications. Its adaptability and the ability to boost the performance of weak models make it valuable in machine learning.

Code:

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import AdaBoostClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')


# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']
```

Split data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

Initialize and train the AdaBoost classifier with 50 estimators (you can adjust this parameter)

adaboost_classifier = AdaBoostClassifier(n_estimators=50, random_state=42)

adaboost_classifier.fit(X_train, y_train)

Predict on the test set

y_pred = adaboost_classifier.predict(X_test)

Calculate accuracy

accuracy = accuracy_score(y_test, y_pred)

print(f'Accuracy: {accuracy * 100:.2f}%')

In [12]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import AdaBoostClassifier
from sklearn.metrics import accuracy_score

# Load the extended dataset from the CSV file
df = pd.read_csv('Crop_recommendation.csv')

# Convert categorical data to numerical using Label Encoding
le = LabelEncoder()
df_encoded = df.apply(le.fit_transform)

# Split dataset into features (X) and target (y)
X = df_encoded.drop(columns=['label'])
y = df_encoded['label']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize and train the AdaBoost classifier with 50 estimators (you can adjust this parameter)
adaboost_classifier = AdaBoostClassifier(n_estimators=50, random_state=42)
adaboost_classifier.fit(X_train, y_train)

# Predict on the test set
y_pred = adaboost_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 9.55%
```

Figure 5.2.5.

5.3. WEBSITE DESIGN

5.3.1.1. HOMEPAGE:

HTML Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <link rel="stylesheet" href="./style.css">
   <title>AgroNexa:Agriculture Reimagined</title>
</head>
<body>

   <h1 class="X">

      <div class="X1" ></div>AgroNexa</div>
      <div class="X1" ><button class="dropbtn"><a
href="./site2.html">Recommendation</a></button></div>
   <div class="X1" ><input type=text placeholder="Search "/>
   </div>
   <div class="X1"><button class="dtoptn">Search</button></div>
   <div class="X1"><button class="dtoptn">Post Your AD</button></div>
   <div class="X1"><button class="dtoptn"><a href="./site3.html"
>Login</a></button></div>
   <div class="X1"><button class="dtoptn"><a href="./site4.html"> All Rent
Listings</a></button></div>

