Smart Farming Application Tool Using Machine Learning and AI

Application Name :- [SMART FARMYY]

<u>SMART FARMYY :- Empowering Farmers with intelligent farming solutions</u>

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"The ultimate goal of farming is not the growing of crops, but the proper cultivation and perfection of human beings."

- MASANOBU FUKUOK

Abstract

Smart Farmyy is an innovative application revolutionizing traditional farming practices by integrating cutting-edge technologies and machine learning algorithms. This application aims to empower farmers with data-driven insights and advanced tools to optimize farm management and increase productivity. Agriculture is a major source of income and employment in India. The most prevalent problem faced by Indian farmers is that they do not select the appropriate crop for their land and do not use the appropriate fertilizer. They will experience a significant drop in production as a result of this. Smart Farmyy has been used to solve the farmers' difficulty. Some its advantages and uses include proper analysis with statistical approach towards fertilizers, soil types, and crop yield statistics to recommend the best crop to farmers as well as fertilizer recommendations based on site-specific features. This decreases the number of times a crop is chosen incorrectly and increases productivity. this problem is solved by proposing a recommendation system through ML models with majority voting technique using Random Forest, Naive Bayes, Support Vector Machine (SVM), as learners to recommend a crop and management of entire agriculture sector with accuracy and instant solutions to all problems
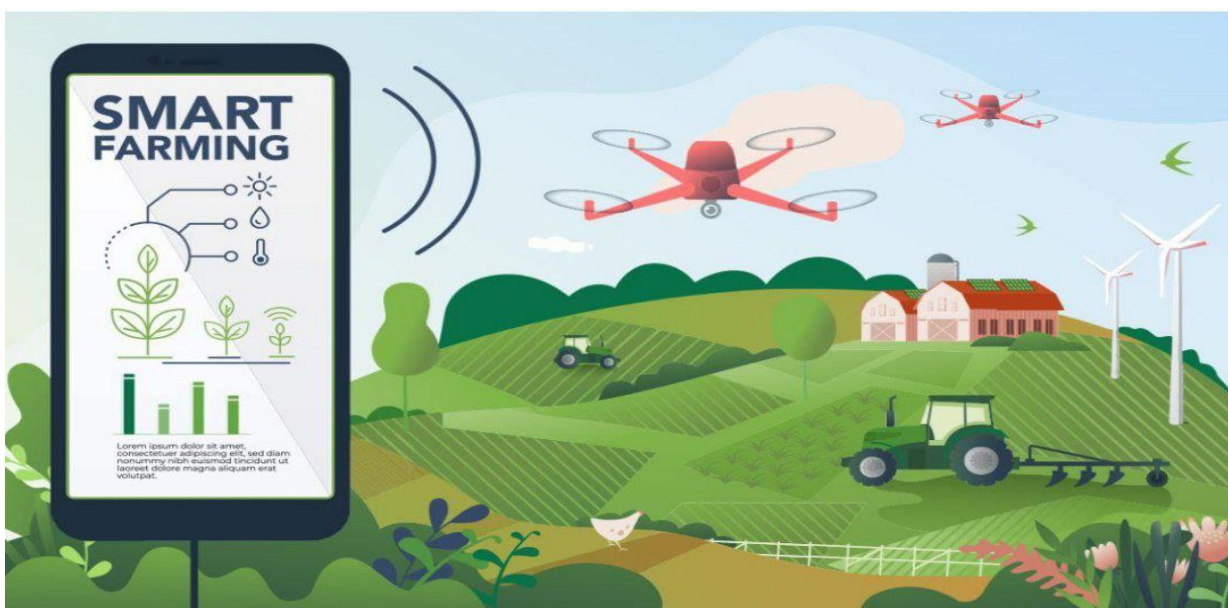
1)<u>Problem Statement:</u>

Farmers encounter significant challenges in modern agriculture, including unpredictable weather conditions, pest outbreaks, and market fluctuations. Traditional farming methods often lack precision and struggle to address these complexities effectively. Farmers require access to accurate and user-friendly tools that provide timely insights for crop management, pest control, and resource optimization. The current gap in access to data-driven solutions hinders farmers' ability to maximize yields and adapt to changing environmental conditions efficiently. Thus, there is a critical need for smart, accessible technologies that empower farmers to make informed decisions and enhance productivity in agriculture.

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1.1)<u>INTRODUCTION</u>

This application aims to empower farmers with data-driven insights and advanced tools to optimize farm management and increase productivity. Smart Farmyy offers a comprehensive suite of features including crop monitoring, pest detection, irrigation management, and market analysis. Leveraging real-time data

streams from weather forecasts, soil sensors, Smart Farmyy provides farmers with actionable recommendations for crop cultivation and resource allocation. Through the implementation of machine learning models, the application enables predictive analytics and proactive risk mitigation, thereby enhancing yield outcomes and reducing losses. With its intuitive interface and collaborative features, Smart Farmyy fosters community engagement and knowledge sharing among farmers, facilitating continuous learning and improvement. Smart Farmyy represents a transformative solution that empowers farmers to embrace modern agricultural practices, achieve sustainability goals, and thrive in a dynamic farming landscape.

A platform of machine learning based website application tool to help in analysis of the farming operation problems that recommends the best crop to grow, fertilizers to use and the diseases caught by the crops

2. Market/Customer/Business Need Assessment:

2.1) <u>MARKET NEED ASSESSMENT</u>

<u>Market Assessment for Smart Farmyy Application:</u>

1. **Market Size and Growth:** The global agricultural technology (AgTech) market is experiencing rapid growth driven by the increasing adoption of digital solutions in agriculture. According to market research reports, the AgTech market is projected to reach significant revenues in the coming years, fueled by the demand for smart farming solutions that enhance efficiency, productivity, and sustainability.

2. **Target Audience:** The primary target audience for Smart Farmyy includes farmers, agricultural cooperatives, and agribusinesses involved in crop production, livestock farming, and horticulture. Additionally, policymakers, agricultural researchers, and investors in the agriculture sector are also potential users or stakeholders of the application.

3. **Competitive Landscape:** The AgTech market is characterized by a diverse array of players offering a wide range of solutions, including farm management software, precision agriculture tools, IoT devices, and data analytics platforms. Smart Farmyy will need to differentiate itself from competitors by offering unique features, superior functionality, and tailored solutions that address specific pain points and requirements of farmers.

4. Market Challenges: Despite the growth opportunities, the AgTech market also faces challenges such as limited access to technology in rural areas, concerns regarding data privacy and security, and resistance to change among traditional farmers. Smart Farmyy will need to address these challenges through targeted marketing, user education, and strategic partnerships with local agricultural organizations and extension services.

5. Regulatory Environment: Regulatory frameworks governing agriculture and technology vary across different regions and countries. Smart Farmyy must ensure compliance with relevant regulations related to data privacy, agricultural standards, and consumer protection in its target markets. Building trust and credibility among users by adhering to regulatory requirements will be essential for market success.

In summary, Smart Farmyy operates in a dynamic and rapidly evolving market characterized by significant growth opportunities, diverse user needs, and competitive challenges. By conducting a thorough market assessment and understanding the nuances of the AgTech landscape, Smart Farmyy can effectively position itself to capitalize on market trends, address customer requirements, and drive sustainable growth in the agriculture technology sector.

Farming is one of the major sectors that influences a country's economic growth .In country like india, majority of the population is dependent on agriculture for their livelihood. Many new technologies , such as Machine learning and Deep learning are being implemented into agriculture so that it is easier for farmers to grow and maximize their yield.

2.2) CUSTOMER NEED /farmer's need assesement

Customer Assessment for Smart Farmyy Application:

1. Farmers: Farmers represent the primary customer segment for Smart Farmyy. These individuals and organizations are engaged in various agricultural activities such as crop cultivation, livestock farming, and horticulture. Farmers seek solutions that help them optimize farm operations, increase productivity, and improve profitability. Key considerations for farmers include ease of use, affordability, and the ability to address specific challenges such as crop monitoring, pest control, and resource management.

2. Agricultural Cooperatives: Agricultural cooperatives play a crucial role in supporting smallholder farmers and rural communities. These organizations may act as intermediaries between farmers and agricultural technology providers, facilitating access to innovative solutions such as Smart Farmyy. Agricultural cooperatives seek tools that enable them to streamline cooperative management, coordinate group activities, and provide value-added services to their members.

3. Agribusinesses: Agribusinesses encompass a wide range of entities involved in agricultural production, processing, distribution, and marketing. These businesses may include large-scale farming operations, food processing companies, agrochemical manufacturers, and agricultural equipment suppliers. Smart Farmyy can offer value to agribusinesses by providing insights into market trends, consumer preferences, and supply chain efficiencies.

4. Investors and Stakeholders: Investors and stakeholders in the agriculture technology sector play a crucial role in driving innovation and investment in smart farming solutions.

In summary, Smart Farmyy serves a diverse range of customers across the agriculture sector, including farmers, agricultural cooperatives, agribusinesses, policymakers, researchers, investors, and other stakeholders. Understanding the unique needs, preferences, and challenges of each customer segment is essential for developing tailored solutions, driving user adoption, and creating long-term value in the agriculture technology market.

2.3) <u>BUSINESS NEED ASSESSMENT</u>

Business Need Assessment for Smart Farmyy Application:

1. Market Demand: There is a significant demand for smart farming solutions among farmers and agricultural stakeholders. The market is driven by the need for increased efficiency, productivity, and sustainability in agriculture. Smart Farmyy aims to capitalize on this demand by offering innovative tools and technologies to address the evolving needs of the agricultural sector.

