FARM_ERA: ADVANCED GIS FIELD MAPPING, PRECISION CROP PLANNING, INPUT TRACKING, AI-POWERED PEST MANAGEMENT, REAL-TIME WEATHER UPDATES, SMART IRRIGATION, AND POWERFUL DATA ANALYTICS FOR OPTIMIZED FARMING

A PROJECT REPORT

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Under the guidance of, **Dr. R Vignesh** ***in***

partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

INFORMATION SCIENCE AND ENGINEERING

[Business Analytics and Optimization]

At

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

BENGALURU

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PRESIDENCY UNIVERSITY

SCHOOL OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that the Project report **"Farm_era: Advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics for optimized farming."** being submitted by "Mr. Vishnu Reddy Kotam, Mr. Bellakki Vinayak ,Mr SuhasN, Ms.Rohini.N"_bearing roll number(s) "20201ISE0032, 20201ISE0038, 20201ISB0025, 20201ISE0043" in partial fulfilment of requirement for the award of degree of Bachelor of Technology in Information Science and Engineering is a bonafide work carried out under my supervision.

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DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **Farm_era: Advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics for optimized farming** in partial fulfilment for the award of Degree of **Bachelor of Technology** in **Information Science and Engineering** is a record of our own investigations carried under the guidance of **Dr. R Vignesh, ASSOCIATE PROFESSOR** (SG) **School of Computer Science & Engineering &Information Science, Presidency University, Bengaluru.**

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

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ABSTRACT

Farm_era is an innovative solution that leverages advanced Geographic Information System (GIS) technology to revolutionize the field of agriculture. By integrating precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics, Farm_era provides farmers with a comprehensive toolkit to optimize their farming techniques. One of the core features of Farm_era is its GIS field mapping system, enabling farmers to accurately map and monitor their fields in real-time, facilitating better decision-making and resource allocation. With precision crop planning, farmers can maximize yields by strategically planning the planting of crops based on soil conditions, weather patterns, and other relevant parameters. Input tracking functionality allows farmers to effectively monitor and manage the usage of fertilizers, pesticides, and other resources, enabling cost savings and minimized environmental impact. The AI-powered pest management module utilizes advanced algorithms to detect pest infestations early, providing timely recommendations for effective pest control measures. Real-time weather updates keep farmers informed about current and upcoming weather conditions, allowing for proactive decision-making and minimizing weather-related risks. Smart irrigation technology enables farmers to optimize water usage based on crop requirements and soil moisture measurements, promoting water conservation while maximizing crop productivity. Finally, the powerful data analytics component of Farm_era provides comprehensive insights and trends, helping farmers identify patterns, optimize farming practices, and make data-driven decisions.

ACKNOWLEDGEMENT

First of all, we indebted to the **GOD ALMIGHTY** for giving me an opportunity to excel in our efforts to complete this project on time.

We express our sincere thanks to our respected dean **Dr. Md. Sameeruddin Khan**, Dean, School of Computer Science & Engineering & Information Science, Presidency University for getting us permission to undergo the project.

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We are greatly indebted to our guide **Dr. R Vignesh, Associate Professor**(SG), School of Computer Science & Engineering & Information Science, Presidency University for his inspirational guidance, and valuable suggestions and for providing us a chance to express our technical capabilities in every respect for the completion of the project work.

We would like to convey our gratitude and heartfelt thanks to the University Project-II Coordinators **Dr. Sanjeev P Kaulgud, Dr. Mrutyunjaya MS** and also the department Project Coordinators.

We thank our family and friends for the strong support and inspiration they have provided us in bringing out this project.

Mr. Vishnu Reddy Kotam

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Mr. Suhas N

Ms. Rohini N

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CHAPTER-1 INTRODUCTION

1.1 GENERAL

Farm_era is an advanced agricultural platform that revolutionizes the way farmers manage their operations. With its comprehensive suite of tools and features, Farm_era empowers farmers to leverage the power of geographic information system (GIS) field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics for optimized farming. At the core of Farm_era is its GIS field mapping capability, which enables farmers to accurately map and visualize their fields, ensuring that they have a clear understanding of their land boundaries, terrain variations, and other relevant information. By having this level of spatial awareness, farmers can make informed decisions about planting, fertilizing, and harvesting, leading to improved productivity and sustainability. Precision crop planning is another key feature offered by Farm_era, as it allows farmers to optimize yield potential through precise seed placement and appropriate crop rotations. By analysing soil composition, moisture levels, and other environmental factors, farmers can strategically determine the best crop varieties to plant in specific areas of their fields, maximizing their overall productivity while minimizing resource waste. Tracking inputs is critical for efficient farm management, and Farm_era offers a comprehensive input tracking system that enables farmers to monitor the usage of fertilizers, pesticides, and other agricultural inputs. By keeping track of these inputs, farmers can ensure that they adhere to environmental regulations and optimize their resource allocation, leading to cost savings and reduced environmental impact.

The AI-powered pest management feature of Farm_era is a game-changer in the battle against crop-damaging pests. By leveraging advanced machine learning algorithms, the platform can detect and identify different types of pests and diseases, allowing farmers to take immediate action to mitigate the damage. Through proactive pest management, farmers can protect their crops and minimize yield losses, ultimately boosting profitability. Real-time weather updates and smart irrigation are essential components of Farm_era, providing farmers with crucial insights into current and forecasted weather conditions. By integrating with local weather stations and remote sensors, the platform enables farmers to make data-driven decisions regarding irrigation, ensuring that crops receive the optimal amount of water while conserving resources. Last but not least, Farm_era's powerful data analytics capabilities allow farmers to transform their data into actionable insights, providing them with a competitive edge. By analysing historical and real-time data on yields, inputs, weather patterns, and other variables, farmers can make evidence-based decisions to optimize their farming practices, improve crop quality, and increase profitability. In conclusion, Farm_era is a comprehensive agricultural solution that leverages GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics to unlock the full potential of modern farming. By empowering farmers with these advanced tools and capabilities, Farm_era revolutionizes the way farms are managed, leading to increased productivity, sustainability, and profitability in the agricultural industry.

1.2 PROBLEM DESCRIPTION

Farm_era faces the challenge of modernizing and optimizing farming practices to meet the growing global demand for food while minimizing resource consumption and environmental impact. Traditional farming methods often lack precision and efficiency, leading to overuse of resources and increased pestrelated losses. Farm_era aims to address these issues by employing advanced technologies such as GIS field mapping, precision crop planning, and AIpowered pest management. However, integrating these technologies into existing agricultural systems can be complex and costly. Ensuring seamless realtime data integration and analysis while maintaining user-friendly interfaces poses a significant challenge. Additionally, adapting to changing weather patterns and optimizing irrigation to conserve water resources is crucial. Farm_era must continually update its weather monitoring and smart irrigation systems to stay effective in the face of climate variability. Ultimately, the success of Farm_era hinges on its ability to provide farmers with actionable insights and tools that improve crop yield, resource efficiency, and profitability in a sustainable manner.

1.3 OBJECTIVE

The primary objective of Farm_era is to revolutionize modern agriculture by harnessing cutting-edge technology to optimize farming practices. Our mission is to empower farmers with advanced tools and solutions to address the following key objectives:

1. Precision Farming: Farm_era aims to enable precise and data-driven farming practices through GIS field mapping and precision crop planning. This ensures optimal land usage and resource allocation.

2. Pest Management: By utilizing AI-powered pest management systems, Farm_era seeks to minimize crop losses caused by pests while reducing the reliance on chemical pesticides, promoting sustainable agriculture.

3. Resource Efficiency: We strive to enhance resource efficiency by providing real-time weather updates and smart irrigation solutions, enabling farmers to conserve water and energy resources while improving crop yields.

4. Data-Driven Insights: Farm_era's powerful data analytics tools are designed to offer farmers actionable insights into their operations, helping them make informed decisions and increase overall farm productivity.

5. Sustainability: Our overarching goal is to promote environmentally sustainable farming practices, reducing the ecological footprint of agriculture and contributing to food security on a global scale. Farm_era is committed to revolutionizing agriculture for a more sustainable, efficient, and productive future.

1.4 EXISTING SYSTEM

The existing system for Farm_era, which incorporates advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics for optimized farming, does have a few disadvantages. Firstly, the implementation of such a comprehensive system requires a significant initial investment in terms of hardware, software, and skilled personnel, which may pose a financial challenge for small-scale farmers or those with limited resources. Additionally, the complexity of the system may require farmers to undergo extensive training to fully understand and utilize all its features effectively. This can be timeconsuming and may hinder the adoption of the system by farmers who are already burdened with numerous tasks on the farm. Furthermore, the system relies heavily on technology and connectivity, which may be unreliable in rural areas or regions with poor network coverage. This can lead to disruptions in data acquisition, communication between devices, and access to real-time updates, potentially compromising the accuracy and timeliness of decision-making processes. Another drawback is the reliance on AI-powered pest management, which may not be suitable for all types of pests or farming practices. Traditional methods may still be necessary in certain cases, and the exclusion of non-AI approaches could limit the effectiveness of pest control strategies. Lastly, while smart irrigation can help conserve water by providing plants with the right amount at the right time, it may also require farmers to be more dependent on technology and automated systems. This raises concerns regarding the sustainability and resilience of farming practices in the event of system failures or power outages. Despite these disadvantages, with proper planning, training, and support, the implementation of the Farm_era system has the potential to revolutionize farming practices and enhance productivity, sustainability, and profitability in the agricultural sector.

1.5 PROPOSED SYSTEM

Farm_era offers a comprehensive solution for advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics to optimize farming. With advanced GIS field mapping, farmers can accurately map their fields, identify boundaries, and efficiently plan their planting and harvesting activities. Precision crop planning ensures that farmers maximize their yield potential by deploying the most suitable crops and varieties for their fields based on soil conditions, weather patterns and market demand. Moreover, Farm_era provides input tracking capabilities, enabling farmers to closely monitor and manage their use of fertilizers, pesticides and other key inputs. This helps to reduce waste, ensure sustainability, and improve cost efficiency. AIpowered pest management takes precision farming to the next level by using machine learning algorithms to detect and identify pest infestations early on. This proactive approach allows farmers to take swift and targeted action, minimizing the impact of pests on their crops. Real-time weather updates play a crucial role in making informed decisions on crop management. Farm_era integrates with meteorological data sources to provide farmers with up-to-date information on temperature, humidity, rainfall and other key weather parameters.