</h1>

 <div ><img src="./AgroNexalogo.png " style="position:fixed;top:90px;left:2%;border-
radius:2px;float: right;"></div>
```

  Welcome to AgroNexa, your premier destination for farm equipment rentals. At AgroNexa, we understand that the right equipment can make all the difference in your agricultural endeavors. Our platform connects farmers and agricultural enthusiasts with a wide range of top-quality farm equipment available for rent. Whether you need tractors, plows, harrows, or specialized machinery, AgroNexa simplifies the process of finding, renting, and returning the tools you need to cultivate success. With our user-friendly interface and a vast network of equipment providers, AgroNexa is here to empower your farming experience and help you reap the benefits of efficiency and productivity. Start your journey with AgroNexa today and unlock the potential of your agricultural pursuits.

AgroNexa goes beyond being just a typical farm equipment rental platform. We take your agricultural success to the next level with our cutting-edge inbuilt Crop Recommendation System. Our innovative system factors in multiple key elements to provide you with the most accurate and beneficial crop suggestions. By analyzing soil nutrient content, seasonal variations, and your available credit, AgroNexa offers personalized recommendations that help you make informed planting decisions.

But we don't stop there. AgroNexa also takes care of your equipment needs. Once the system suggests the ideal crop for your conditions, it seamlessly integrates with our extensive inventory of rental equipment. You'll receive tailored equipment recommendations related to the chosen crop, ensuring you have access to the right tools for your agricultural journey.

With AgroNexa's holistic approach, you not only receive crop recommendations that maximize your yield but also easy access to the equipment that makes it all possible. It's all about simplifying and enhancing your farming experience, from planning to harvest.
<h3 style="position: fixed;top:650px;left:3%">LOCALIZED,EFFICIENT AND EASY</h3>
<h3 style="position: fixed;top:700px;left:3%">BETTER FARMING , BETTER METHOD , BETTER ENVIRONMENT</h3>
<h3 style="position: fixed;top:750px;left:3%">RENTING STARTS FROM ₹50 PER DAY </h3>
<h2 style="position: fixed;left:66%;top:580px;"> Trending Items</h2>
<img src="./Combine Harvertor.png " width="250px" height="250px" style="position: fixed;left:45%;top:650px;">
<img src="./Plow.png " width="250px" height="250px" style="position: fixed;left:57.5%;top:650px;">

<img src="./Seeder.png " width="250px" height="250px" style="position: fixed;left:70%;top:650px;">
<img src="./Tractor.png" width="250px" height="250px" style="position: fixed;left:82.5%;top:650px;">

<footer class="Z">

&#169 Copyright 2023</footer>

</body>
</html>]

5.3.1.2. LOGIN PAGE:

HTML CODE:

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <link rel="stylesheet" href="./style.css">
   <title>AgroNexa Login Page</title>
</head>
<body>
   <h1 class="X">

      <div class="X1" ></div>AgroNexa</div>
      <div class="X1" ><button class="dropbtn"><a
href="./site2.html">Recommendation</a></button></div>
   <div class="X1" ><input type=text placeholder="Type Equipment Name"/>
   </div>
   <div class="X1"><button class="dtoptn">Search</button></div>
   <div class="X1"><button class="dtoptn">Post Your AD</button></div>
   <div class="X1"><button class="dtoptn"><a href="./site1.html"
>Back</a></button></div>
   <div class="X1"><button class="dtoptn"><a href="./site4.html"> All Rent
Listings</a></button></div>


   </h1>
    <img src="./UserProf.png" height="200px" width="200px" style="position: fixed;
top:20.5%;left:45%" >

 <div >
      <li style="position: absolute;
      top:43%;
      left:41%;
      font-size: 35px;
      list-style: none;">Username:&amp;nbsp;&amp;nbsp;<input type=text placeholder="Type
Your Usernname "/></li>

      <li style="position: absolute;
      top:48%;
      left:41%;
      font-size: 35px;
      list-style: none;">Password: &amp;nbsp; <input type=text placeholder="Type Your
Password  "/></li>

   </div>
```

```
    <div >

        <button class="J21" style="position: absolute; top:56%; left: 49%" >Login</button>

        <button class="J21"style="position: absolute; top:60%; left: 47.5%">Forgot
Password</button>
    </div>


    <h2 class="Y">
        <div class="Y1">Registration</div>
        <div class="Y1">Forgot Account</div>
        <div class="Y1">Admin Login</div>

    </h2>

    <footer class="Z">
        &#169 Copyright 2023</footer>

</body>
</html>
```

5.3.1.3. RECOMMENDATION PAGE:

HTML CODE:

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <link rel="stylesheet" href="./style.css">
   <title>AgroNexa recommendations</title>
</head>
<body>

   <h1 class="X">

      <div class="X1" ></div>AgroNexa</div>
      <div class="X1" ><button class="dropbtn"><a
href="./site1.html">Back</a></button></div>
   <div class="X1" ><input type=text placeholder="Search "/>
   </div>
   <div class="X1"><button class="dtoptn">Search</button></div>
   <div class="X1"><button class="dtoptn">Post Your AD</button></div>
   <div class="X1"><button class="dtoptn"><a href="./site3.html"
>Login</a></button></div>
   <div class="X1"><button class="dtoptn"><a href="./site4.html"> All Rent
Listings</a></button></div>

</h1>

<div >
   <li style="position:fixed;top:16%;left: 38%;list-style: none;">Amount of nitrogen(N)
content in soil:         <input
type=text placeholder="Type Value In PPM"/></li>
   <li style="position:fixed;top:20%;left: 38%;list-style: none;">Amount of
phosphorous(P) content in soil:   <input type=text placeholder="Type Value
In PPM"/></li>
   <li style="position:fixed;top:24%;left: 38%;list-style: none;">Amount of potassium
content(K) in soil:      <input type=text
placeholder="Type Value In PPM"/></li>

<li style="position:fixed;top:28%;left: 38%;list-style: none;">Enter Temperature Range
in Celcius(C):      <input type=text placeholder="Type Value
In Celcius"/></li>
   <li style="position:fixed;top:32%;left: 38%;list-style: none;">Enter Humidity In
Percentage :
            