2. Competitive Landscape: The agriculture technology (AgTech) market is highly competitive, with numerous players offering a range of solutions for farm management, precision agriculture, and data analytics. Smart Farmyy needs to differentiate itself by providing unique features, user-friendly interfaces, and superior customer service to gain a competitive edge in the market.

3. Customer Requirements: Understanding the needs and preferences of farmers is crucial for the success of Smart Farmyy. Conducting market research and gathering feedback from potential users will help identify key pain points and requirements that the application should address. Features such as real-time data analytics, predictive insights, and seamless integration with existing farm management systems are likely to be high-priority for customers.

4. Business Model Viability: Developing a sustainable business model is essential for the long-term success of Smart Farmyy. The application can explore various revenue streams such as subscription-based pricing models, pay-per-use services, and partnerships with agricultural input providers. Additionally, exploring opportunities for data monetization and strategic collaborations can further enhance the application's revenue potential.

5. Regulatory Compliance: Smart Farmyy must adhere to regulatory requirements related to data privacy, security, and agricultural standards. Ensuring compliance with relevant regulations and obtaining necessary certifications will build trust among customers and enhance the credibility of the application.

7. User Experience and Engagement: Providing a positive user experience is key to retaining customers and fostering engagement with the Smart Farmyy application. Intuitive interfaces, responsive customer support, and regular updates and enhancements can help enhance user satisfaction and encourage continued usage of the application.

3).Target Specifications and Characterization:

3.1) Target Specifications and Characterization for Smart Farmyy Application:

1. **Primary Target Audience**: Farmers: Individuals and organizations engaged in crop cultivation, livestock farming, and horticulture.

2. Characteristics of Target Audience:
 Diverse Farming Practices: Farmers may engage in various agricultural activities, including arable farming, livestock rearing, and specialty crop production.

Varying Crop Types: Different regions and farmers may specialize in growing different types of crops based on climate, soil conditions, and market demand. Geographical Considerations: Farming practices and challenges may vary based on geographic location, including factors such as climate, topography, and available resources.

 3. Specific Needs and Requirements:
 Ease of Use: Smart Farmyy should have an intuitive and user-friendly interface that is accessible to farmers with varying levels of technical expertise.

Adaptability: The application should be adaptable to different farming contexts and scalable to accommodate the needs of smallholder farmers as well as large-scale agricultural operations.

4).External Search:

4.1) External Search for Smart Farmyy Application:

1. Online Research Articles:

Explore academic journals, industry publications, and online repositories for research articles related to smart farming technologies, precision agriculture, and agricultural data analytics. Look for studies and case studies that highlight the benefits and challenges of implementing smart farming solutions in different agricultural contexts.

2.Market Analysis Reports:

Access market analysis reports and industry studies on the agriculture technology (AgTech) market, including trends, growth projections, and key players.
Identify market segments, target audiences, and potential opportunities for Smart Farmyy in different geographic regions and agricultural sectors.

3.Agricultural Databases:

Utilize agricultural databases and repositories to gather information on crop yields, weather patterns, soil characteristics, and other relevant data sources.
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Explore publicly available datasets and APIs that can be integrated into Smart Farmyy to provide real-time insights and analytics for farmers.

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5) **Benchmarking**

Benchmarking alternative products is a crucial step in understanding the competitive landscape and identifying opportunities for differentiation and improvement for Smart Farmyy. Here's how you can benchmark alternate products in the agriculture technology (AgTech) market:

1. Identify Competitors: Begin by identifying existing products and services in the AgTech market that offer functionalities similar to Smart Farmyy. This could include farm management software, precision agriculture tools, IoT devices, and data analytics platforms.

2. Evaluate Features and Functionalities: Compare the features and functionalities offered by alternative products with those proposed for Smart Farmyy. Consider aspects such as:

- **Crop monitoring and management capabilities**

- **Pest and disease detection algorithms**

- **Irrigation optimization tools**

- **Market analysis and forecasting functionalities**

- **User interface and ease of use**

3.Assess Performance and Reliability:

Evaluate the performance and reliability of alternative products based on user reviews, testimonials, and case studies. Look for feedback on factors such as data accuracy, system stability, and responsiveness to user needs

4. Consider Pricing and Affordability:

Analyze the pricing models and affordability of alternative products compared to the proposed pricing strategy for Smart Farmyy. Consider factors such as subscription fees, upfront costs, and additional charges for premium features or services.

5. Examine Customer Support and Training:

Assess the level of customer support and training provided by alternative products. Look for resources such as user manuals, tutorials, online forums, and dedicated customer support channels that help users troubleshoot issues and maximize the value of the product.

6. Explore Integration and Compatibility:

Consider the compatibility and integration capabilities of alternative products with existing farm management systems, hardware devices, and data sources. Look for APIs, SDKs, and interoperability features that facilitate seamless integration with other tools and platforms.

7. Review Market Share and Adoption:

Research the market share, adoption rates, and customer base of alternative products in the AgTech market. Consider factors such as brand reputation, customer loyalty, and market penetration when assessing the competitive landscape.

8. Identify Strengths and Weaknesses:

Based on the benchmarking analysis, identify the strengths and weaknesses of alternative products relative to Smart Farmyy. Use this information to refine the value proposition, differentiate key features, and address gaps in the market.

By benchmarking alternate products, Smart Farmyy can gain valuable insights into industry best practices, customer preferences, and competitive positioning, ultimately informing strategic decisions and enhancing the value proposition for its target audience.
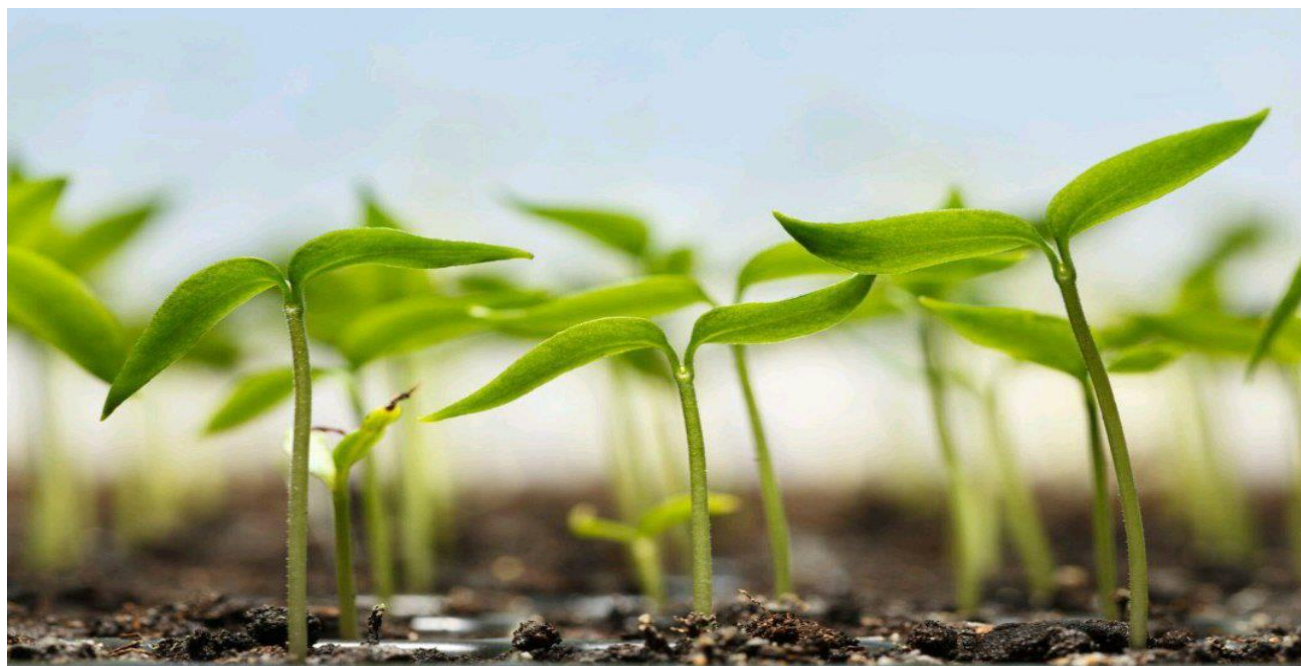
6). <u>APPLICABLE RESTRICTION</u>

1. Data Privacy Regulations:

2. Intellectual Property Rights

3. Environmental Regulations:

4. Ethical Considerations

5.Access and Equity

7). APPLICABLE REGULATIONS

Regulations governing smart farming can vary significantly depending on the country or region. However, several common areas of regulation and guidelines are typically applicable:

1. Environmental Regulations: Many countries have regulations concerning environmental protection, including rules related to the use of pesticides, fertilizers, and other agricultural chemicals. Compliance with these regulations is essential to minimize environmental impact and ensure sustainable farming practices.

2. Food Safety Standards: Governments often establish standards and regulations to ensure the safety and quality of food products. These standards may include guidelines for handling, storage, and transportation of agricultural products, as well as requirements for labeling and traceability.

3. Data Privacy and Security: Smart farming technologies often involve the collection and analysis of large amounts of data, including sensitive information about crops, livestock, and farm operations. Compliance with data privacy regulations, such as the General Data Protection Regulation (GDPR) in the European Union or the California Consumer Privacy Act (CCPA) in the United States, is crucial to protect the privacy rights of individuals.