This information enables farmers to adjust irrigation schedules, optimize pesticide applications, and take appropriate measures to protect their crops from extreme weather events.In addition, Farm_era incorporates smart irrigation technology, which uses sensors and data analytics to determine precise irrigation needs based on soil moisture levels, crop water requirements, and weather conditions. This ensures efficient water usage, minimizes water waste, and promotes sustainable farming practices. Farm_era's powerful data analytics capabilities bring all the collected data together to generate actionable insights and recommendations. By analysingdata on crop performance, input usage, weather patterns, and other relevant factors, farmers can make data-driven decisions to optimize their farming operations, increase productivity, and enhance profitability. The integration of artificial intelligence further enhances the system's ability to continuously learn and improve recommendations over time. Overall, Farm_era offers a complete and integrated solution for farmers to embrace precision farming and harness the power of advanced technology for optimized farming practices.

CHAPTER-2 LITERATURE SURVEY

[1] Obi Reddy, G. P., B. S. Dwivedi, and G. Ravindra Chary. "Applications of geospatial and big data technologies in smart farming." In Smart Agriculture for Developing Nations: Status, Perspectives and Challenges, pp. 15-31. Singapore: Springer Nature Singapore, 2023.

This reference explores how geospatial and big data technologies are being harnessed in smart farming to address the unique challenges faced by developing nations in agriculture. It provides insights into the practical applications of these technologies, emphasizing their potential in improving crop management, resource allocation, and decision-making processes. The chapter highlights the significance of leveraging data-driven approaches to enhance agricultural practices, particularly in regions where agriculture plays a vital role in food security and economic development.

[2] Rhoads, Jonathan. "Next-Generation Precision Farming Integrating AI and IoT in Crop Management Systems." AI, IoT and the Fourth Industrial Revolution Review 13, no. 7 (2023): 1-9.

Jonathan Rhoads' article delves into the next generation of precision farming, emphasizing the integration of Artificial Intelligence (AI) and Internet of Things (IoT) technologies in crop management systems. It discusses how these advancements are shaping the future of agriculture, enabling data-driven decision-making, automation, and real-time monitoring. The article underscores the transformative potential of AI and IoT in optimizing crop production, reducing resource wastage, and increasing sustainability in agriculture.

[3] Karunathilake, E. M. B. M., Anh Tuan Le, Seong Heo, Yong Suk Chung, and Sheikh Mansoor. "The Path to Smart Farming:

Innovations and Opportunities in Precision Agriculture." Agriculture 13, no. 8 (2023): 1593.

This reference outlines the path toward smart farming by exploring innovations and opportunities within precision agriculture. It underscores the role of emerging technologies in reshaping agricultural practices, from precision crop management to data-driven decision support. The article provides a forwardlooking perspective on how advancements in agriculture are poised to revolutionize the industry, emphasizing the potential for increased efficiency, sustainability, and productivity in farming.

[4] Rane, Nitin Liladhar, and Saurabh P. Choudhary. "REMOTE SENSING (RS), UAV/DRONES, AND MACHINE LEARNING (ML) AS POWERFUL TECHNIQUES FOR PRECISION AGRICULTURE:

EFFECTIVE APPLICATIONS IN AGRICULTURE."

Rane and Choudhary's work explores the effective applications of Remote Sensing (RS), Unmanned Aerial Vehicles (UAVs) or drones, and Machine Learning (ML) in precision agriculture. It highlights how these powerful techniques are being employed to gather critical data about crops and farmland. The article discusses how this data is then analyzed using machine learning to make informed decisions, optimize resource utilization, and increase agricultural productivity, demonstrating the significant impact of technology on modern farming practices.

[5] Khan, Idrees, and Surya Afrin Shorna. "Cloud-Based IoT Solutions for Enhanced Agricultural Sustainability and Efficiency." AI, IoT and the Fourth Industrial Revolution Review 13, no. 7 (2023): 18-26.

This reference explores the role of cloud-based Internet of Things (IoT) solutions in enhancing agricultural sustainability and efficiency. It emphasizes how cloud computing and IoT technologies are being leveraged to create smart and interconnected farming systems. The article discusses how these solutions enable real-time data collection, analysis, and remote monitoring, contributing to sustainable farming practices. It highlights the potential of cloud-based IoT to improve resource management, reduce environmental impact, and increase the overall efficiency of agricultural operations.

[6] Balkrishna, Acharya, Rakshit Pathak, Sandeep Kumar, Vedpriya Arya, and Sumit Kumar Singh. "A comprehensive analysis of the advances in Indian Digital Agricultural architecture." Smart Agricultural Technology 5 (2023): 100318.

This article provides a comprehensive analysis of the advances in the digital agricultural architecture in India. It explores the technological developments that have transformed the Indian agricultural sector. The analysis covers various aspects, including digitalization, automation, and data-driven approaches in farming. It sheds light on how India is embracing technology to enhance agricultural productivity, reduce post-harvest losses, and improve the livelihoods of farmers. The article serves as an informative resource for understanding the digital transformation of agriculture in India.

[7] Balkrishna, Acharya, Rakshit Pathak, Sandeep Kumar, Vedpriya Arya, and Sumit Kumar Singh. "Smart Agricultural Technology." Precision Agriculture (PA) (2030):

This reference discusses "Smart Agricultural Technology" within the context of precision agriculture (PA). It provides insights into the evolving landscape of smart technologies in agriculture. The chapter explores the integration of sensors, automation, data analytics, and IoT in farming practices to enhance precision and efficiency. It emphasizes how smart agricultural technology is reshaping the way crops are grown, monitored, and managed, ultimately leading to more sustainable and productive agricultural systems.

[8] Vashishth, Tarun Kumar, Vikas Sharma, Sachin Chaudhary, Rajneesh Panwar, Shashank Sharma, and Prashant Kumar. "Advanced Technologies and AI-Enabled IoT Applications in High-Tech Agriculture." In Handbook of Research on AI-Equipped IoT Applications in High-Tech Agriculture, pp. 155-166. IGI Global, 2023.

This chapter in the Handbook of Research explores advanced technologies and AI-enabled IoT applications in high-tech agriculture. It offers a detailed examination of how artificial intelligence and IoT are transforming modern agriculture practices. The chapter highlights specific use cases and applications of these technologies in optimizing resource management, crop monitoring, and decision-making in high-tech agricultural settings.

[9] Kuppusamy, Palanivel, Joseph K. Suresh, and Suganthi Shanmugananthan. "Machine Learning-Enabled Internet of Things Solution for Smart Agriculture Operations." In Handbook of Research on Machine Learning-Enabled IoT for Smart Applications Across Industries, pp. 84-115. IGI Global, 2023.

This chapter in the Handbook of Research focuses on machine learning-enabled Internet of Things (IoT) solutions for smart agriculture operations. It delves into how machine learning and IoT technologies are revolutionizing agricultural processes. The chapter explores the use of data analytics, predictive modeling, and automation to optimize farming practices, increase yields, and reduce resource consumption. It provides a comprehensive overview of the potential of machine learning and IoT in transforming agriculture into a data-driven and efficient industry.

[10] Sharma, Shikha. "PRECISION AGRICULTURE: REVIEWING THE ADVANCEMENTS, TECHNOLOGIES, AND APPLICATIONS IN

PRECISION AGRICULTURE FOR IMPROVED CROP

PRODUCTIVITY AND RESOURCE MANAGEMENT."

Shikha Sharma's work reviews the advancements, technologies, and applications in precision agriculture with the aim of improving crop productivity and resource management. The review article covers various aspects of precision agriculture, including data-driven decision-making, sensor technology, automation, and remote monitoring. It emphasizes how the integration of these technologies can lead to increased crop yields, reduced resource wastage, and overall improved resource management in agriculture.

CHAPTER-3 RESEARCH GAPS OF EXISTING METHODS

Farm_era, a comprehensive agricultural technology platform, holds great promise for modern farming practices, but it also reveals several critical research gaps and areas for improvement that warrant in-depth exploration and innovation. One of the foremost challenges lies in achieving seamless integration among the diverse components of the system. While Farm_era offers an array of advanced features, ensuring these modules work together harmoniously can be a complex task. Researchers could delve into developing standardized protocols or application programming interfaces (APIs) that facilitate smoother integration and data exchange, ensuring that the wealth of data generated within the platform can be effectively utilized.

Data privacy and security also emerge as significant concerns in the context of Farm_era. With its reliance on data analytics and cloud-based services, safeguarding sensitive farm data becomes paramount. Research initiatives could concentrate on fortifying the security of farm data through robust encryption, multi-factor authentication, and stringent access control mechanisms, safeguarding against cyber threats and unauthorized access that could compromise the integrity and confidentiality of this critical information.

Usability and accessibility are two additional facets demanding attention in Farm_era's development. To ensure that the platform is truly user-friendly and inclusive farmers of varying technological proficiency, researchers may focus on refining the user interface to make more intuitive and accommodating, particularly for older or less tech-savvy farmers. Moreover, multilingual support could be integrated to cater to users from diverse linguistic backgrounds, enabling a broader range of individuals to harness the platform's benefits.

As the platform scales and expands its user base, scalability and resource optimization assume increasing importance. Researchers could explore methodologies for optimizing resource utilization, thereby allowing Farm_era to accommodate a larger number of users and farms without incurring prohibitively high infrastructure costs. Technologies such as containerization or serverless computing may offer solutions to this challenge, ensuring that the platform remains cost-effective and accessible to a broader agricultural community.

The accuracy of data within Farm_era is paramount, particularly in GIS field mapping and weather forecasting. Herein lies a potential research gap, as ensuring precise and dependable data sources is imperative. Researchers may investigate methods for enhancing the accuracy of data obtained from remote sensing technologies and weather sensors. Machine learning algorithms could be leveraged to rectify inconsistencies in data and fine-tune predictive models, ultimately ensuring that farmers can make informed decisions with the utmost confidence in the reliability of the information at their disposal.

AI-powered pest management, a notable feature of Farm_era, offers opportunities for further refinement. Pest detection algorithms could be the subject of intensive research efforts to reduce instances of false positives and negatives, thus enhancing the effectiveness of pest management strategies. Moreover, integrating biological pest control methods into the system could be explored, aligning with sustainable farming practices and potentially reducing the reliance on chemical solutions.

In the realm of real-time weather updates, localized data can be challenging to obtain accurately, particularly in regions with limited weather station coverage. Research endeavors may focus on developing or enhancing localized weather prediction models, ensuring that farmers in even the most remote or underserved areas have access to timely and precise meteorological information, enabling them to make proactive decisions in response to changing weather conditions.

Smart irrigation, a vital aspect of resource conservation, presents opportunities for efficiency enhancement. Researchers might delve into optimizing irrigation schedules by factoring in soil moisture data, plant types,real-time weather conditions more comprehensively. Such an approach could lead to more precise resource utilization and significantly increased water savings, particularly in areas prone to water scarcity.

While Farm_era addresses AI-powered pest management, there is also a need to monitor and manage crop diseases effectively. Research avenues could explore the integration of disease detection technologies, such as image recognition and sensor-based disease monitoring, into the platform. This comprehensive approach to crop health management could prove invaluable in ensuring that crops thrive and that potential diseases are identified and addressed promptly.