       <input type=text placeholder="Type
Value In Percentage"/></li>
```

```
 <li style="position:fixed;top:40%;left: 38%;list-style: none;">Enter Rainfall Amount Per Year(Cubic):&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp; <input type=text placeholder="Type Value In Cubic"/></li>
    <li style="position:fixed;top:36%;left: 38%;list-style: none;">Enter pH of the soil: &amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp; &amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp; &amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp;&amp;nbsp; &amp;nbsp;<input type=text placeholder="Type Value on pH scale"/></li>
</div>

<button class="droptn"style="position: fixed;top:50%;left:46.5%;">Recommend Crop To Plant </button>
<h2 style="position: fixed;top: 55%;left:46%">Crop to plant: Rice</h2>
<button class="droptn"style="position: fixed;top:65%;left:46%;">Show Recommended Listings</button>

<footer class="Z">
&#169 Copyright 2023</footer>

</body>
</html>
```

5.3.1.4. LISTINGS PAGE:

HTML CODE:

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <link rel="stylesheet" href="./style.css">

   <title>AgroNexa Products</title>
</head>
<body>

   <h1 class="X">

      <div class="X1" ></div>AgroNexa</div>
      <div class="X1" ><button class="dropbtn"><a
href="./site2.html">Recommendation</a></button></div>
   <div class="X1" ><input type=text placeholder="Search "/>
   </div>
   <div class="X1"><button class="dtoptn">Search</button></div>
   <div class="X1"><button class="dtoptn">Post Your AD</button></div>
   <div class="X1"><button class="dtoptn"><a href="./site3.html"
>Login</a></button></div>
   <div class="X1"><button class="dtoptn"><a href="./site1.html"> Go
Back</a></button></div>

</h1>

<img src="./PageImage/Harvestor1.png" height="275px" width="275px" style="position:
fixed; top:10%; left:2%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 2%;">
   <li>Brand Name : John Deere</li>
   <li>Type: Harvertor</li>
   <li>Age: 7 Years</li>
   <li>Rent Per Day: 8000</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 7%">Rent</button>
</div>

<img src="./PageImage/Seeder1.png" height="275px" width="275px" style="position:
fixed; top:10%; left:18%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 18%;">
   <li>Brand Name : Case IH</li>
   <li>Type: Seeder</li>
   <li>Age: 2 Years</li>
```

```
    <li>Rent Per Day: 2000</li>
    <li>Location : Chennai </li>
    <button class="dropbtn" style="position: fixed;left: 23%">Rent</button>
</div>

<img src="./PageImage/Tractor1.png" height="275px" width="275px" style="position:
fixed; top:10%; left:34%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 34%;">
    <li>Brand Name : JCB</li>
    <li>Type: Tractor</li>
    <li>Age: 3 Years</li>
    <li>Rent Per Day: 4000</li>
    <li>Location : Chennai </li>
    <button class="dropbtn" style="position: fixed;left: 39%">Rent</button>
</div>

<img src="./PageImage/Plow1.png" height="275px" width="275px" style="position:
fixed; top:10%; left:51%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 51%;">
    <li>Brand Name : John Deere</li>
    <li>Type: Plow</li>
    <li>Age: 9 Years</li>
    <li>Rent Per Day: 1200</li>
    <li>Location : Chennai </li>