4. Labor Regulations: Farms employing smart farming technologies must adhere to labor laws and regulations governing working conditions, wages, and employment practices. Compliance with these regulations helps ensure fair treatment of workers and prevents labor abuses.

5. Intellectual Property Rights: Companies developing and deploying smart farming technologies may need to navigate intellectual property laws related to patents, trademarks, and copyrights. Protecting intellectual property rights can help safeguard innovations and prevent unauthorized use or reproduction of proprietary technologies.

6. Animal Welfare Regulations: For farms that raise livestock, compliance with regulations related to animal welfare and humane treatment is essential. These regulations may cover housing conditions, handling practices, and transportation of animals.

7. International Trade Agreements: Farms engaged in international trade must comply with trade agreements and regulations governing the import and export of agricultural products. Compliance with these regulations helps facilitate trade and ensures that products meet quality and safety standards.

8. Land Use and Zoning Laws: Farms must comply with local land use and zoning regulations, which may dictate permissible agricultural activities, building structures, and land management practices.

It's essential for farmers, agricultural businesses, and technology providers to stay informed about relevant regulations and ensure compliance with applicable laws to operate legally and responsibly. Consulting legal experts and regulatory authorities can help navigate complex regulatory landscapes and mitigate compliance risks. Additionally, staying proactive and engaged in industry discussions and initiatives can help shape future regulatory frameworks that support innovation and sustainable agriculture practices.
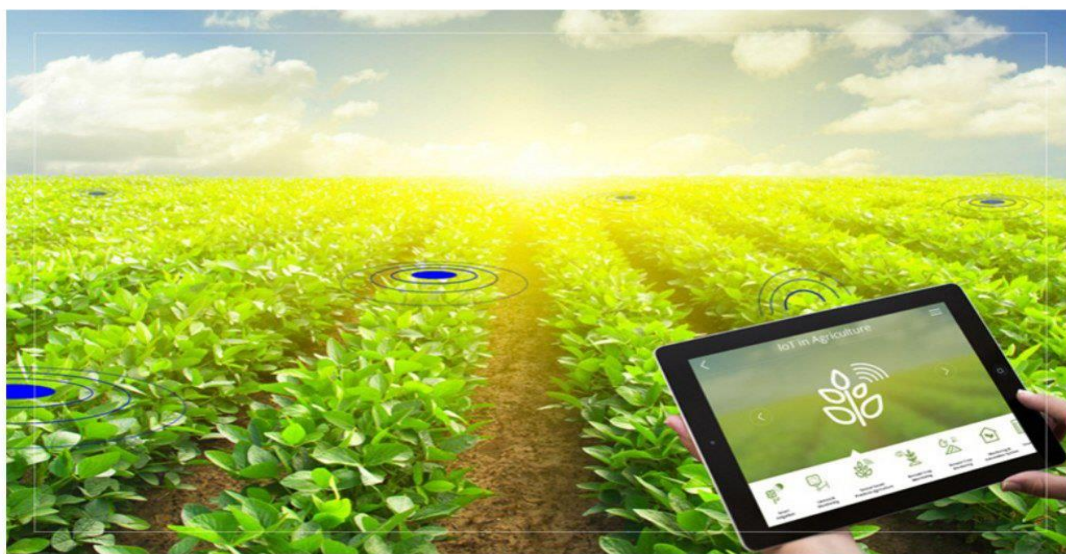
8).BUSINESS MODEL

The business model for Smart Farmyy should be designed to generate revenue while providing value to farmers and other stakeholders in the agriculture sector. Here are some potential monetization ideas for Smart Farmyy:

1. Subscription Model: Offer subscription plans with tiered pricing based on the features and functionalities available in Smart Farmyy. Farmers can choose a plan that suits their needs and budget, with options for monthly or annual payments.

2. Freemium Model: Provide a basic version of Smart Farmyy for free with limited features, and offer premium upgrades or additional functionalities through paid subscriptions. This allows farmers to try out the application before committing to a paid plan.

3. Pay-per-Use Model: Implement a pay-per-use model where farmers pay for specific features or services within Smart Farmyy on a per-transaction basis. For example, farmers could pay for access to advanced analytics, pest detection services, or market forecasting tools as needed.

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4.Data Monetization: Explore opportunities to monetize the data generated by Smart Farmyy, such as aggregated farm data, crop yield predictions, weather forecasts, and market trends. Offer data analytics services or insights reports to farmers, agricultural researchers, and agribusinesses for a fee

5. Value-Added Services:

Offer value-added services such as personalized consultancy, training workshops, and on-demand support to complement the core functionalities of Smart Farmyy. Farmers may be willing to pay for expert advice, customized recommendations, and hands-on training to optimize their farming operations.

6. Partnerships and Sponsorships:

Explore partnerships with agricultural input providers, equipment manufacturers, and agritech startups to offer integrated solutions and value-added services to farmers. Collaborate with industry stakeholders to co-develop features, sponsor events, and promote Smart Farmyy to target audiences.

7. Affiliate Marketing: Partner with agricultural product suppliers, e-commerce platforms, and service providers to promote their products and services to Smart Farmyy users. Earn commissions or referral fees for sales generated through the application.

8. Data Integration Services: Offer data integration services to agricultural organizations, research institutions, and government agencies seeking to integrate Smart Farmyy with existing farm management systems, IoT devices, and data platforms.

9. Licensing and White-labeling: Explore opportunities to license the technology and white-label Smart Farmyy to agricultural organizations, cooperatives, and service providers who wish to offer branded versions of the application to their customers.