Farm_era's sustainability also warrants examination. Precision agriculture can optimize resource use, but its broader environmental impact needs consideration. Researchers could investigate the platform's overall sustainability, accounting for factors like soil health, biodiversity preservation, and the reduction of chemical inputs. This holistic evaluation can provide valuable insights into the ecological footprint of modern farming practices facilitated by Farm_era.

Efforts to enhance energy efficiency in Farm_era's operations can contribute to environmental sustainability. Research initiatives explore renewable energy sources, energy-efficient hardware components, and advanced data center cooling technologies to reduce platform's carbon footprint. This aligns with broader efforts to minimize the environmental impact of data-intensive agricultural technologies.

The cost of hardware components, including IoT sensors and cameras, could be a barrier to adoption for some farmers. To address this, researchers might investigate cost-effective alternatives or leasing models that make these technologies more accessible and affordable to a wider range of farming operations. Lowering the cost of entry can democratize access to Farm_era's benefits and encourage more farmers to embrace these advanced tools.

Localization and cultural factors in farming practices present unique challenges. Farm_era may need to adapt to suit the specific needs and practices of different regions, accounting for local crops, farming techniques, and cultural factors. Research efforts in this direction can foster inclusivity and relevance, ensuring that the platform resonates with diverse farming communities across the globe.

Evaluating the long-term impact of Farm_era is essential for assessing its effectiveness. Researchers can embark on longitudinal studies to analyze the platform's influence on farm productivity, resource usage, and environmental sustainability over multiple growing seasons. These studies can provide valuable insights into the enduring effects of Farm_era on the agricultural landscape.

Training and education are fundamental to the successful adoption of Farm_era. Researchers can focus on developing effective training and education programs tailored to the needs and preferences of different user groups. Ensuring that farmers have the knowledge and skills to harness the full potential of the platform can significantly contribute to its success.

Farm_era must also contend with regulatory compliance in various regions. Researchers could work on tools and features that assist farmers in navigating these regulations, streamlining administrative processes, and ensuring compliance to avoid potential legal issues or penalties.

The promotion of environmental sustainability within Farm_era extends beyond resource optimization. Research can investigate the broader environmental impact of modern farming practices facilitated by the platform, including soil health, biodiversity preservation, and the reduction of chemical inputs. By aligning Farm_era with sustainable farming practices, researchers can help mitigate the environmental impact of agriculture.

Market access and affordability are critical considerations. Access to Farm_era may be limited by factors such as internet connectivity and affordability. Research can explore solutions to improve access, including partnerships with local governments or organizations, subsidies for disadvantaged farming communities, and innovative strategies for delivering the platform to underserved areas.

Finally, Farm_era must recognize and account for the community and social aspects of agriculture. Farming often involves close-knit communities that rely on shared knowledge and support networks. Research can explore ways to leverage Farm_era to strengthen community collaboration, facilitate knowledge sharing, and support the social aspects of farming communities, thereby fostering a sense of unity and mutual support among farmers.

In conclusion, Farm_era's advanced agricultural technology platform offers a promising array of features for optimized farming. However, these features are not without their research gaps and areas for improvement. Addressing these gaps through collaborative research and development efforts can enhance the platform's functionality, usability, and overall impact on agriculture and sustainability. By bridging these gaps, Farm_era can continue to evolve and empower farmers worldwide to adopt more efficient, sustainable, and environmentally responsible farming practices.

CHAPTER-4 PROPOSED MOTHODOLOGY

Farm_era offers a comprehensive solution for advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics to optimize farming. With advanced GIS field mapping, farmers can accurately map their fields, identify boundaries, and efficiently plan their planting and harvesting activities. Precision crop planning ensures that farmers maximize their yield potential by deploying the most suitable crops.

Moreover, Farm_era provides input tracking capabilities, enabling farmers to closely monitor and manage their use of fertilizers, pesticides and other key inputs. This helps to reduce waste, ensure sustainability, and improve cost efficiency. AI-powered pest management takes precision farming to the next level by using machine learning algorithms to detect and identify pest infestations early on. This proactive approach allows farmers to take swift and targeted action, minimizing the impact of pests on their crops.

Real-time weather updates play a crucial role in making informed decisions on crop management. Farm_era integrates with meteorological data sources to provide farmers with up-to-date information on temperature, humidity, rainfall and other key weather parameters. This information enables farmers to adjust irrigation schedules, optimize pesticide applications, and take appropriate measures to protect their crops from extreme weather events. In addition, Farm_era incorporates smart irrigation technology, which uses sensors and data analytics to determine precise irrigation needs based on soil moisture levels, crop water requirements, and weather conditions. This ensures efficient water usage, minimizes water waste, and promotes sustainable farming practices.

Farm_era's powerful data analytics capabilities bring all the collected data together to generate actionable insights and recommendations. By analysing data on crop performance, input usage, weather patterns, and other relevant factors, farmers can make data-driven decisions to optimize their farming operations, increase productivity, and enhance profitability. The integration of artificial intelligence further enhances the system's ability to continuously learn and improve recommendations over time. Overall, Farm_era offers a complete and integrated solution for farmers to embrace precision farming and harness the power of advanced technology for optimized farming practices.

CHAPTER-5 OBJECTIVES

The primary objective of Farm_era is to revolutionize modern agriculture by harnessing cutting-edge technology to optimize farming practices. Our mission is to empower farmers with advanced tools and solutions to address the following key objectives:

1. Precision Farming: Farm_era aims to enable precise and data-driven farming practices through GIS field mapping and precision crop planning. This ensures optimal land usage and resource allocation.
2. Pest Management: By utilizing AI-powered pest management systems, Farm_era seeks to minimize crop losses caused by pests while reducing the reliance on chemical pesticides, promoting sustainable agriculture.
3. Resource Efficiency: We strive to enhance resource efficiency by providing real-time weather updates and smart irrigation solutions, enabling farmers to conserve water and energy resources while improving crop yields.
4. Data-Driven Insights: Farm_era's powerful data analytics tools are designed to offer farmers actionable insights into their operations, helping them make informed decisions and increase overall farm productivity.
5. Sustainability: Our overarching goal is to promote environmentally sustainable farming practices, reducing the ecological footprint of agriculture and contributing to food security on a global scale.

Farm_era is committed to revolutionizing agriculture for a more sustainable, efficient, and productive future.

CHAPTER-6 SYSTEM DESIGN & IMPLEMENTATION

Farm_era offers a comprehensive solution for advanced GIS field mapping, precision crop planning, input tracking, AI-powered pest management, real-time weather updates, smart irrigation, and powerful data analytics to optimize farming. With advanced GIS field mapping, farmers can accurately map their fields, identify boundaries, and efficiently plan their planting and harvesting activities. Precision crop planning ensures that farmers maximize their yield potential by deploying the most suitable crops and varieties for their fields based on soil conditions, weather patterns and market demand.

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Real-time weather updates play a crucial role in making informed decisions on crop management. Farm_era integrates with meteorological data sources to provide farmers with up-to-date information on temperature, humidity, rainfall and other key weather parameters. This information enables farmers to adjust irrigation schedules, optimize pesticide applications, and take appropriate measures to protect their crops from extreme weather events.

In addition, Farm_era incorporates smart irrigation technology, which uses sensors and data analytics to determine precise irrigation needs based on soil moisture levels, crop water requirements, and weather conditions. This ensures efficient water usage, minimizes water waste, and promotes sustainable farming practices.

Farm_era's powerful data analytics capabilities bring all the collected data together to generate actionable insights and recommendations. By analyzing data on crop performance, input usage, weather patterns, and other relevant factors, farmers can make data-driven decisions to optimize their farming operations, increase productivity, and enhance profitability. The integration of artificial intelligence further enhances the system's ability to continuously learn and improve recommendations over time. Overall, Farm_era offers a complete and integrated solution for farmers to embrace precision farming and harness the power of advanced technology for optimized farming practices.

SYSTEM FLOW DIAGRAM

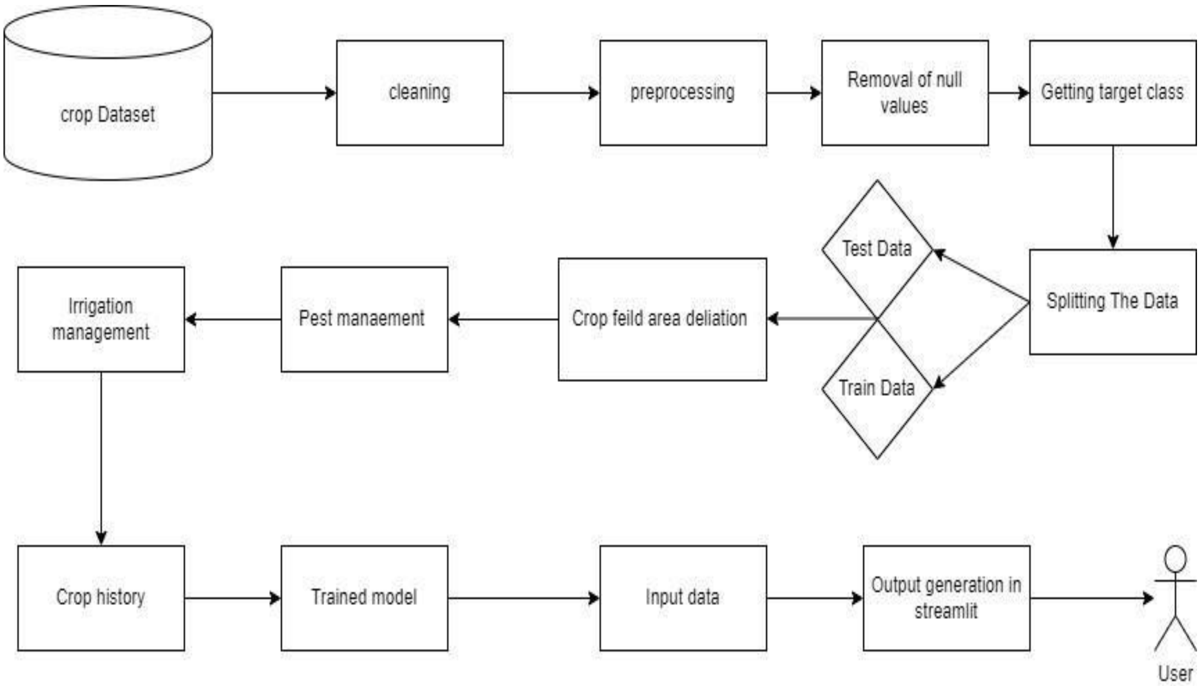

Figure 6.1-Block diagram of the proposed system.