    <button class="dropbtn" style="position: fixed;left: 56%">Rent</button>
</div>

<img src="./PageImage/Seeder2.png" height="275px" width="275px" style="position:
fixed; top:10%; left:68%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 68%;">
    <li>Brand Name : Case IH</li>
    <li>Type: Seeder</li>
    <li>Age: 5 Years</li>
    <li>Rent Per Day: 1450</li>
    <li>Location : Chennai </li>
    <button class="dropbtn" style="position: fixed;left: 73%">Rent</button>
</div>

<img src="./PageImage/Harvestor2.png" height="275px" width="275px" style="position:
fixed; top:10%; left:84%;"/>
<div style="position: fixed; list-style: none;top: 43%;left: 84%;">
    <li>Brand Name : JCB</li>
    <li>Type: Harvertor</li>
    <li>Age: 2 Years</li>
    <li>Rent Per Day: 12000</li>
    <li>Location : Chennai </li>
    <button class="dropbtn" style="position: fixed;left: 89%">Rent</button>
</div>
```

```
<img src="./PageImage/Plow2.png" height="275px" width="275px" style="position:
fixed; top:58%; left:2%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 2%;">
   <li>Brand Name : Horsch</li>
   <li>Type: Plow</li>
   <li>Age: 1 Years</li>
   <li>Rent Per Day: 3000</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 7%">Rent</button>
</div>

<img src="./PageImage/Irrigation1.png" height="275px" width="275px" style="position:
fixed; top:58%; left:18%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 18%;">
   <li>Brand Name :Yanmar</li>
   <li>Type: Irriagtor</li>
   <li>Age: 7 Years</li>
   <li>Rent Per Day: 800</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 23%">Rent</button>
</div>

<img src="./PageImage/Tractor2.png" height="275px" width="275px" style="position:
fixed; top:58%; left:34%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 34%;">
   <li>Brand Name : Massey Ferguson</li>
   <li>Type: Tractor</li>
   <li>Age: 3 Years</li>
   <li>Rent Per Day: 5000</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 39%">Rent</button>
</div>

<img src="./PageImage/Irrigation2.png" height="275px" width="275px" style="position:
fixed; top:58%; left:51%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 51%;">
   <li>Brand Name :Horsch</li>
   <li>Type: Irrigator</li>
   <li>Age: 1 Years</li>
   <li>Rent Per Day: 1500</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 56%">Rent</button>
</div>
```

```
<img src="./PageImage/Plow3.png" height="275px" width="275px" style="position:
fixed; top:58%; left:68%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 68%;">
   <li>Brand Name : Yanmar</li>
   <li>Type: Plow</li>
   <li>Age: 2 Years</li>
   <li>Rent Per Day: 2000</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 73%">Rent</button>
</div>

<img src="./PageImage/Tractor3.png" height="275px" width="275px" style="position:
fixed; top:58%; left:84%;"/>
<div style="position: fixed; list-style: none;top: 89%;left: 84%;">
   <li>Brand Name : Massey Ferguson</li>
   <li>Type: Tractor</li>
   <li>Age: 4 Years</li>
   <li>Rent Per Day: 2500</li>
   <li>Location : Chennai </li>
   <button class="dropbtn" style="position: fixed;left: 89%">Rent</button>
</div>
<div>


<footer class="Z">
&#169 Copyright 2023</footer>

</body>
</html>
```