10. Advertising Revenue: Explore opportunities for targeted advertising within Smart Farmyy, such as sponsored content, banner ads, and promotional offers from relevant agricultural brands and suppliers. Monetize the application's user base by displaying relevant ads and sponsored content to farmers
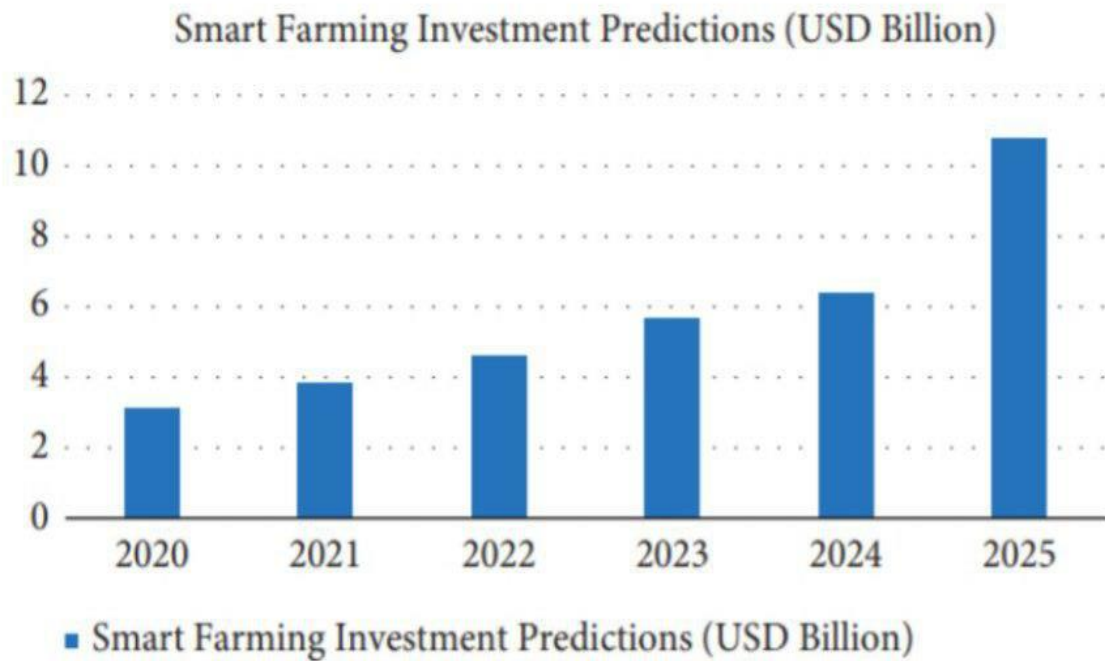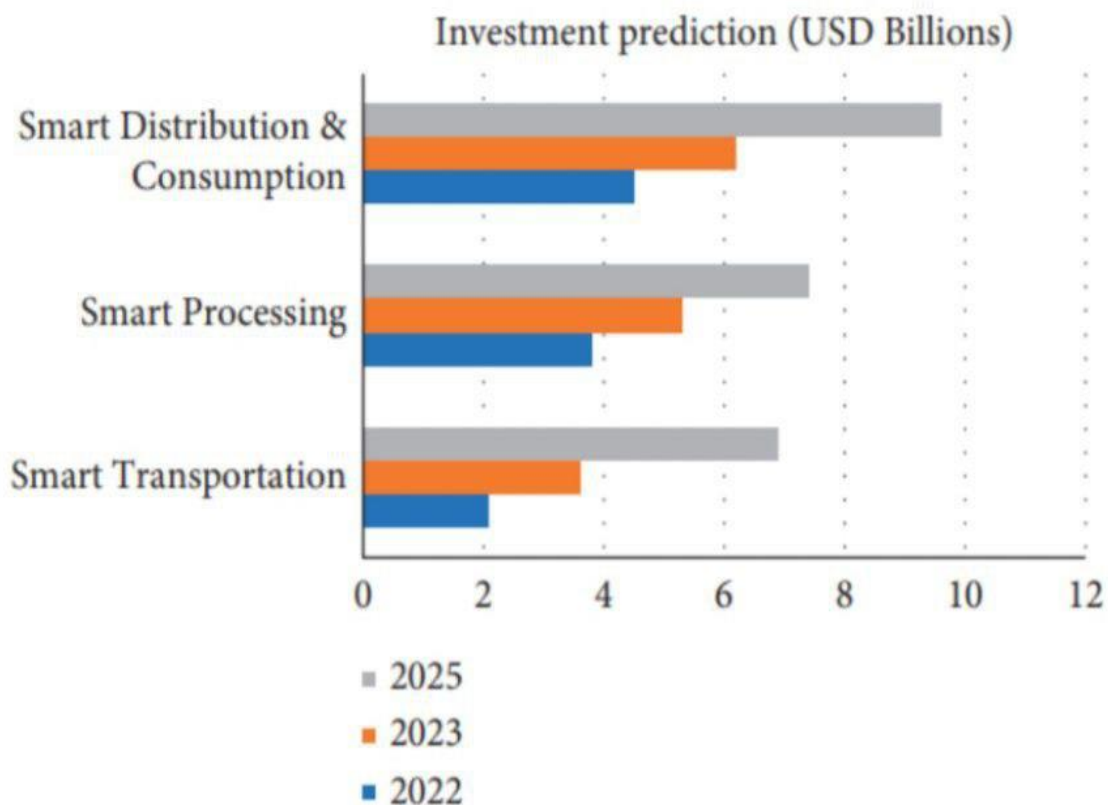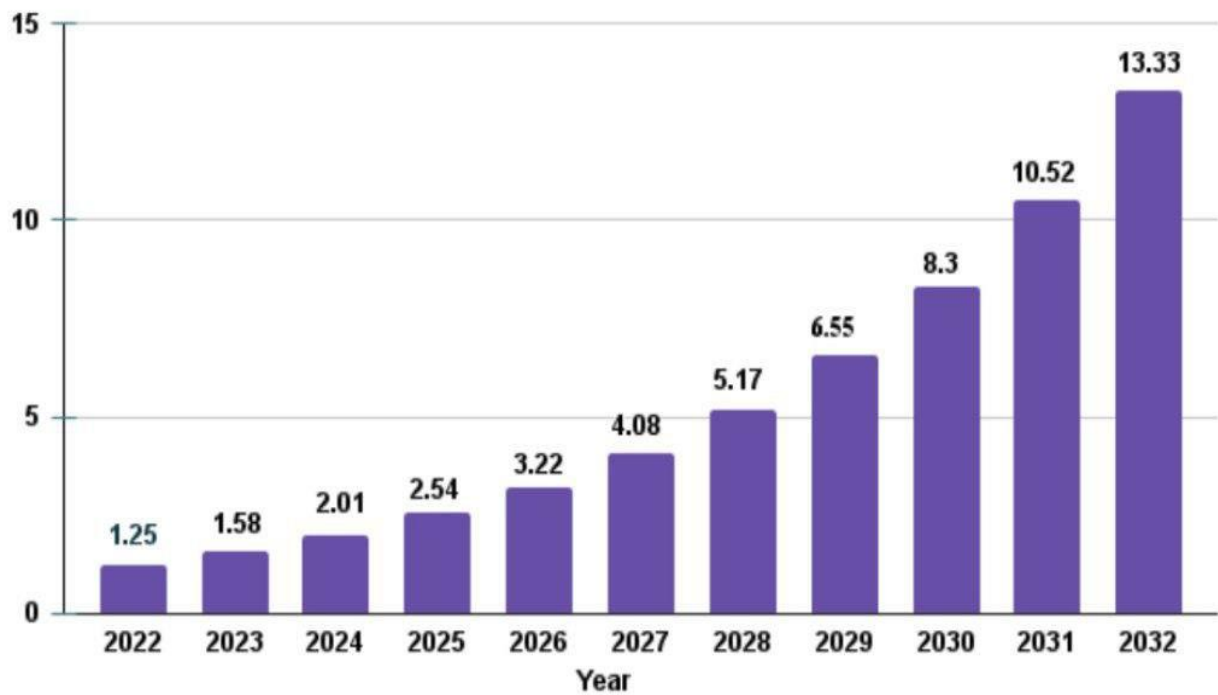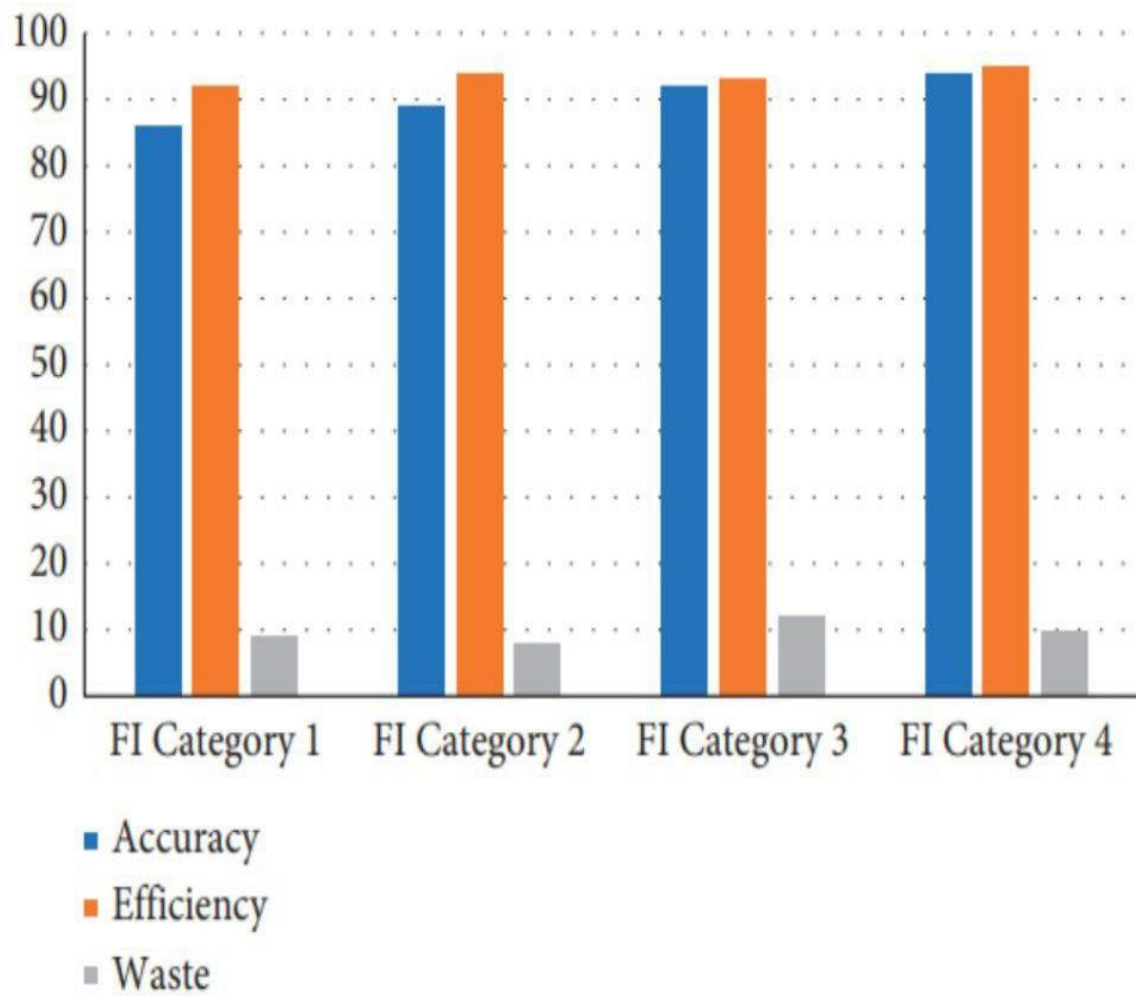
Figure 1: Prediction of smart farming investments.

Figure 2: Future investment prediction in FI.

Accuracy
Efficiency
Waste

9)CONCEPT GENERATION

Food is one of the most important things for humans. In order to get enough nutrition supply humans must get enough food quality food. But there are still exsisting problems related to food supply Agriculture in India plays a predominant role in economy and employment. The common problem existing among the Indian farmers are they don't choose the proper crop supported their soil requirements and also which fertilizer to be used for crop.

Farmers require access to accurate and user-friendly tools that provide timely insights for crop management, pest control, and resource optimization. This problem of the farmers has been addressed smart farmyy application. Crop selection and crop yield and such many other agricultural problems. The aim of this project is to predict suitable crop based on the given climate parameters and location and also to predict the yield of that crop based on the season and area of the field using machine learning algorithms. A platform of machine learning based website application tool to help in analysis of the farming operation.