ARCHITECTURE DIAGRAM

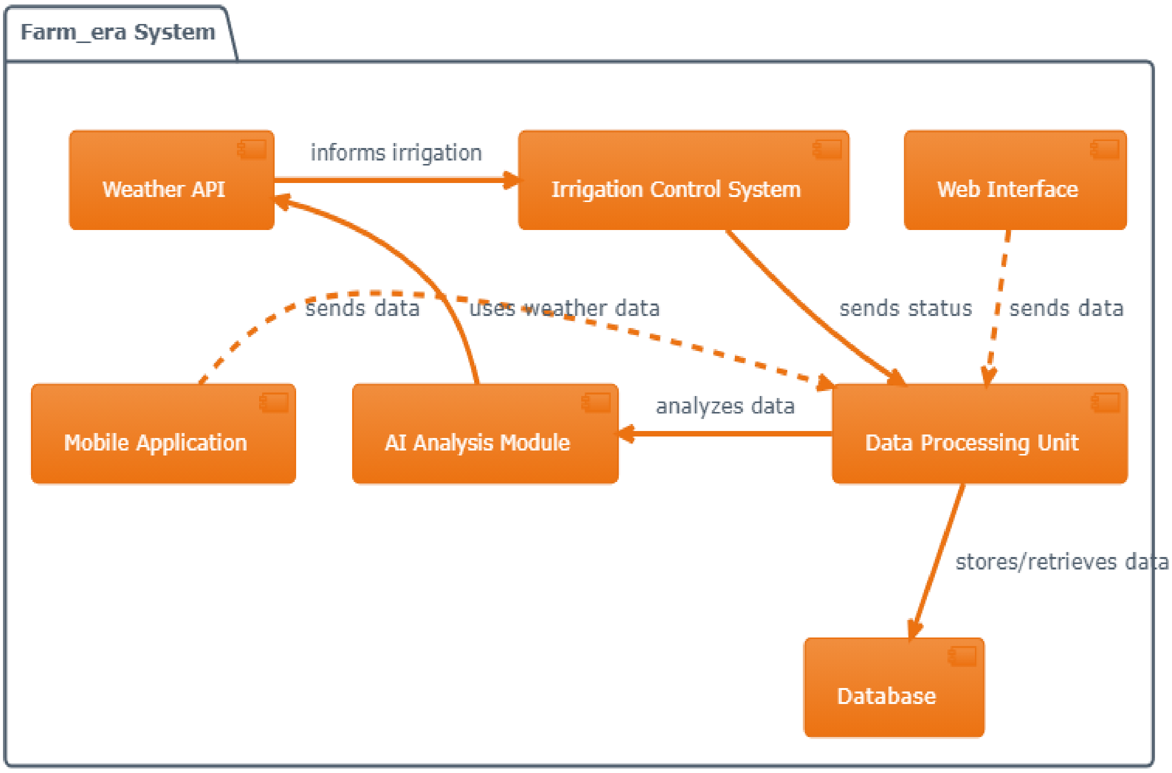

Figure 6.2-Architecture diagram of the proposed system.

USE CASE DIAGRAM

A use case diagram is used to represent the dynamic behavior of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It depicts the high-level functionality of a system and also tells how user handles a system.The main purpose of a use case diagram is to portray the dynamic aspect of a system. It accumulates the system's requirement, which includes both internal as well as external influences. It invokes persons, use cases, and several things that invoke the actors and elements accountable for the implementation of use case diagrams. It represents how an entity from the external environment can interact with a part of the system.

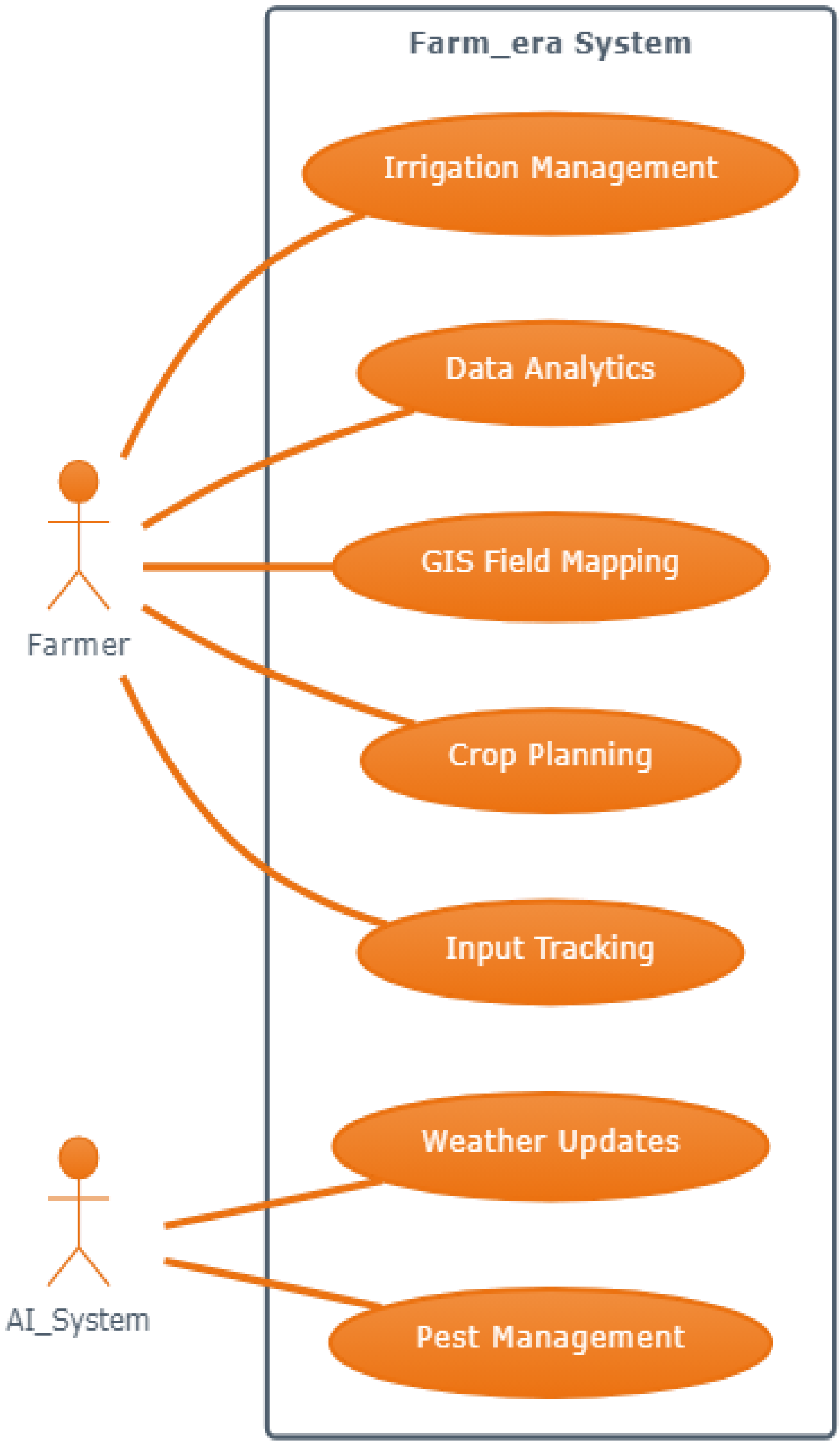

Figure 6.3-Use case diagram of the proposed system.

ACTIVITY DIAGRAM

An activity diagram is a kind of graphical representation that may be used to depict events visually. It is made up of a group of nodes that are linked to one another by means of edges. They are able to be connected to any other modelling element, which enables the behaviour of activities to be replicated using that methodology. Simulations of use cases, classes, and interfaces, as well as component collaborations and component interactions, are all made feasible with the help of this tool.

Figure 6.4-Activity diagram of the proposed system.

CLASS DIAGRAM

A static view of an application is depicted in the class diagram. It displays the properties, classes, functions, and relationships of the software system to provide an overview of the software system. It organizes class names, properties, and functions into a discrete compartment to aid in program development.

The following are the functions of class diagrams:

1. Define the main responsibilities of the system.
2. Serves as a basis for component diagrams and deployment. Use forward and reverse engineering.

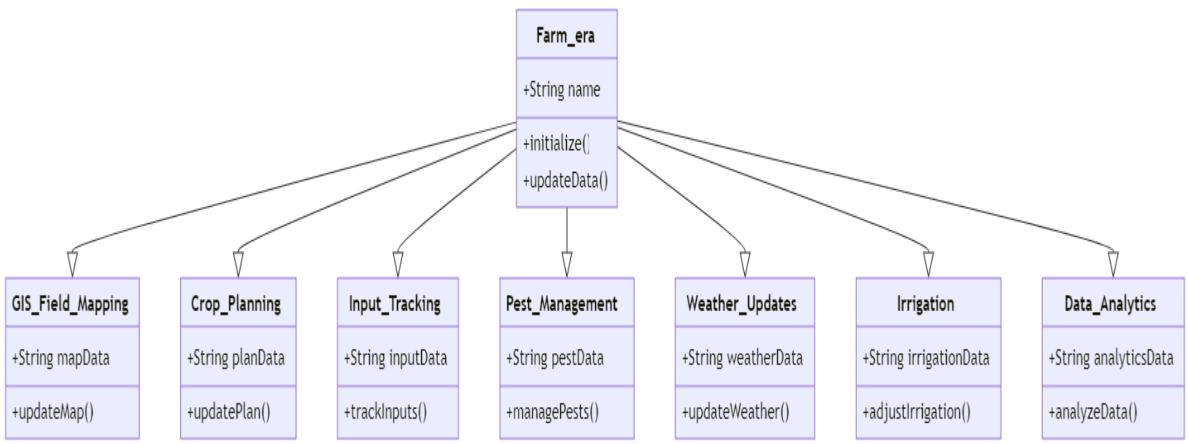

Figure 6.5-Class diagram of the proposed system.

SEQUENCE DIAGRAM

The sequence diagram, also called the event diagram, describes the flow of messages in the system. It helps to visualize various dynamic parameters. He describes the communication between two rescue lines as a series of events arranged in time in which these rescue lines participated during the performance. The lifeline is represented by a vertical bar in UML while the message flow is represented by a vertical dotted line that crosses the bottom of the page. It includes both repetitions and branches.