5.3.2. FRONTEND CSS CODE:

```
html{ background-color:#e3f1d2;}

.X{ background-color:rgb(242, 255, 216);
   height:80px;
   position: absolute;
   width: 100%;
   left:0;
   top:-20px;
   display: flex;
   flex-direction: row;
   flex-wrap:wrap;
   justify-content: space-evenly;}

.J{position: absolute;
   top:43%;
   left:41%;
   font-size: 35px;
   list-style: none;}

.Y{ background-color: #e2f8c7;
   position: absolute;
   top:60px;
   left:0;
   width: 100%;
   display: flex;
   flex-direction: row;
   flex-wrap: wrap;
   justify-content: space-evenly;}

.Z{ background-color: #96C291;
   position: fixed;
   bottom: 0;
   width: 100%;
   left:0%;}

.img{display:flex;
   flex-direction: column;
   position: relative;
   top:130px;}

.img1{
   display: flex;
   flex-direction: row;
   justify-content: space-around;}
```

5.4. WEBSITE SCREENSHOTS:

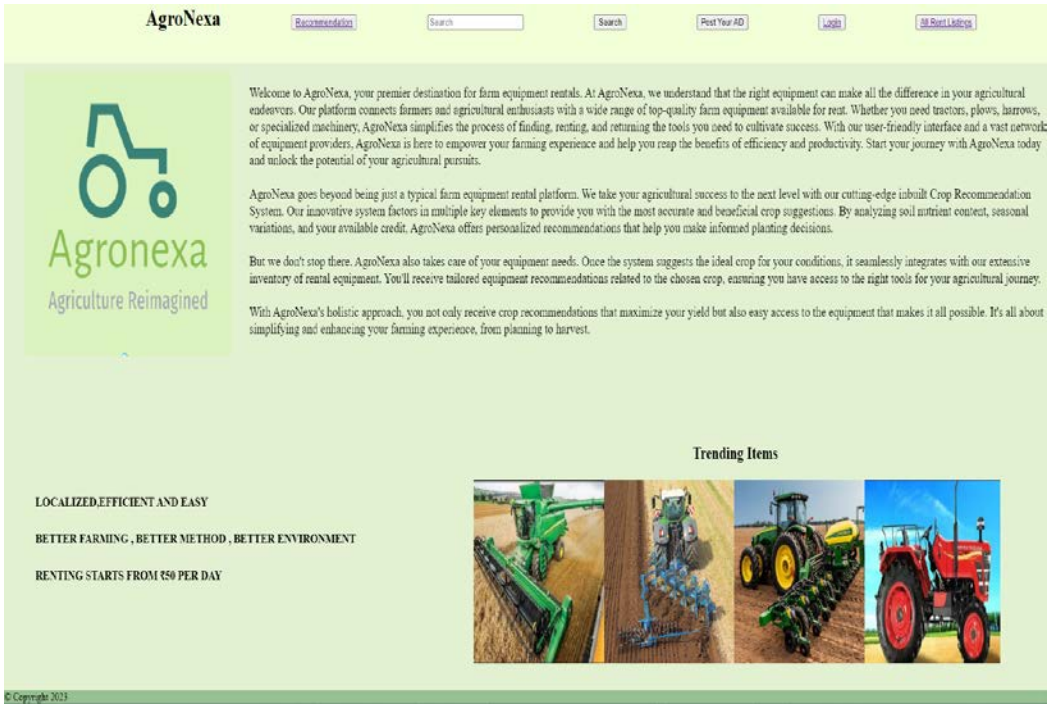


Figure 5.4.1. HOMEPAGE

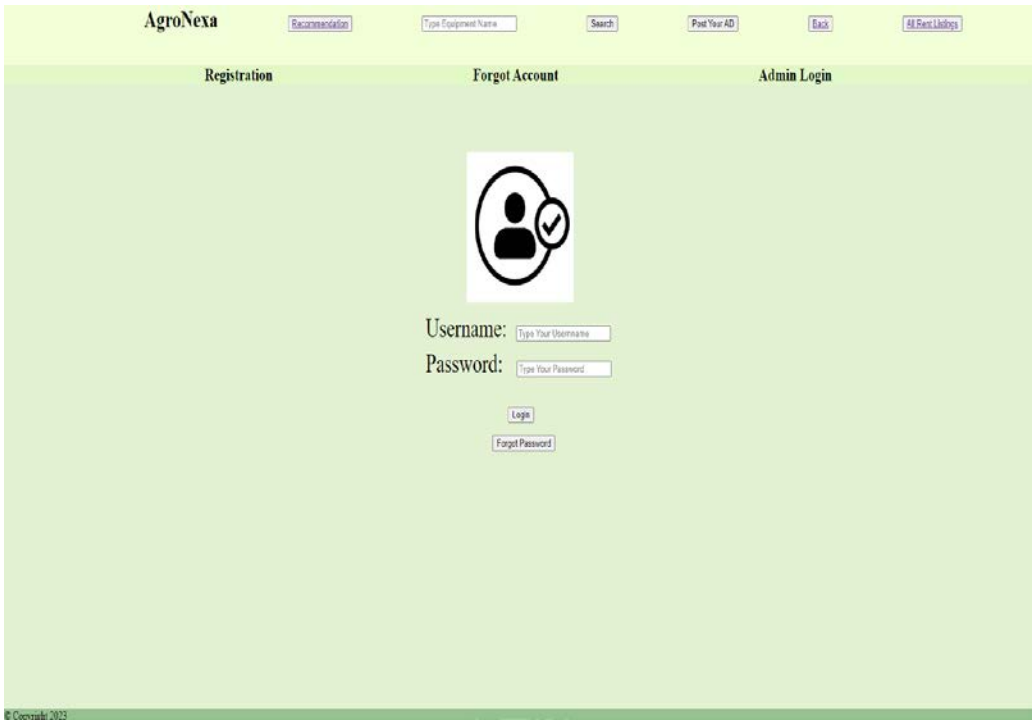


Figure 5.4.2. LOGIN PAGE

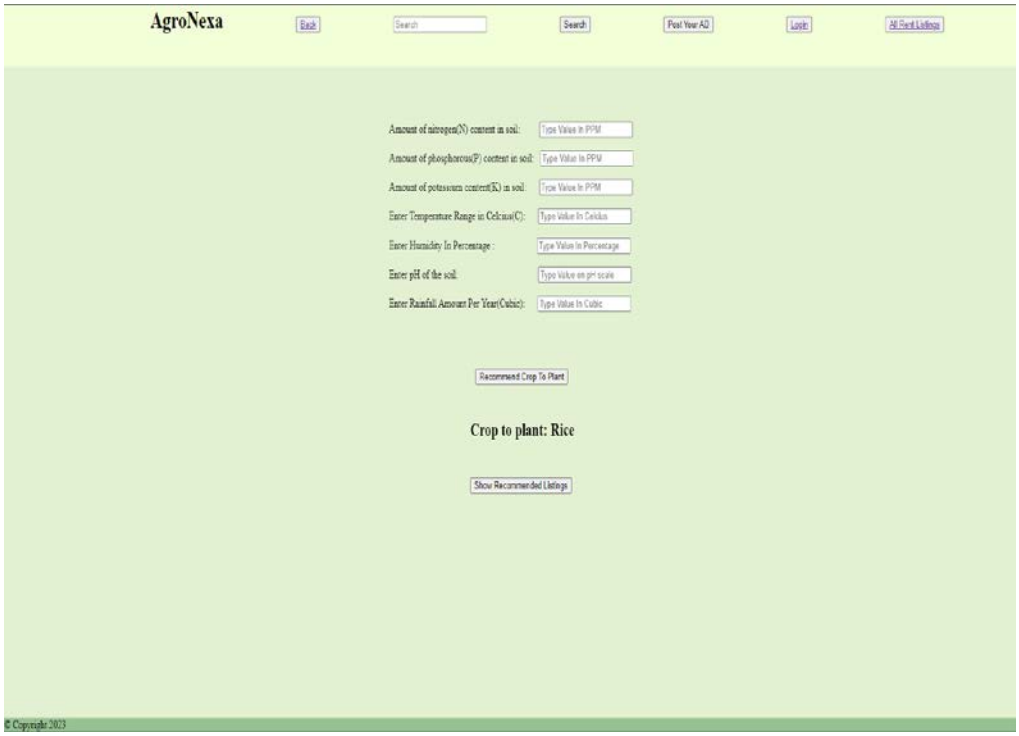


FIGURE 5.4.3 RECOMMENDATION PAGE

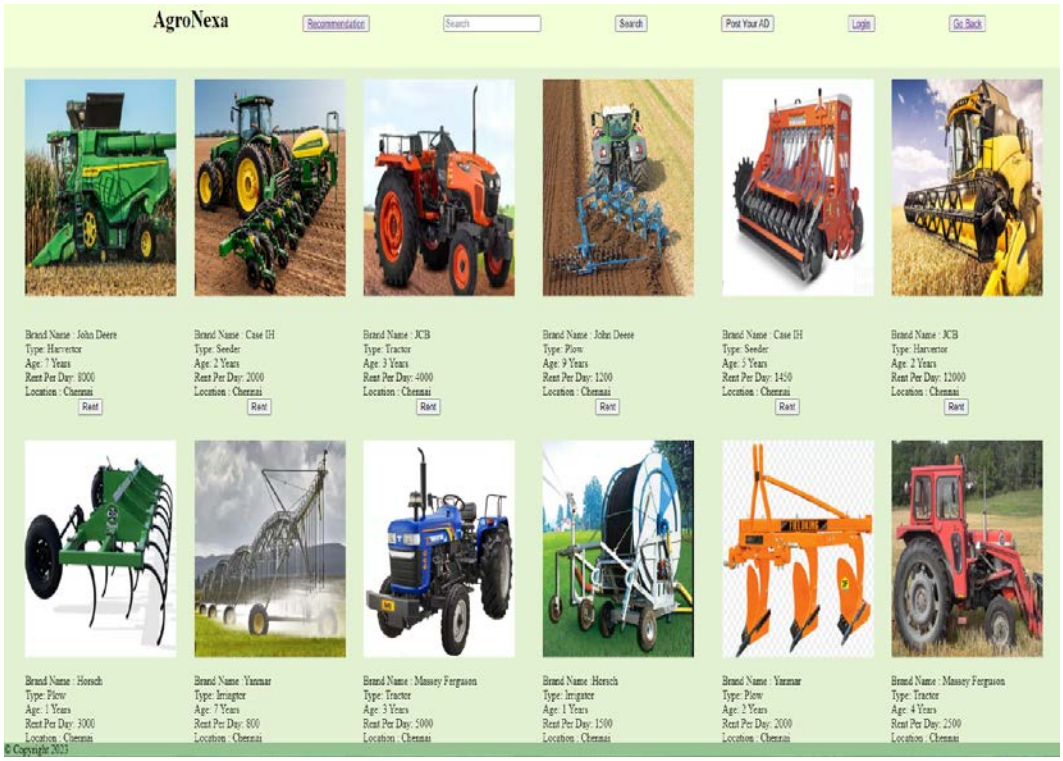


FIGURE 5.4.4 LISTINGS PAGE

CHAPTER 6

RESULTS AND DISCUSSION

6.1. DATASET ANALYSIS USING VARIOUS METRICS:

```
Step 2: Display Basic Dataset Information
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2200 entries, 0 to 2199