9.1) Plan of Implementation

The steps involved in this system implementation are :-
a) Acquisition of Training Dataset: The accuracy of any machine learning algorithm depends on the number of parameters and the correctness of the training dataset. For the system, we are using various datasets all downloaded for government website and kaggle. Datasets include:- Yield dataset, Fertilizer dataset ,Soil nutrient content dataset, Rainfall, Temperature dataset

Requirement Analysis → System Design → Implementation → Testing → Deployment → Maintenance

Waterfall Model
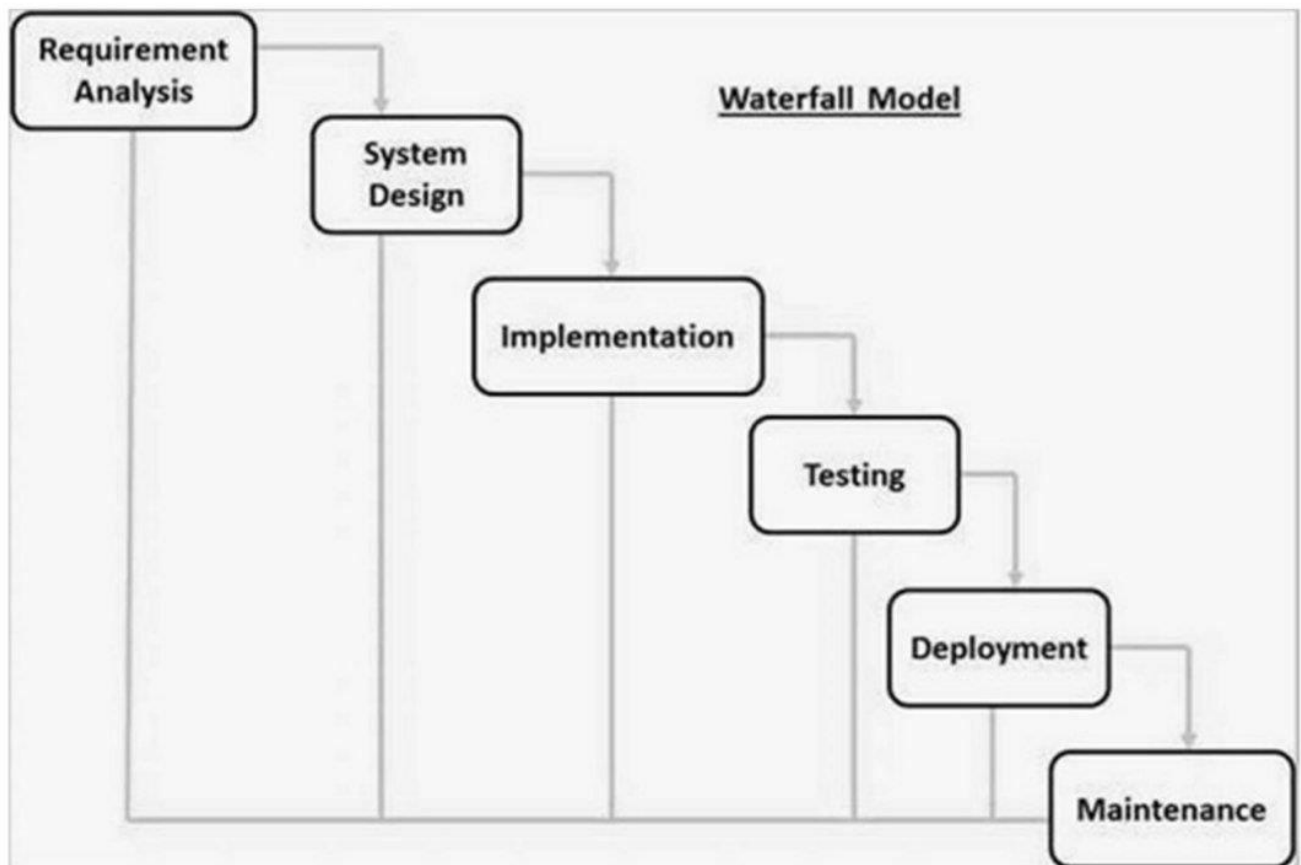
b). Data Preprocessing: This step includes replacing the null and 0 values for yield by -1 so that it does not effect the overall prediction. Further we had to encode the dataset so that it could be fed into the our ML models.

c). Training ML model : After the preprocessing step we used the dataset to train different machine learning models like Random forest, Decision Tree, Support Vector Machine(SVM) and Logistic regression to attain accuracy as high as possible.

d).Model Evaluation and Saving Model: All the ML models which are trained would be evaluated by comparing performance (Evaluations Metrics) and Final efficient model is saved using pickle library.

e).Model Exportation and Integration with Webapp: The saved efficient ML model would be integrated with Flask Web Application which would further meant for prediction in user friendly web interface.

f). Real-time Testing of Application: This step includes real-time testing of our whole application using an system which consists of a).Soil NPK Sensor, b).Capacitive Soil Moisture Sensor, c).Temperature Sensor, d).Wireless Transceiver module and e).Arduino Nano board.

 Soil NPK sensor, Soil Moisture and Temperature sensors are dipped into soil along with help of Arduino Nano board to acquire all the features of soil.

We get real-time data of soil like N, P, K, Moisture, Temperature, etc which are used to test our pre-built Web Application manually and get the predictions done.

10) CONCEPT DEVELOPMENT

Smart Famyy is machine learning based project designed to provide accurate solutions and meaningful insights for farmers. The system uses different algorithms to find solutions to the farming related problems related to crops, fertilizers, to help farmers to make decisions for their problems. The application will assist farmers in increasing agriculture productivity, cultivating land , proper use of crops to maximize their efficiency.
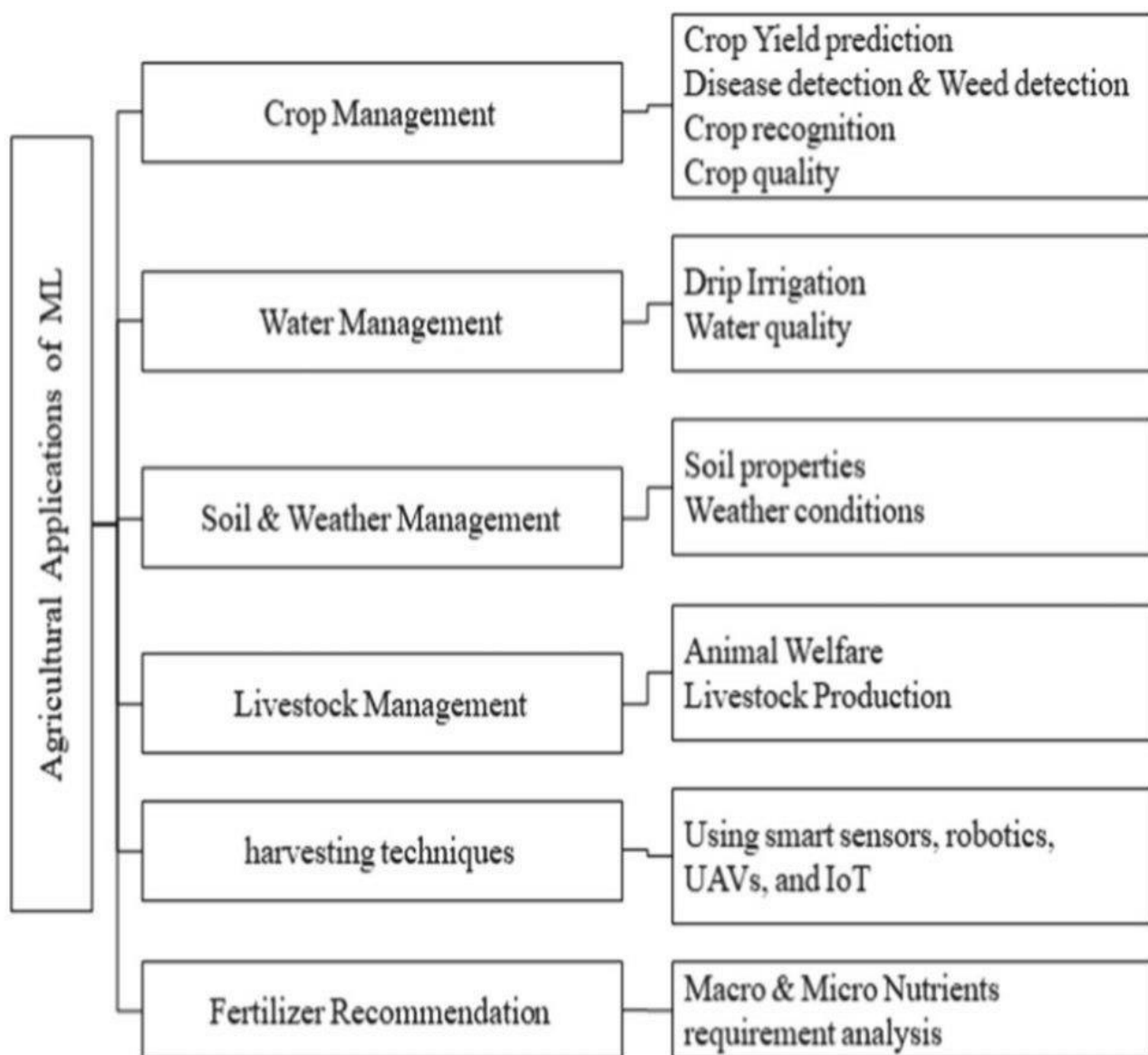
10.1) Data preprocessing

After analyzing and visualizing the data, the next step is preprocessing.

Data preprocessing is an important step as it helps in cleaning the data and making it suitable for use in machine learning algorithms. Most of the focus in preprocessing is to remove any

outliers or erroneous data, as well as handling any missing values. Missing data can be dealt with in two ways. The first method is to simply remove the entire row which contains the missing or error value. While this an easy to execute method, it is better to use only on large datasets. Using this method on small datasets can reduce the dataset size too much, especially if there are a lot of missing values.