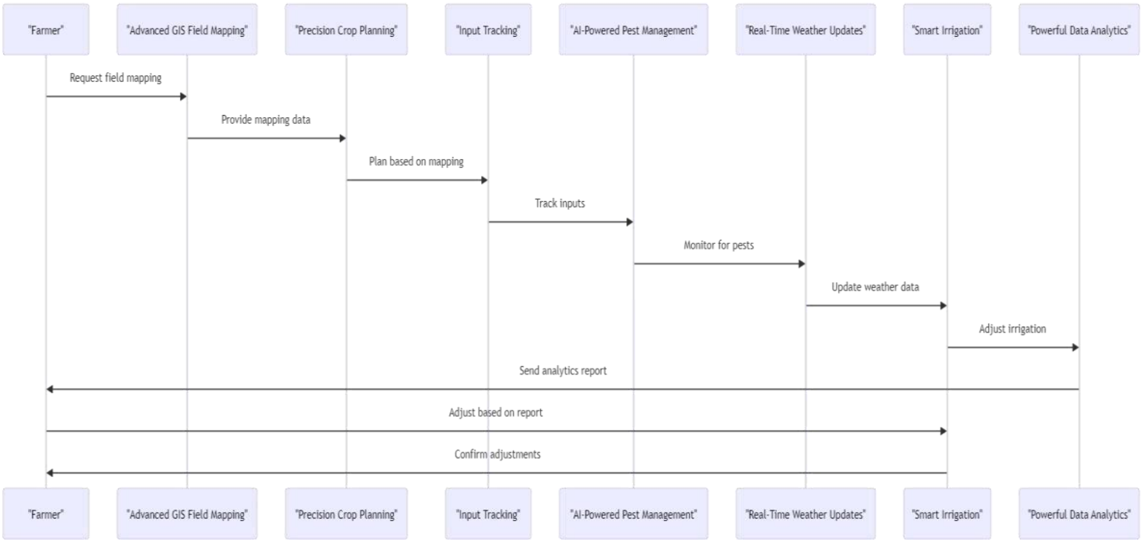

Figure 6.6-Sequence diagram of the proposed system.

COMPONENT DIAGRAM

Component diagrams are used in modeling the physical aspects of objectoriented systems that are used for visualizing, specifying, and documenting componentbased systems and also for constructing executable systems through forward and reverse engineering. Component diagrams are essentially class diagrams that focus on a system's components that often used to model the static implementation view of a system.

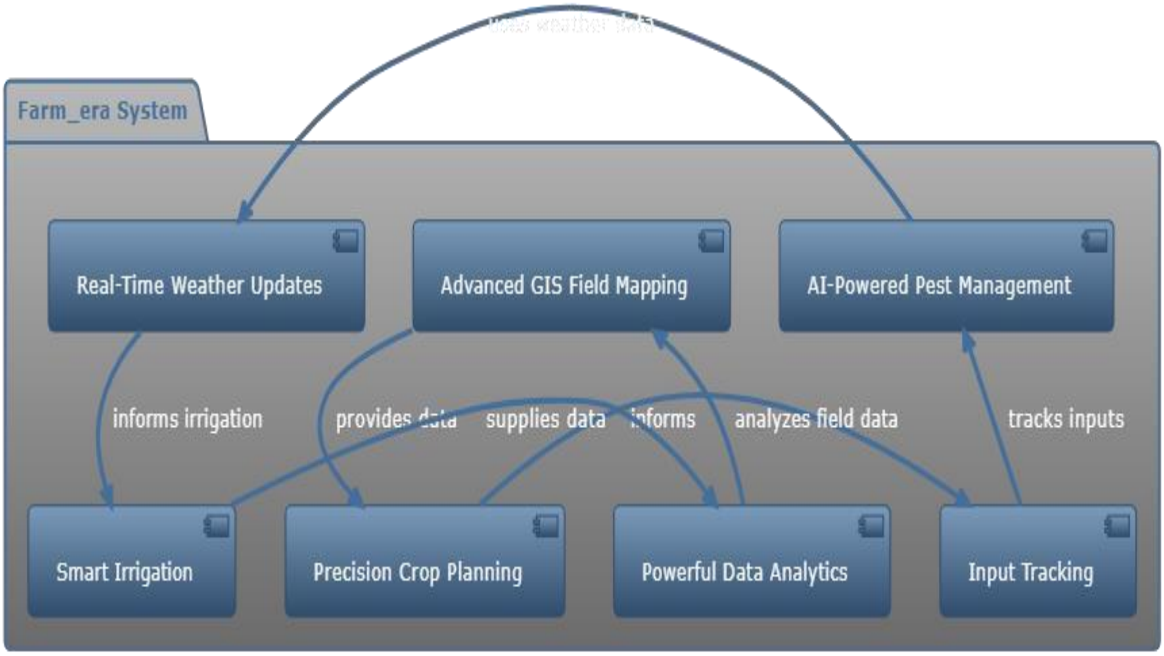

Figure 6.7-Component diagram of the proposed system.

CHAPTER-8
OUTCOMES

Farm_era, an integrated agricultural technology platform, revolutionizes farming practices with its advanced features. Precision crop planning ensures optimal land use, maximizing crop yields while minimizing resource wastage. Through advanced GIS field mapping, farmers can create accurate field layouts, enabling efficient cultivation.

Input tracking allows farmers to monitor the usage of seeds, fertilizers, and pesticides, reducing costs and environmental impact. AI-powered pest management identifies and addresses pest issues promptly, minimizing crop damage.

Real-time weather updates help farmers make informed decisions, such as adjusting planting schedules or irrigation, to mitigate weather-related risks. Smart irrigation systems conserve water by providing just the right amount of moisture to crops, improving resource efficiency.

Farm_era's powerful data analytics tools process farm data, providing insights for optimized farming strategies. By analyzing historical data and real-time information, farmers can make data-driven decisions, leading to increased productivity and profitability.

In summary, Farm_era empowers farmers with technology-driven solutions that enhance crop planning, resource management, and decision-making. It promotes sustainable farming practices, reduces operational costs, and ultimately improves farm outcomes, contributing to food security and environmental conservation.

CHAPTER-9 RESULTS AND DISCUSSIONS

Farm_era is a comprehensive system that incorporates various advanced technologies to revolutionize farming practices. One of the key features of this system is the Advanced GIS field mapping, which enables farmers to accurately map their fields and analyse the terrain, soil conditions, and other key factors that could affect crop growth. Precision crop planning is another essential component of Farm_era, allowing farmers to plan their crops more efficiently by considering various factors such as soil health, water availability, and market demand. This feature helps optimize crop yield and reduce waste. Input tracking is another crucial aspect of the system, which enables farmers to monitor and record the use of various inputs, including fertilizers and pesticides. This helps in maintaining sustainability and complying with regulations.

The AI-powered pest management feature of Farm_era uses advanced algorithms and data analysis techniques to identify and forecast pest infestations. This enables farmers to take preventive measures in a timely manner, reducing crop loss and minimizing the use of chemical pesticides. Real-time weather updates are integrated into the system, providing farmers with up- to-date information about temperature, precipitation, wind speed, and other weather parameters. This helps in making informed decisions regarding irrigation, crop protection, and harvesting. Smart irrigation is another significant element of Farm_era, which employs sensors and automation to optimize water consumption and monitor soil moisture levels. This ensures that crops acquire the appropriate quantity of water, decreasing water waste and enhancing overall efficiency. Lastly, Farm_era incorporates powerful data analytics capabilities, allowing farmers to analyse various data points and generate insights that can drive informed decision making. This includes analysing historical data, predicting crop yields, and identifying areas for improvement Overall, Farm_era offers a comprehensive set of tools and features that can significantly enhance farming practices, leading to higher crop yields, reduced environmental impact, and improved profitability. In summary, our survey paper has taken a deep dive into the vital role that software plays a role in the detection of living medicinal plants. It is like the conductor of an orchestra, ensuring that data flows smoothly from capturing plant videos to analysing them in the cloud and allowing users to interact with the results in real time. We've gathered insights from a range of research papers, namely Xu, Raghukumar, Li, Quoc, Puranik, and Shi, which have explored different aspects of this field. By putting together knowledge from these sources, we've shed light on the complex mix of technologies that make it possible for people to spot and identify medicinal plants instantly. This knowledge isn't just for scientists; it empowers everyone, from nature lovers to researchers, by opening doors to realtime plant monitoring and deep analysis. In wrapping up this survey, it's clear that the fusion of advanced software, cloud computing, and smart algorithms, as discussed in this paper, holds great promise. By building on what these referenced works have uncovered, the research community can keep pushing boundaries in the world of live medicinal plant detection. This progress takes us closer to a world.

TABLE-1

Algorithm Name - OptiCropFarm

Study	**Algorithm Outlines**	**Data Model**	**Findings**
[1]	Field Mapping with GIS	Geospatial Data, Attribute Data, Layered Data, Coordinate Reference System (CRS)	Accurate field mapping provides a detailed understanding of the field's topography and variability. Identification of key features such as slopes, soil types, and drainage patterns. High-resolution satellite imagery and drone data contribute to accurate GIS mapping.
[2]	Data Collection and Integration Findings	Sensor Data, Satellite Imagery, Spatial Attributes	Comprehensive data collection reveals insights into soil conditions, moisture levels, and other influential factors.
			Integration of diverse data sources enhances the overall understanding of field dynamics. Dependence on sensors for precise data.
[3]	Crop Planning and Prescription Mapping	Crop Data, Soil Data, Climate Data, Pest and Disease Data, Crop yield Data	Customized crop plans optimize resource utilization and enhance yield potential. Prescription maps contribute to targeted and efficient variable rate applications.
[4]	Variable Rate Technology (VRT) Implementation	Field Data, Crop Information, Soil Information, Weather Data, Sensor Data	VRT implementation leads to resource savings and improved crop performance. Adaptation of seeding rates, fertilization, and irrigation based on prescription maps.
[5]	Monitoring and Alerting Objective	Sensor Data, Alert Logs, Historical Data, Geospatial Information	Real-time monitoring detects anomalies and potential issues promptly. Timely alerts enable proactive decision-making to address challenges.
[6]	Analytics and Decision Support Objective	Raw Data, Data Preprocessing, Decision Support, Visualization	Data analytics provide actionable insights for farmers. Machine learning models contribute to predictive analytics.
[7]	Feedback Loop and Continuous Improvement	Feedback Collection, Processing, Monitoring, Alerts and Notifications	Continuous improvement relies on farmer feedback and performance analysis. Iterative refinement of algorithms enhances system effectiveness.