Data columns (total 8 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   N            2200 non-null   int64
 1   P            2200 non-null   int64
 2   K            2200 non-null   int64
 3   temperature  2200 non-null   float64
 4   humidity     2200 non-null   float64
 5   ph           2200 non-null   float64
 6   rainfall     2200 non-null   float64
 7   label        2200 non-null   object
dtypes: float64(4), int64(3), object(1)
memory usage: 137.6+ KB
None
```

FIGURE 6.1.1.

```
Step 3: Display Basic Statistics
                N           P           K  temperature     humidity  \
count  2200.000000  2200.000000  2200.000000  2200.000000  2200.000000
mean     50.551818    53.362727    48.149091    25.616244    71.481779
std      36.917334    32.985883    50.647931     5.063749    22.263812
min       0.000000     5.000000     5.000000     8.825675    14.258040
25%      21.000000    28.000000    20.000000    22.769375    60.261953
50%      37.000000    51.000000    32.000000    25.598693    80.473146
75%      84.250000    68.000000    49.000000    28.561654    89.948771
max     140.000000   145.000000   205.000000    43.675493    99.981876
```

FIGURE 6.1.2.

	ph	rainfall
count	2200.000000	2200.000000
mean	6.469480	103.463655
std	0.773938	54.958389
min	3.504752	20.211267
25%	5.971693	64.551686
50%	6.425045	94.867624
75%	6.923643	124.267508