This can severely affect the accuracy of the result. Since ours is a relatively small dataset, we will not be using this method. The dataset that we used had values that were in string format

so we had to transform and encode the into integer valued so as to pass as an input to the neural network.

10.2) Features and uses/functions of app include

Irrigation Management System

A more efficient irrigation system is needed to   increase agricultural output while minimising water waste. The alarming drop in groundwater levels is   another reason a new system is needed.
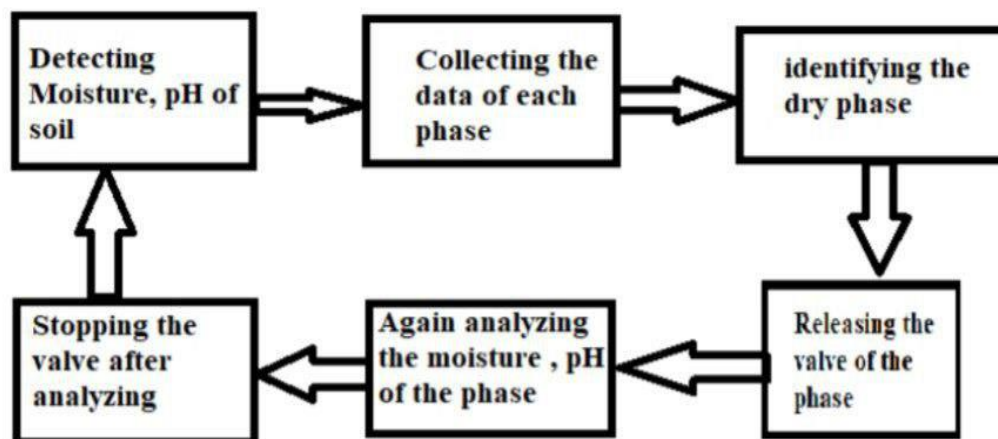
Crop Quality.

Crop quality, which is typically determined by elements like soil and climate conditions, cultivation methods, and crop traits, to name a few, has a significant impact on the market. Agricultural producers often make more money when selling high-quality products because they can command higher price

Crop Management

Managing a crop involves taking into account qualitative and quantitative data which is used in agriculture. Using the crop management approaches such as yield prediction, disease & weed detection, crop recognition, and crop quality agriculture productivity can be increased and the cost can be reduced

<u>ML regression algorithms:</u> are compared for biophysical parameter retrieval with neural networks (NNs) and random forests (RFs). Several state-of-the-art convolutional neural network (CNN) architectures with region suggestions have been trained using transfer learning to automatically recognize seeds within petri dishes and predict whether the seeds germinated or not. Using CNN has higher performance compared to conventional and manual methods for measurement of quality

<u>Water Management</u>

Water management is required in agriculture industry as a large amount of fresh water is needed for the farming and intern effective water management will increase the availability and water quality intern by reducing the water pollution

<u>Livestock Management</u>

Livestock management includes tasks related to their health, nutrition, and growth monitoring. Machine learning is used in these activities to examine the animals' chewing, eating, and movement behaviors (such as standing, moving, drinking, and feeding habits), which reveal the level of stress the animal is under and, thus, aid in predicting their propensity for sickness, rate of weight gain, and level of production.

<u>Soil and Weather Management</u>

Soil management deals with the problems of soil/land degradation due to natural cause or overuse of fertilizers.

Fertilizers Recommendation

By utilizing fertilizers, the necessary nutrients are added to the soil, where they are then transported by the roots to the plants. Fertilizers like potassium (K), phosphorus (P), and nitrogen (N) are three of the main macronutrients that plants require in order to remain healthy

Weed identification

This module helps in identifying the weed present in farm and also suggest herbicides for the predicted weed. To predict the Weeds

Pesticides identification

This module helps in identifying the insects and pests present in farm and also suggest pesticides for the predict insect

Pest and Disease Control

The controlled use of pesticides and fertilizers aids in increasing crop quality while decreasing agricultural costs
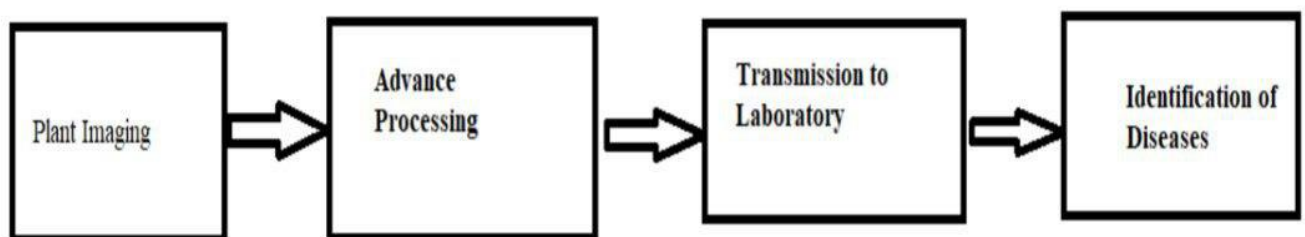
Controlled Use of Fertilizers

Application of fertilizer is crucial to plant growth and quality However, maximizing fertilizer use in productive areas is labor intensive. Fertilizers for agriculture allow for the tracking of nutrient levels in the soil, including nitrogen (N), phosphorus (P), potassium (K), This means that the crop's quality and the nutritional stability of the soil can be maintained

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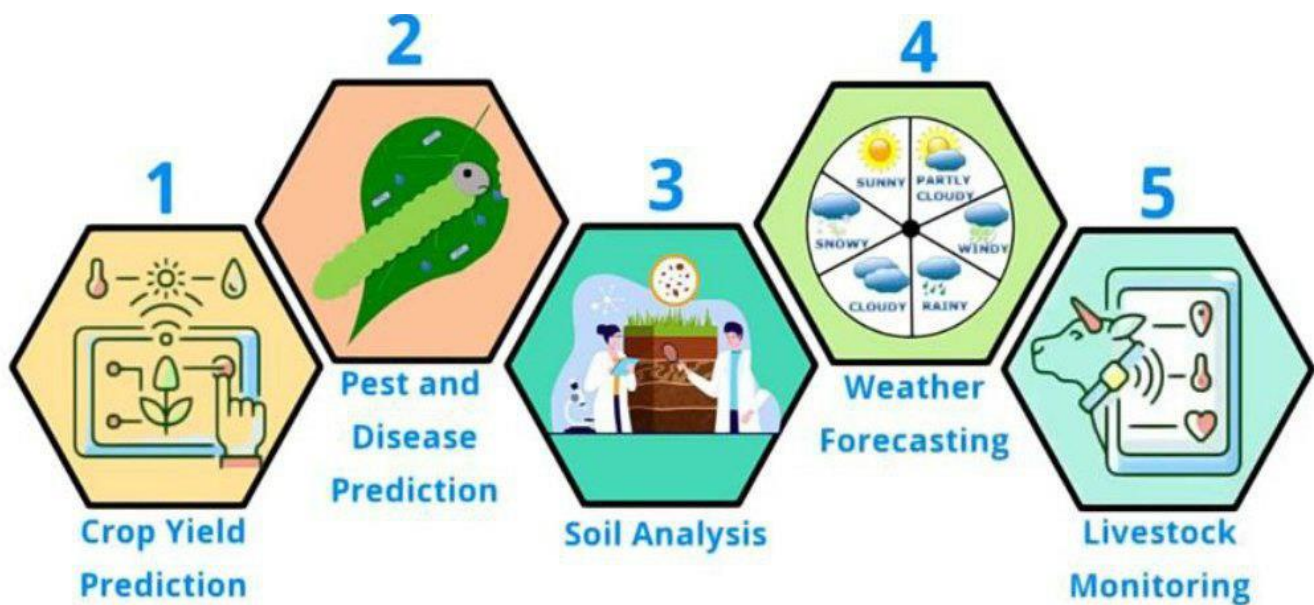
10.3) Project Scope

☐ Improve farm management efficiency by adjusting field/crop treatments

☐ Getting a better result for which type of crop will be growing on your agriculture field.

☐ Getting more productivity from less efforts by using our application

☐ Improve farm management efficiency by adjusting field/crop treatments

☐ Optimize efforts and resources, reduce consumption and waste, and boost land productivity.