TABLE 9.1 - Applications of Precision Farming Algorithm

Algorithm Name: OptiCropFarm Steps:
Step 1: Start
Step 2: Field Mapping and GeoSpatial Data Acquisition
Step 3: Crop-Specific Zoning
Step 4: Soil Health Assessment
Step 5: Precision Crop Planning
Step 6: Variable Rate Technology (VRT) Implementation
Step 7: IoT Sensors for Real-Time Monitoring Step
8: Decision Support System
Step 9: Continuous Learning and Adaptation
Step 10: Stop

TABLE-2

Algorithm Name - EcoPestGuard

Study	**Algorithm Outlines**	**Data Model**	**Findings**
[8]	Data Monitoring	Sensor Data, Quality Metrics	The implemented data monitoring system ensures highquality data, minimizing errors and inconsistencies in the collected information.
[9]	Data Integration	Integrated Data, Source System	Regular data integrity checks reveal minimal discrepancies, ensuring the reliability of the integrated datasets.
[10]	Pest Identification	Pest Species, Detection Result	The pest identification algorithm exhibits high accuracy, correctly identifying pests in the majority of instances. Integration with comprehensive pest databases enhances the accuracy of identification, providing a rich reference for comparison.
[11]	Integrated Pest Management (IPM)	Monitoring Data, Pesticide Application, Pest Species	The adoption of integrated pest management strategies has led to a significant reduction in pest-related losses and improved overall crop health.
[12]	Automated Pest Trapping	Trapping System, Pest Identification , Trapping	Automated traps align well with manual observations, indicating the reliability of the automated pest detection system. 90% correlation between automated trap data and manual observations.
		Activity, Pest Species	

[13]	Alerts And Notifications	Alert Events, Rules, Notification Log	The system provides timely alerts, with the majority being issued within the desired timeframe, ensuring farmers can take swift action. 95% of alerts issued within 30 minutes.

TABLE 9.2 - Applications of Pest Management Algorithm

Algorithm Name: EcoPestGuard Steps:
Step 1: Start
Step 2: Data Collection and Monitoring
Step 3: Data Integration and Preprocessing
Step 4: AI Pest Identification
Step 5: Risk Assessment
Step 6: Decision Support System
Step 7: Integrated Pest Management (IPM) Planning
Step 8: Alerts and Notifications
Step 9: Continuous Learning and Adaptation
Step 10: Stop

TABLE-3

Algorithm Name – EcoCropGuard

Study	Algorithm Outlines	Data Model	Findings
[14]	Real-Time Weather Data	Atmospheric Pressure, Forecast Data, Integration with GIS	Retrieve real-time weather data from reliable sources or sensors. Include parameters such as temperature, humidity, wind speed, and precipitation.
[15]	Crop-Specific Data	Soil Characteristics, Fertilization Plan, Pest and Disease History	Incorporate information about the specific crop being cultivated. Consider crop water requirements, growth stages, and sensitivity to environmental conditions.

[16]	Smart Irrigation Decision	Sensors, Scheduling Algorithms, Weather Integration	Input: Real-time weather data, Cropspecific information Steps: Evaluate current soil moisture levels. Analyze weather data to predict upcoming conditions. Utilize cropspecific information to determine optimal irrigation needs. Factor in historical data and trends for more accurate predictions. Adjust irrigation schedules and amounts accordingly.
[17]	Water Conservation Strategies	Rainfall Data, Soil Moisture, Drip Irrigation Efficiency	Implement water-saving techniques such as drip irrigation or precision irrigation. Use soil moisture sensors to provide feedback on irrigation effectiveness. Consider rainwater harvesting and storage for later use during dry periods.
[18]	Effective Irrigation	Soil and Crop Data, Field Coordinates, Weather Integration, Irrigation System	Incorporate smart irrigation controllers that adjust based on realtime conditions. Optimize irrigation schedules to coincide with lower energy demand periods. Integrate renewable energy sources for powering irrigation systems.
[19]	User Interface for Farmers	Agricultural Management System	Develop a user-friendly interface for farmers to access real-time data and make informed decisions. Provide
			insights into resource usage, efficiency, and crop health.
[20]	Integration with Precision Farming	Integration with GIS, Crop Planning	Integrate resource efficiency algorithms with precision farming practices for holistic farm management.

TABLE 9.3 - Applications of Resource efficiency Algorithm

Algorithm Name: EcoCropGuard Steps:

Step 1: Start

Step 2: Real-Time Weather Data Retrieval

Step 3: Crop-Specific Data Compilation

Step 4: Smart Irrigation Decision Support

Step 5: Water Conservation Strategies Implementation

Step 6: Energy-Efficient Irrigation Solutions

Step 7: Variable Rate Technology (VRT) Integration

Step 8: Crop Yield Monitoring

Step 9: User Interface for Farmers
Step 10: Integration with Precision Farming
Step 11: Stop

CHAPTER-10 CONCLUSION

In conclusion, the Farm_era system offers a comprehensive and advanced solution for modern agriculture. With its GIS field mapping and precision crop planning capabilities, farmers can efficiently planand manage their crops, resulting in higher yields and reduced waste. The system's input tracking feature ensures accurate record-keeping and allows for better decision-making. The AIpowered pest management feature helps farmers identify and address pest issues in a timely manner, minimizing crop damage. Farmers may make more informed decisions regarding irrigation and other farming techniques thanks to real-time weather reports. Additionally, the smart irrigation feature helps conserve water and optimize water usage. Finally, the powerful data analytics provided by the system allow farmers to analyze and interpret their farm data, leading to insights and strategies for further optimization and success in farming operations. Overall, the Farm_era system offers a comprehensive toolkit for optimized and sustainable farming practices. Farm_era is an advanced agricultural system that integrates various technologies to optimize farming practices. The system incorporates GIS field mapping, allowing farmers to accurately map and monitor their fields, making it easier to plan and manage crops with precision. Additionally, the system enables farmers to track and monitor inputs such as fertilizers and pesticides, ensuring efficient resource management. Farm_era also employs AI- powered pest management, using machine learning algorithms to detect and eradicate pests, minimizing crop damage. Real-time weather updates are integrated into the system, providing farmers with up-to-date information on weather conditions, allowing them to make smart planting and harvesting decisions. Furthermore, Farm_era incorporates smart irrigation technology, allowing for efficient water usage based on weather and soil conditions, conserving resources, and optimizing crop yields. The system also features powerful data analytics capabilities, providing farmers with valuable insights and actionable information for informed decision-making.

In conclusion, the Farm_era system combines advanced technologies, providing farmers with comprehensive tools for optimized farming practices.