max	9.935091	298.560117

FIGURE 6.1.3.

Correlation is a statistical measure that describes the extent to which two or more variables change together. It quantifies the degree to which a change in one variable corresponds to a change in another variable. Correlation is used to assess the strength and direction of the linear relationship between variables.

There are two main types of correlation:

Positive Correlation: When two variables move in the same direction, they are said to have a positive correlation. This means that as one variable increases, the other variable also tends to increase, and vice versa.

Negative Correlation: When two variables move in opposite directions, they are said to have a negative correlation. This means that as one variable increases, the other variable tends to decrease, and vice versa.

Step 4: Calculate Correlations

	N	P	K	temperature	humidity	ph
N	1.000000	-0.231460	-0.140512	0.026504	0.190688	0.096683
P	-0.231460	1.000000	0.736232	-0.127541	-0.118734	-0.138019
K	-0.140512	0.736232	1.000000	-0.160387	0.190859	-0.169503
temperature	0.026504	-0.127541	-0.160387	1.000000	0.205320	-0.017795
humidity	0.190688	-0.118734	0.190859	0.205320	1.000000	-0.008483
ph	0.096683	-0.138019	-0.169503	-0.017795	-0.008483	1.000000
rainfall	0.059020	-0.063839	-0.053461	-0.030084	0.094423	-0.109069

FIGURE 6.1.4.