☐ Which type of fertilizers should be used if any crop having any disease we can minimize using our app
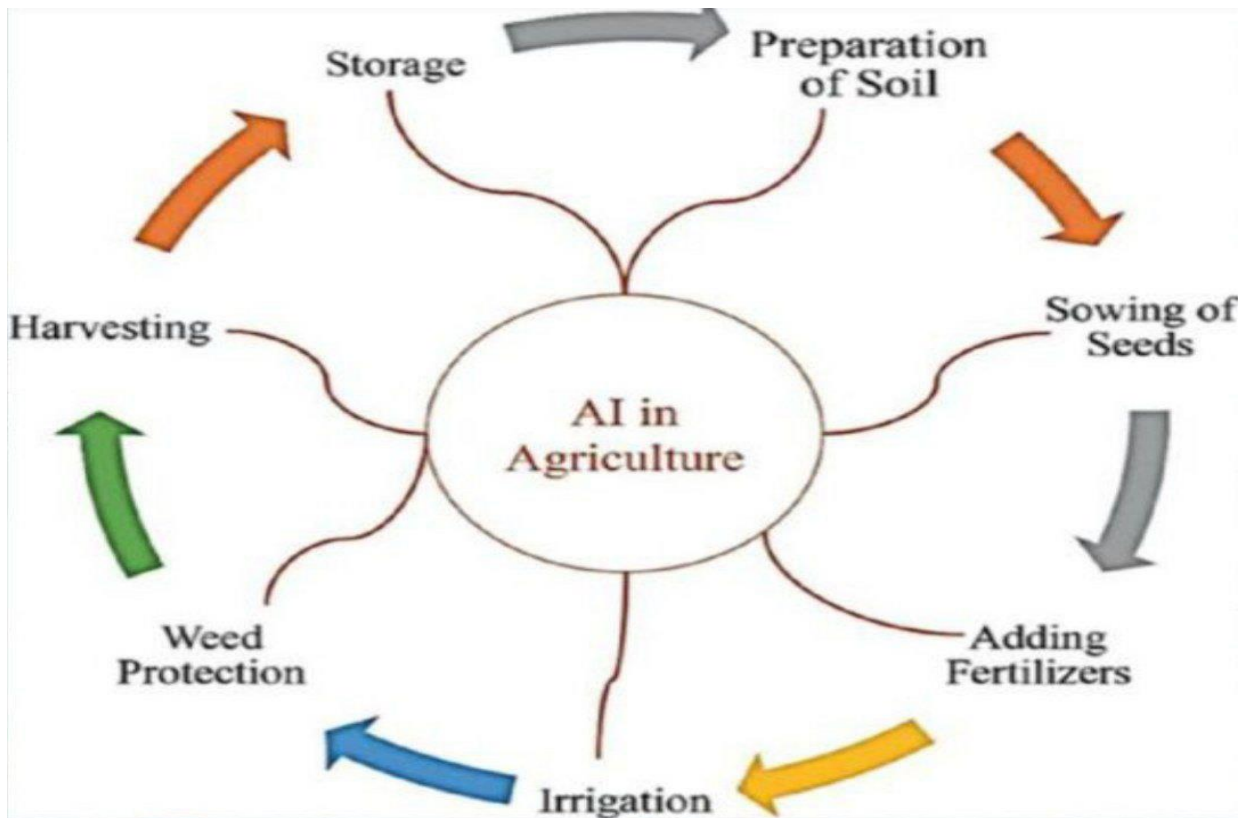
11) SERVICE PROTOTYPE
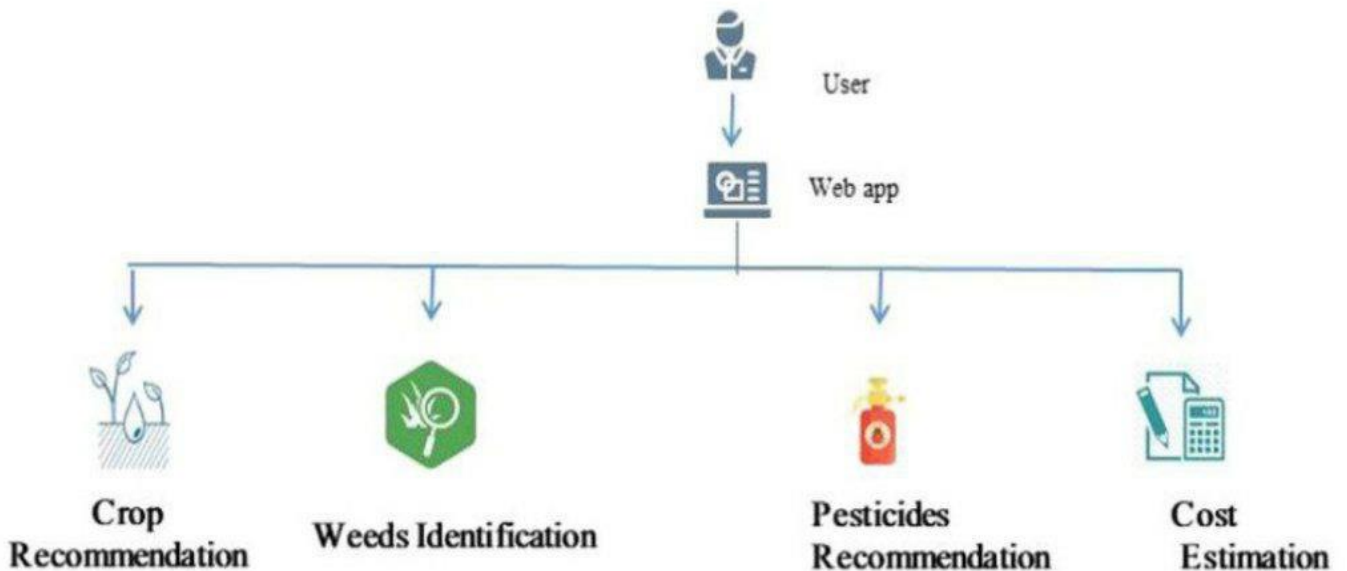
11.1) FEASIBILITY STUDY:

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out.

This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

♦ ECONOMICAL FEASIBILITY

♦ TECHNICAL FEASIBILITY

♦ SOCIAL FEASIBILIT

11.2) ALGORITHAMS USED.
RANDOM FOREST ALGORITHAM:

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. and assign

DECISION TREE:

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome. In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node.

Decision nodes are used to make any decision and have multiple branches, whereas Leaf nodes are the output of those decisions and do not contain any further branches. The decisions or the test are performed on the basis of features of the given dataset. It is a graphical representation for getting all the possible solutions to a problem/decision based on given conditions.

It is called a decision tree because, similar to a tree, it starts with the root node, which expands on further branches and constructs a tree-like structure. In order to build a tree, we use the CART algorithm, which stands for Classification and Regression Tree algorithm.

11.3) Field Management:

Using different AI techniques to manage fields for extra profit, it is always better to take Security measures for anything, using AI we can do predicting climate change, a future need harvest and soil that will save the future failure.
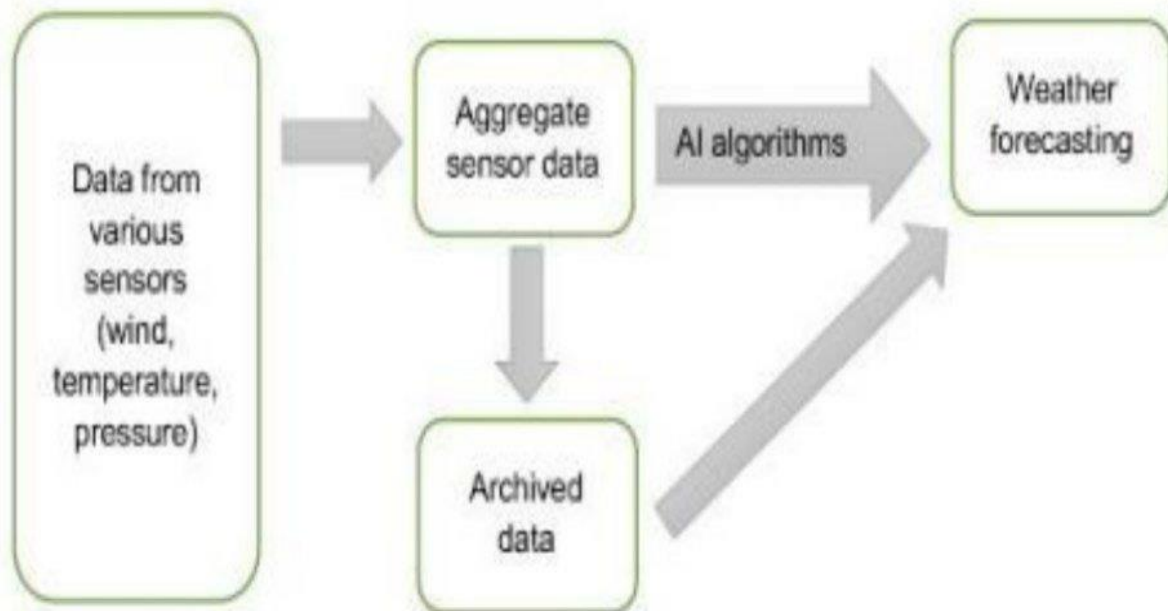
Machine learning model generation and analysis of a crop in a much complex process, which include huge input data in terms of image and text. Machine learning algorithms make it possible to get important information and insights from a large amount of data.

The system will become intelligent and be able to provide definitive facts and make as a result of the application of ML algorithms to data

from various farm inputs.