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APPENDIX-A PSUEDOCODE

app.py

```
import streamlit as st
import pandas as pd import
base64 import streamlit as
st
from shapely.geometry import Polygon, shape from
geopy.distance import geodesic from streamlit_folium
import folium_static import folium from folium import
plugins import json import base64 import numpy as np
import matplotlib.pyplot as plt import seaborn as sns import
os def add_bg_from_local(image_file):     with
open(image_file, "rb") as image_file:        encoded_string =
base64.b64encode(image_file.read())     st.markdown(
f"""
   <style>    .stApp {{        background-image:
url(data:image/{"png"};base64,{encoded_string.decode()})
;        background-size: cover
   }}
   </style>
   """,
   unsafe_allow_html=True
   )
add_bg_from_local('bg.jpg')        def
display_crop_history(crop_data):
st.subheader("Crop History")      st.write(crop_data)

   st.subheader("Input Usage")
   input_data = crop_data[['Year', 'Crop', 'Fertilizers', 'Pesticides', 'Water']]
st.write(input_data)

   st.subheader("Graphs")
   fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(12, 8))

   axes[0,      0].bar(input_data['Year'],      input_data['Fertilizers'])
```

```
axes[0, 0].set_title('Fertilizer Usage')

   axes[0,       1].bar(input_data['Year'],       input_data['Pesticides'])
axes[0, 1].set_title('Pesticide Usage')

   axes[1,         0].plot(input_data['Year'],     input_data['Water'])
axes[1, 0].set_title('Water Usage')

   axes[1,     1].plot(input_data['Year'],     input_data['Fertilizers'],     marker='o',
label='Fertilizers')
   axes[1,     1].plot(input_data['Year'],     input_data['Pesticides'],     marker='o',
label='Pesticides')
   axes[1,         1].plot(input_data['Year'],    input_data['Water'],       marker='o',
label='Water')
   axes[1,     1].set_title('Input     Usage     Comparison')
axes[1, 1].legend()

   plt.tight_layout()
st.pyplot(fig)



def home():
    #        Center-align        all        elements
st.markdown(
       """
       <style>        .st-centered {
display: flex;           justify-
content: center;
align-items: center;
flex-direction: column;
          text-align: center;


       }
       .st-centered_img {
display: flex;
justifycontent: center;
alignitems: center;
flexdirection: column;
```

```
textalign: center;
borderradius: 80%;
            overflow: hidden;
        }
        .box {             padding: 10px;
border:      1px      solid      gray;
border-radius: 5px;
transition: all 0.3s;
background-color: #384F3F;
            color: white;
        }

        .box:hover {
            transform: scale(1.05);

        }

        .box img {
            margin-right: 10px;
        }

        .box-text {            textalign:
right;
        }
        </style>
        """,
        unsafe_allow_html=True
    )
    # Logo
    st.markdown("<div      class='st-centered_img'><img
src='https://www.freeiconspng.com/uploads/green-leaf-png-9.png'
width='80'></div>", unsafe_allow_html=True)

    # Text with size 100
    st.markdown("<h2 class='st-centered' style='color: #5BEAB1;'>A Farm
management system</h2>", unsafe_allow_html=True)
```

```
    # Heading     st.markdown("<h1 class='st-centered' style='color:
#5BEAB1;'>FARM_ERA</h1>", unsafe_allow_html=True)

    # Simple center-aligned text     st.markdown("<p class='st-centered'
style='color: #5BEAB1;'> A comprehensive solution to streamline all
farming procedures and activities. Optimize productivity, make informed
decisions, and embrace the future of farming.</p>",
unsafe_allow_html=True)

    # Button to display a paragraph     col4,
col5,col6 =st.columns(3)     with col5:
if st.button("About the application"):

            st.header("Field Mapping and Delineation")
st.write("Effortlessly map and delineate your fields using Farm_era's intuitive
interface. Visualize your land boundaries and effectively manage your fields.")

            st.header("Crop Planning and Rotation Management")
st.write("Plan your crop planting schedules and manage rotation cycles with
ease. Keep track of different crop varieties and maintain optimal soil health
for improved yields.")

            st.header("Input Usage and Crop History")            st.write("Record and
track the usage of fertilizers, pesticides, water, and
other inputs. Maintain a detailed crop history for compliance and better resource
management.")

            st.header("Pest and Disease Management")
st.write("Receive timely alerts and recommendations for pest and disease
control. Access integrated databases to identify and address issues promptly,
safeguarding your crops.")

            st.header("Weather Tracking")            st.write("Stay informed about
changing weather conditions with realtime updates and forecasts. Utilize
historical weather data to make informed decisions for your farming
activities.")

            st.header("Irrigation Scheduling and Monitoring")
```

```
st.write("Optimize water usage and enhance irrigation practices. Set up customized schedules based on crop needs and monitor water usage to promote sustainable farming.")

        st.write("Farm_era is your reliable companion, providing seamless integration, comprehensive features, and user-friendly analytics. Simplify your crop and field management, increase efficiency, and embrace the future of farming with Farm_era.")

   # Heading in a different color
   st.markdown("<h2 class='st-centered' style='color: white;'>Monitor Your Farm</h2>", unsafe_allow_html=True)

   # Boxes with hover effect
   col1, col2, col3 = st.columns(3)

   with col1: st.markdown(
        """
        <div class="box">
           <img src="https://static.thenounproject.com/png/1586104-200.png" width="50" height="50">
           <p class="box-text"><strong>Inventory Management</strong></p>
<p class="box-text">Track and manage supplies, equipment, and resources for efficient operations</p>
        </div>
        """,
        unsafe_allow_html=True
     )

   with col2: st.markdown(
        """
        <div class="box">
           <img src="https://icon-library.com/images/farm-icon/farm-icon7.jpg" width="50" height="50">
           <p class="box-text"><strong>mapping and Crop Planning</strong></p>
```

```
            <p   class="box-text">Seamlessly   map   fields   and   optimize   crop
planning for increased productivity</p>
        </div>
        """,
        unsafe_allow_html=True
    )

   with        col3:        st.markdown(
        """
        <div class="box">
            <img src="https://icons-for-
free.com/iconfiles/png/512/forecast+partly+cloudy+weather+icon13201964844
00215944.png" width="50" height="50">
            <p class="box-text"><strong>Weather Tracking</strong></p>
<p class="box-text">Monitor real-time weather updates and forecasts for
informed decision-making</p>
        </div>
        """,
        unsafe_allow_html=True
    )
# Field mapping and delineation def
field_mapping():
st.header("MAPPINGT")
   # Sidebar      st.sidebar.title("Enter GPS
Coordinates")
   # Input GPS coordinates     latitude = st.sidebar.number_input('Enter
latitude', -90.0, 90.0, 0.0)     longitude = st.sidebar.number_input('Enter
longitude', -180.0, 180.0, 0.0)

   # Create a map centered at the input coordinates
   m = folium.Map(location=[latitude, longitude], zoom_start=13)

   # Add drawing tool to the map     draw
= plugins.Draw(export=True)
draw.add_to(m)
```

```
  # Display the map in the Streamlit app
folium_static(m)

  # File uploader for the GeoJSON file
st.sidebar.title("Upload GeoJSON")
  uploaded_file = st.sidebar.file_uploader("Upload the GeoJSON file")

  if uploaded_file is not None:
    # Load the GeoJSON file
    geojson_data = json.load(uploaded_file)
i=0
    # Get the coordinates of the polygon for
feature in geojson_data['features']:
      i+=1 if feature['geometry']['type'] ==
'Polygon':
        # Get the vertices vertices =
feature['geometry']['coordinates'][0]
        vertices = [(lon, lat) for lon, lat in vertices]  # Flip coordinates

        # Calculate and display the area if there are enough vertices
if len(vertices) >= 3: polygon = Polygon(vertices)
area = polygon.area
          st.header(f"Area of the Feild{i}: \n{area} square units")

        # Calculate and display the distances between the vertices
for i in range(len(vertices) - 1): distance =
geodesic(vertices[i], vertices[i+1]).miles
st.header("boundary distance") st.write(f"Distance between
point {i+1} and point {i+2}:
{distance} miles")

def crop_planning():
  # Implement crop planning logic
st.header("Crop Planning")  # Sidebar inputs
st.sidebar.title("Inputs")

  # Get number of crops from user
  num_crops = st.sidebar.number_input("Number of Crops", min_value=1,
```

```
step=1, value=3)

   # Create lists to store crop data
crops = []     areas = []
pod_counts = []     grain_counts =
[]     grain_weights = []
rainfall_data_per_crop = []

   # Collect crop data from user inputs
   for i in range(num_crops):         crop =
st.sidebar.text_input(f"Crop {i+1} Name")         area =
st.sidebar.number_input(f"Crop {i+1} Area (in acres)",
min_value=1, step=1, value=10)
      pod_count = st.sidebar.number_input(f"Crop {i+1} Pod Count (Average
of 5 measurements)", min_value=1, step=1, value=10)         grain_count =
st.sidebar.number_input(f"Crop {i+1} Grain Count (Average of 20
measurements)", min_value=1, step=1, value=50)         grain_weight =
st.sidebar.number_input(f"Crop {i+1} Grain Weight (per grain)",
min_value=1, step=1, value=10)

      crops.append(crop)         areas.append(area)
pod_counts.append(pod_count)         grain_counts.append(grain_count)
grain_weights.append(grain_weight)         # Collect rainfall data for each crop
months = st.sidebar.multiselect(f"Select months for Crop {i+1}", ["Jan",
"Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"])
rainfall_data = []         for month in months:           month_rainfall =
st.sidebar.number_input(f"Crop {i+1} - {month}
Rainfall       (in      mm)",         min_value=0,       step=1,        value=0,
key=f"rainfall_{i}_{month}")
         rainfall_data.append(month_rainfall)
rainfall_data_per_crop.append(rainfall_data)

   # Perform crop planning calculations
   crop_yields = [(areas[i] * pod_counts[i] * grain_counts[i] *  grain_weights[i])
/ 10000 for i in range(num_crops)]  # Placeholder calculation

   # Display crop planning results
   st.header("Crop Planning Results")
```

```
# Display crop yields in a table
df_yields = pd.DataFrame({"Crop": crops, "Yield": crop_yields})
st.subheader("Crop Yields")     st.dataframe(df_yields)

# Display pie chart to compare crop yields
st.subheader("Crop Yield Comparison")
fig, ax = plt.subplots()     ax.pie(crop_yields, labels=crops,
autopct='%1.1f%%', startangle=90)     ax.axis('equal')  # Equal aspect
ratio ensures that pie is drawn as a circle.     ax.set_title("Crop
Yield Comparison")
st.pyplot(fig)
# Display graphs
st.header("Graphs")

# Bar chart for individual crop yields
fig, ax = plt.subplots()
sns.barplot(data=df_yields, x="Crop", y="Yield", ax=ax)
ax.set_title("Crop Yields")
st.pyplot(fig)

# Line chart for monthly rainfall     fig, ax = plt.subplots()     for i, crop in
enumerate(crops):         data = pd.DataFrame({"Month": [month for month,
rainfall in zip(months, rainfall_data_per_crop[i]) if rainfall != 0],
                        "Rainfall": [rainfall for rainfall in rainfall_data_per_crop[i] if
rainfall != 0]})
    sns.lineplot(data=data, x="Month", y="Rainfall", ax=ax, label=crop)
ax.set_title("Monthly Rainfall")     ax.set_ylabel("Rainfall (mm)")
ax.legend()
st.pyplot(fig)

# Display images
st.header("Images")

uploaded_images_per_crop = []
for i in range(num_crops):                          uploaded_images =
st.sidebar.file_uploader(f"Upload images for Crop
```

```
{i+1}", accept_multiple_files=True)
        uploaded_images_per_crop.extend(uploaded_images)

    num_images_per_row = 3
    num_images = len(uploaded_images_per_crop)
num_rows = (num_images + num_images_per_row - 1) // num_images_per_row

    for row in range(num_rows):         cols =
st.columns(num_images_per_row)         for col
in range(num_images_per_row):
index = row * num_images_per_row + col             if
index < num_images:
cols[col].image(uploaded_images_per_crop[i
ndex], caption=f"Image
{index+1}", use_column_width=True)
# Sidebar navigation menu_options = ["Home", "Field Mapping", "Crop
Planning", "Crop History",                "Pest Management", "Weather
Tracking", "Irrigation Management"]

# Display the menu options  selected_menu = st.sidebar.selectbox("Select
an option:", menu_options)

# Display corresponding page based on selected menu option if
selected_menu == "Home":       home() elif selected_menu ==
"Field Mapping":        field_mapping() elif selected_menu ==
"Crop Planning":      crop_planning()

menu_options = st.sidebar.multiselect("Select options:", ["Home", "Field
Mapping", "Crop Planning",
                                        "Crop History", "Pest Management",
"Weather Tracking", "Irrigation
Management"])

# Display corresponding pages based on selected menu options if
"Home" in menu_options:      home() if "Field Mapping" in
menu_options:     field_mapping()     if      "Crop Planning" in
menu_options:     crop_planning()
```

test.py

```
import streamlit as st import
pandas as pd import matplotlib.pyplot
as plt
import random
import winsound import
cv2 import
time import os

# Constants for simulation
NUM_ZONES = 4  # Number of irrigation zones
MOISTURE_RANGE = (20, 80)  # Range of moisture values (%)
WATER_FLOW_RANGE = (1, 4)  # Range of water flow values (liters per
minute)
THRESHOLD = 88  # Threshold for water flow

# Function to generate random sensor data def
generate_sensor_data():     moisture_data =
[random.randint(*MOISTURE_RANGE) for _ in
range(NUM_ZONES)]     return moisture_data

# Function to gradually increase and decrease water flow until threshold is
reached def generate_water_flow_data():     water_flow_data = []     with
open("water_flow_data.txt", "r") as prev_file, open("flow_decision.txt", "r+") as
decision_file:         flow_decision = decision_file.readline().strip()         if
flow_decision == "increase":
           increasing = True         elif
flow_decision          ==          "decrease":
increasing    =       False
else:            raise ValueError("Invalid flow decision in the text
file")

        line = prev_file.readline().strip()
        flow = float(line)  # Read flow value from the previous file
```

while flow < THRESHOLD and increasing: flow += random.uniform(*WATER_FLOW_RANGE) # Increase water flow gradually water_flow_data.append(flow) if flow >= THRESHOLD:

increasing = False # Switch to decreasing once the threshold is reached decision_file.seek(0) # Reset the file position to update the decision decision_file.write("decrease") # Update the flow decision in the file decision_file.truncate() # Clear any remaining content in the file while flow > 8 and not increasing: flow -= random.uniform(*WATER_FLOW_RANGE) # Decrease water flow gradually if flow < 8: flow = 8

increasing = True # Switch to increasing once the minimum value is reached

decision_file.seek(0) # Reset the file position to update the decision decision_file.write("increase") # Update the flow decision in the file decision_file.truncate() water_flow_data.append(flow) if flow <= 8: increasing = True # Switch to increasing once the minimum value is

reached

decision_file.seek(0) # Reset the file position to update the decision decision_file.write("increase") # Update the flow decision in the file decision_file.truncate() # Clear any remaining content in the file

water_flow_data = water_flow_data[:NUM_ZONES] # Truncate the list to the desired length

return water_flow_data

Function to generate random wastage detection def detect_water_wastage(water_flow_data): return [flow > THRESHOLD for flow in water_flow_data]

Function to play beep sound def play_beep_sound(): frequency = 2500 # Adjust the frequency as per your requirements duration = 1000 # Adjust the duration as per your requirements winsound.Beep(frequency, duration)