6.2. COMPARISON BETWEEN VARIOUS ALGORITHMS:

6.2.1. NAÏVE BAYES

```
Accuracy: 98.86%
```

6.2.2. SVM

```
Accuracy: 97.73%
```

6.2.3. K-NEAREST NEIGHBOUR

```
Accuracy: 88.18%
```

6.2.4. RANDOM FOREST

```
Accuracy: 99.32%
```

6.2.5. AdaBoost

```
Accuracy: 9.55%
```

Based on the accuracy results provided for different machine learning algorithms on your dataset, it's clear that Random Forest achieved the highest accuracy of 99.32%, followed by Naive Bayes with 98.86% accuracy. These high accuracies suggest that both Random Forest and Naïve Bayes are strong candidates for building a recommendation system. However, the choice of algorithm should consider other factors as well:

Accuracy: Random Forest has the highest accuracy, indicating that it's proficient at making accurate predictions. It's suitable for tasks where precision is critical.

Complexity: Random Forest is an ensemble algorithm that combines multiple decision trees, making it more complex and computationally intensive. Naive Bayes, on the other hand, is simpler and computationally efficient.

Interpretability: Naive Bayes is a straightforward algorithm with easily interpretable results. It's easy to understand the reasons behind its predictions. Random Forest, being an ensemble method, may be less interpretable.

Scalability: Naive Bayes is a lightweight algorithm that works well with large datasets. Random Forest, while powerful, can be slower and resource- intensive with very large datasets.

Robustness: Random Forest is known for handling noisy or missing data well. It's a robust choice when dealing with real-world, messy datasets.

Overfitting: Naive Bayes is less prone to overfitting, while Random Forest can be more prone to overfitting if not carefully tuned.

Algorithmic Requirements: The choice of algorithm may also depend on the specific requirements and constraints of your recommendation system. Consider factors such as real-time prediction, memory usage, and the need For online learning.

Based on the provided accuracy results alone, Random Forest stands out as the best-performing algorithm. However, the choice between Random Forest and Naive Bayes should consider the trade-offs mentioned above. If interpretability and computational efficiency are essential, Naive Bayes might be a better choice. If the highest accuracy is the top priority, then Random Forest is the way to go.

CHAPTER 7

CONCLUSION

7.1. CONCLUSION:

Building a Farm Equipment Rental Portal with Recommendation System In the ever-evolving landscape of agriculture, the integration of modern technology has become imperative for the sustainability and success of the farming community. Our journey in creating a Farm Equipment Rental Portal with a Crop Recommendation System has been a testament to the potential of innovation in addressing the evolving needs of farmers and agricultural stakeholders.

Throughout this project, we have achieved significant milestones, and our findings and outcomes underscore the following key points:

Empowering Farmers: The central objective of our Farm Equipment Rental Portal is to empower farmers by providing them with a user-friendly platform to access and rent a wide range of farm equipment. By eliminating the barriers associated with equipment ownership, we have made modern, efficient farming practices accessible to all, regardless of farm size or location.

Crop Recommendation System: The Crop Recommendation System embedded within our portal leverages data-driven insights to assist farmers in making informed decisions about the crops they cultivate. By considering various factors, including soil conditions, climate, and market demand, we enable farmers to optimize their crop selection, leading to increased yields and profitability.

Enhancing Efficiency: With our platform, we aim to enhance the efficiency of agricultural operations. By recommending equipment based on the chosen crop, we ensure that farmers have access to the tools that best suit their specific needs, reducing waste and improving productivity.

Sustainability and Environmental Responsibility: Our platform also underscores our commitment to sustainability and environmental responsibility. By helping farmers optimize their crop selection and equipment use, we contribute to more sustainable farming practices, reducing resource wastage and environmental impact.

Machine Learning and Data Analysis: The integration of machine learning techniques for crop recommendation and data analysis for equipment selection has been a critical component of our project's success. These technologies bring data-driven decision-making to the forefront of farming.

CHAPTER 8

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