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│   │ Preprocessing/      │   │        │   │ Preprocessing/      │   │
│   │ cleaning of data    │   │        │   │ cleaning of data    │   │
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│   │ Feature extraction  │   │        │   │ Feature extraction  │   │
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│   ┌─────────────────────┐   │        │   ┌─────────────────────┐   │
│   │ Model generation    │   │        │   │ Applying model      │   │
│   │ using ML techniques │   │──────► │   │ to data             │   │
│   └─────────────────────┘   │        │   └─────────────────────┘   │
│            │                │        │            │                │
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│   │   Model for Test    │───┼────────┼──►│  Crop based Decision│   │
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│       Training Phase        │        │        Testing Phase        │
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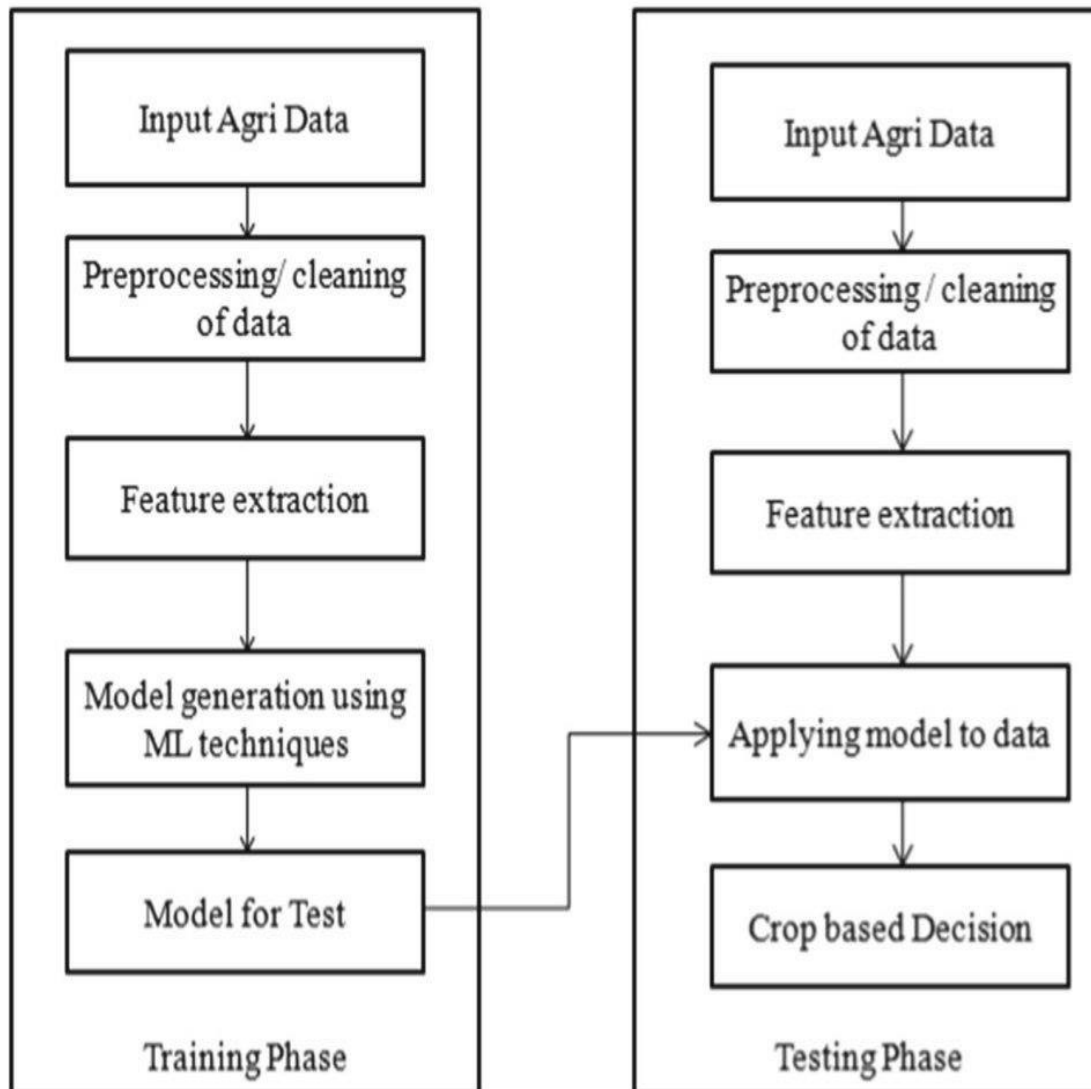
11.4) <u>INPUT DESIGN:</u>

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can

occur by having people keying the data directly into the system.

11.5) **OUTPUT DESIGN:**

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.
2. Select methods for presenting information.

12) **Product details**

Product Details of Smart Farmyy:
1. How does it work?:

Smart Farmyy operates as a cloud-based agriculture management platform accessible through web and mobile applications. It collects real-time data from various sources including IoT sensors deployed across the farm, satellite imagery, weather forecasts, soil databases, and market data. The data is processed and analyzed using machine learning algorithms and predictive analytics to generate actionable insights and recommendations for farmers. Farmers can access the platform to monitor crop health, track resource usage, receive alerts for pest outbreaks or adverse weather conditions, and make informed decisions to optimize farm operations

2. **Data Sources**:

Sensors: Collect data on soil moisture, temperature, humidity, and other environmental parameters.

Weather Forecasts: Offers real-time weather data and forecasts to help farmers plan irrigation, pest control, and harvesting activities.

Soil Databases: Stores information on soil types, nutrient levels, pH levels, and fertility to guide soil management practices.

Market Data: Includes pricing trends, demand forecasts, and market analysis for agricultural commodities

3.Algorithms needed to implement are;-
## **Random Forest:**

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. 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". Random forests(RF) is a versatile machine-learning method for crop yield predictions at regional and global scales for its high accuracy and precision, ease of use, and utility in data analysis.

K-Nearest Neighbor (KNN):

K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning technique.K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available categories. K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a well suite category by using K- NN algorithm. K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problem

Artificial Neural Network:

The term "Artificial neural network" refers to a biologically inspired sub-field of artificial intelligence modeled after the brain. An Artificial neural network is usually a computational network based on biological neural networks that construct the structure of the human brain. Similar to a human brain has neurons interconnected to each other, artificial neural networks also have neurons that are linked to each other in various layers of the networks.
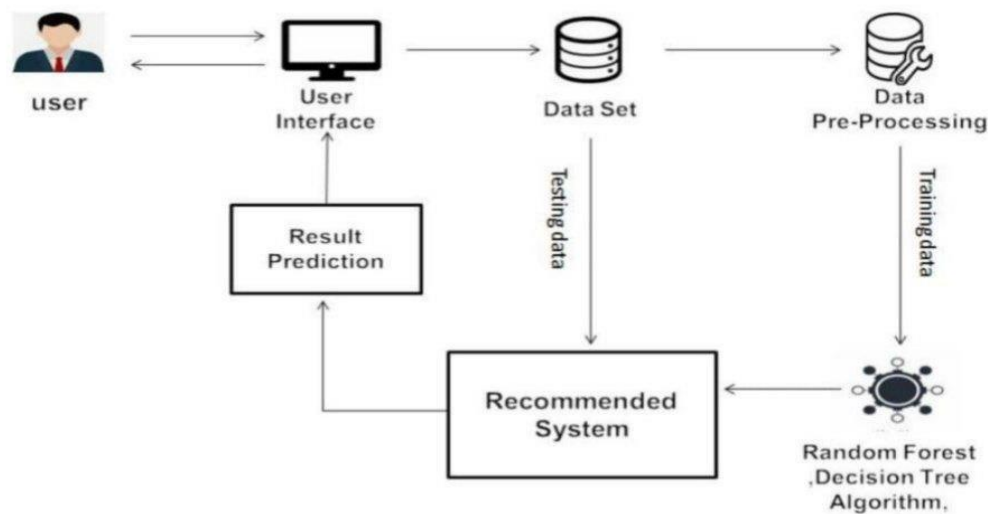
4.User Interfaces

☐ Front End Software: Flask Framework integrated with HTML, CSS, JS, BOOTSTRAP

☐ Back End Software: Machine Learning (Python)

Hardware Interfaces

☐ RAM - Minimum 512 MB.

☐ Processor - i3 or above and above with 2.5 GHz

Software Interfaces

☐ OS: Ubuntu, Windows, Mac

☐ Tools: VScode or Python IDE and Jupyter Notebook.

☐ Programming Language: Python flask, HTML, CSS, JS, BOOTSTRAP.

☐ Dataset: A Dataset which is openly available in kaggle.

☐ Libraries/Tools : Seaborn, Pandas, NumPy, SciKit-Learn, Pytorch, ResNet-9, SQLAlchemy

5. **Team Required to Develop:**

Software Engineers: Experienced in full-stack development, web development, and mobile application development.

Data Scientists: Proficient in machine learning, data analytics, and statistical modeling for processing and analyzing agricultural data.

UI/UX Designers: Skilled in designing intuitive user interfaces and engaging user experiences for web and mobile applications.

Product Managers: Responsible for overseeing the development process, defining product requirements, and ensuring alignment with customer needs and business
objectives.

6. **Cost:**

The cost of developing Smart Farmyy would vary based on factors such as the complexity of features, scale of deployment, and team composition.
Costs may include software development expenses, infrastructure costs, data acquisition and integration fees, and ongoing maintenance and support expenses.

13) Conclusion

In conclusion, Smart Farmyy represents a transformative solution in the agriculture technology landscape, offering farmers and agricultural stakeholders advanced tools and insights to optimize farm operations, increase productivity, and promote sustainability.

Through the integration of cutting-edge technologies such as machine learning, sensors, and data analytics, Smart Farmyy empowers farmers with real-time monitoring, predictive analytics, and actionable recommendations tailored to their unique needs and challenges.

The development and implementation of Smart Farmyy require a multidisciplinary approach, involving collaboration among data scientists, software engineers, and domain experts. By leveraging a combination of data sources, algorithms, and user-friendly interfaces, Smart Farmyy enables farmers to make informed decisions about crop management, irrigation scheduling, pest control, and market analysis.

In summary, Smart Farmyy stands as a beacon of innovation and progress in the agriculture industry, poised to shape the future of farming and cultivate a more resilient, efficient, and sustainable agricultural sector for generations to come.

14) <u>References</u>

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