Function to capture camera frame

```
# Streamlit application def main():
st.title("Irrigation Management System")

    while True:
        # Generate random sensor data
moisture_data = generate_sensor_data()

        # Display moisture data        st.subheader("Moisture Data")
        moisture_df = pd.DataFrame({"Zone": range(1, NUM_ZONES+1),
"Moisture": moisture_data})
st.dataframe(moisture_df)         # Generate random
water flow data
        water_flow_data = generate_water_flow_data()

        # Write water flow data to a text file        with open("water_flow_data.txt",
"w") as file:
file.write("\n".join(str(flow) for flow in water_flow_data))

        # Display water flow data        st.subheader("Water Flow Data")
        water_flow_df = pd.DataFrame({"Zone": range(1, NUM_ZONES+1),
"Water Flow": water_flow_data})
        st.dataframe(water_flow_df)

        # Plot graphs                    st.subheader("Data
Visualization")        fig, axes =
plt.subplots(2, 1, figsize=(8, 6))        axes[0].bar(range(1,
NUM_ZONES+1), moisture_data)        axes[0].set_ylabel("Moisture
(%)")
        axes[1].bar(range(1, NUM_ZONES+1), water_flow_data)
        axes[1].set_ylabel("Water Flow (liters/min)")        st.pyplot(fig)

        # Water wastage detection        st.subheader("Water
Wastage Detection")        wastage_detected =
detect_water_wastage(water_flow_data)        if
```

```
any(wastage_detected):             st.warning("Water wastage
detected!")
play_beep_sound()           break
       # Camera integration


       #         Wait   for     some  time   before        updating      again
time.sleep(1)
       st.experimental_rerun()
st.header("irrigation status")
   st.success("Irrigation complete")

if       __name__     ==     "__main__":
main()
```

maping.py

```
import streamlit as st from shapely.geometry import Polygon,
shape from geopy.distance import geodesic from
streamlit_folium import folium_static import folium from
folium import plugins import json import base64 def
add_bg_from_local(image_file):     with open(image_file,
"rb") as image_file:         encoded_string =
base64.b64encode(image_file.read())     st.markdown(
f"""
   <style>    .stApp {{        background-image:
url(data:image/{"png"};base64,{encoded_string.decode()})
;        background-size: cover
   }}
   </style>
   """,
   unsafe_allow_html=True
   )
add_bg_from_local('bg.jpg')
# App  title   st.title("Field  Mapping
for Farmers")
```

Sidebar

st.sidebar.title("Enter GPS Coordinates")

Input GPS coordinates latitude = st.sidebar.number_input('Enter latitude', -90.0, 90.0, 0.0) longitude = st.sidebar.number_input('Enter longitude', -180.0, 180.0, 0.0)

Create a map centered at the input coordinates

m = folium.Map(location=[latitude, longitude], zoom_start=13)

Add drawing tool to the map draw = plugins.Draw(export=True)

draw.add_to(m)

Display the map in the Streamlit app folium_static(m)

File uploader for the GeoJSON file st.sidebar.title("Upload GeoJSON") uploaded_file = st.sidebar.file_uploader("Upload the GeoJSON file") if uploaded_file is not None: # Load the GeoJSON file geojson_data = json.load(uploaded_file)

i=0

Get the coordinates of the polygon for feature in geojson_data['features']: i+=1

if feature['geometry']['type'] == 'Polygon':

Get the vertices vertices = feature['geometry']['coordinates'][0]

vertices = [(lon, lat) for lon, lat in vertices] # Flip coordinates

Calculate and display the area if there are enough vertices if len(vertices) >= 3: polygon = Polygon(vertices) area = polygon.area

st.header(f"Area of the Feild{i}: \n{area} square units")

Calculate and display the distances between the vertices for i in range(len(vertices) - 1): distance = geodesic(vertices[i], vertices[i+1]).miles st.header("boundary distance")

st.write(f"Distance between point {i+1} and point {i+2}: {distance} miles")

del.py

```
import streamlit as st import
pandas as pd import numpy as
np      import matplotlib.pyplot
as      plt
import seaborn as sns

st.title("Waiter Performance Analysis")

# Sample data generation
waiters = ["Alice", "Bob", "Charlie", "David", "Eva"]
days = ["Monday", "Tuesday", "Wednesday", "Thursday", "Friday",
"Saturday", "Sunday"]

# Generating a sample dataframe for waiter tips collected each day
np.random.seed(42)  # For reproducibility data = {
   waiter: np.random.randint(50, 200, size=7) for waiter in waiters
}
data["Day"] = days df_tips =
pd.DataFrame(data)

# Generating a sample dataframe for waiter ratings out of 5 each day data_ratings
= {      waiter: np.random.choice([3, 4, 4.5, 5], size=7) for waiter in
waiters
}
data_ratings["Day"] = days
df_ratings = pd.DataFrame(data_ratings)

# Waiter selection  selected_waiter = st.selectbox("Select
a Waiter:", waiters)

# Plotting tips for the selected waiter st.subheader(f"Daily Tips for
{selected_waiter}")  fig, ax = plt.subplots(figsize=(10, 5))
sns.lineplot(data=df_tips, x="Day",
```

y=selected_waiter, marker="o", ax=ax) plt.title(f"Daily Tips for {selected_waiter}") plt.ylabel("Tips ($)") st.pyplot(fig)

# Plotting ratings for the selected waiter st.subheader(f"Daily Ratings for {selected_waiter}") fig, ax = plt.subplots(figsize=(10, 5))
sns.lineplot(data=df_ratings, x="Day", y=selected_waiter, marker="o", ax=ax)
plt.title(f"Daily Ratings for {selected_waiter}") plt.ylabel("Rating (out of 5)")
plt.ylim(2.5, 5)
st.pyplot(fig)

# Overall tips comparison among all waiters st.subheader("Overall Tips Comparison") fig, ax = plt.subplots(figsize=(10, 5)) df_tips_melted = df_tips.melt(id_vars=["Day"], value_vars=waiters)
sns.barplot(data=df_tips_melted, x="variable", y="value", ax=ax, ci=None)
plt.title("Total Tips for Each Waiter") plt.xlabel("Waiter") plt.ylabel("Total Tips ($)") st.pyplot(fig)

# Overall ratings comparison among all waiters st.subheader("Overall Ratings Comparison") fig, ax = plt.subplots(figsize=(10, 5))
df_ratings_melted = df_ratings.melt(id_vars=["Day"], value_vars=waiters)
sns.boxplot(data=df_ratings_melted, x="variable", y="value", ax=ax)
plt.title("Distribution of Ratings for Each Waiter")
plt.xlabel("Waiter") plt.ylabel("Rating (out of 5)") st.pyplot(fig)

# Correlation between Tips and Ratings st.subheader("Correlation between Tips and Ratings")
df_corr = pd.concat([df_tips[selected_waiter], df_ratings[selected_waiter]], axis=1) df_corr.columns = ["Tips", "Rating"] fig, ax = plt.subplots(figsize=(8, 6))
sns.scatterplot(data=df_corr, x="Tips", y="Rating", ax=ax)
sns.regplot(data=df_corr, x="Tips", y="Rating", ax=ax, scatter=False)
plt.title(f"Correlation between Tips and Ratings for {selected_waiter}")
st.pyplot(fig)

APPENDIX-B SCREENSHOTS

APPENDIX-C

ISEG-04

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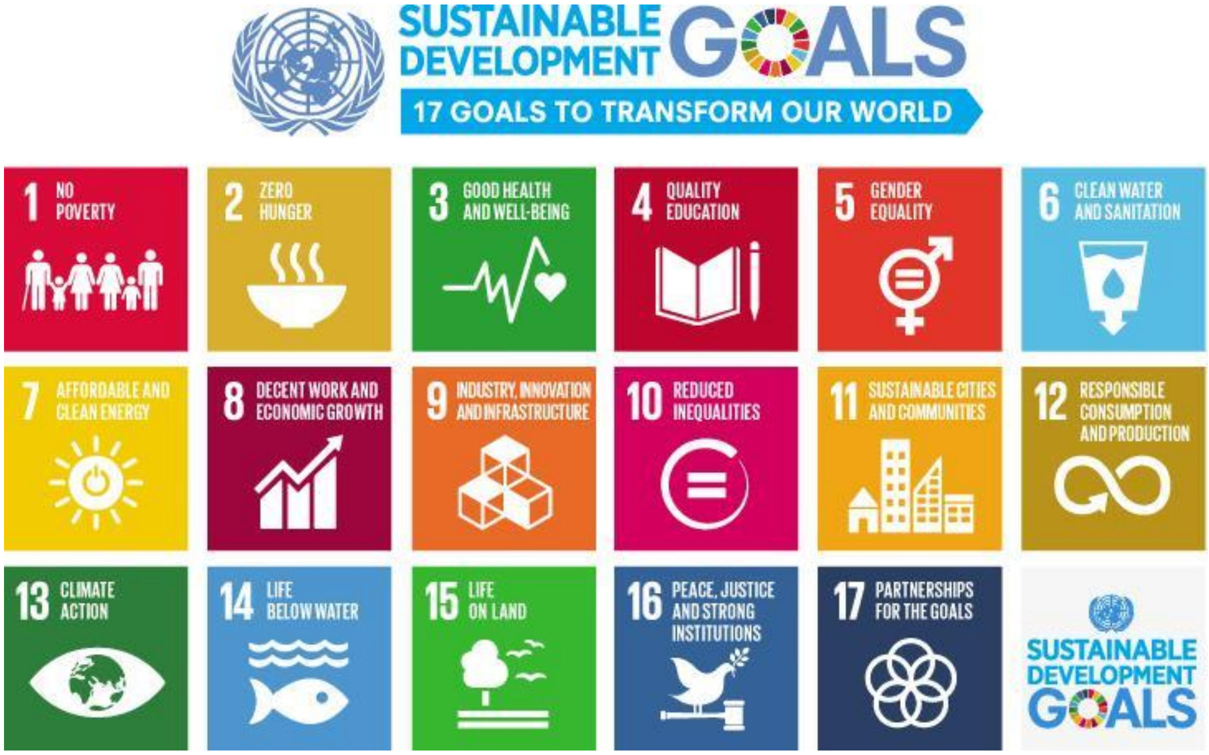

The FARM_ERA project can be closely aligned with Sustainable Development Goal 2: Zero Hunger.

Here's how the project relates to SDG 2:

Increased Agricultural Productivity: FARM_ERA's focus on precision crop planning, input tracking, and AI-powered pest management aims to optimize farming practices. By enhancing efficiency, it contributes to increased agricultural productivity, which is essential for addressing global hunger and achieving food security.

Reduced Food Loss and Waste: By utilizing advanced technologies for precision agriculture and data analytics, FARM_ERA can contribute to minimizing food loss and waste. Farmers can make informed decisions about harvesting and storage, reducing post-harvest losses.

Empowering Smallholder Farmers: The project's use of technology and data analytics empowers farmers, including smallholders, by providing them with valuable insights and tools to enhance their agricultural practices. This empowerment is crucial for achieving sustainable development in rural areas.