**ABESEC Ghaziabad**



**Department of Computer Science & Engineering**

**SYNOPSIS REPORT**

**(Session 2023-24)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project Title: Agri-Intellect: Where Agriculture meets ML** | | | | |
| **Project Type**(application, product, research, review etc.) | |  | | |
|  | **Name** | **Roll Number** | **Section** | **Signature** |
| **Group member (1)** | **Amrit Singh** | **2000320100018** | **A** |  |
| **Group member (2)** | **Harsh Verma** | **2000320100064** | **A** |  |
| **Project Guide** | **Ms. Sandhya Avasthi** | **Remarks:** | | |
| **Signature** |  |
| **Date of submission** |  |

**Table of Content:**

* 1. **Problem Introduction**

**1.1.1 Motivation**

**1.1.2 Project Objective**

**1.1.3 Scope of the Project**

* 1. **Related Previous Work**
  2. **Software and Hardware Requirements**
     1. **Software**
     2. **Hardware**
  3. **Proposed Methodology**
  4. **Deliverables**
  5. **Stakeholders**
  6. **Gantt Chart**
  7. **References**
  8. **Problem Introduction**
     1. **Introduction**

Agriculture, often referred to as the backbone of many economies, plays a pivotal role in shaping a country's economic development and food security. It is the primary source of livelihood for a significant portion of the global population. However, the agricultural sector faces numerous challenges, ranging from unpredictable weather patterns to resource constraints and the ever-present threat of crop diseases. To address these challenges and ensure sustainable agricultural growth, innovative solutions are imperative.

In recent years, the convergence of cutting-edge technologies, particularly Machine Learning and Deep Learning, has begun to transform traditional farming practices. These technologies offer promising avenues to increase crop yields, optimize resource utilization, and reduce the impact of environmental factors on agriculture. This project introduces a novel research endeavour aimed at harnessing the power of advanced technology to revolutionize farming practices.

* + 1. **Problem Statement**

In traditional agriculture, farmers face numerous challenges related to crop selection, fertilizer management, disease detection, and market pricing. These challenges often result in suboptimal yields, resource wastage, increased costs, and economic uncertainties. To address these issues and empower farmers with data-driven solutions, this project aims to develop a comprehensive smart agriculture system. The system will incorporate machine learning and deep learning techniques to provide crop recommendations based on soil data, offer fertilizer recommendations tailored to specific crops and soil conditions, enable the early detection of plant diseases from images, and predict crop prices. The project's primary objective is to enhance agricultural productivity, sustainability, and economic stability for farming communities while promoting environmentally responsible practices. To achieve these goals, the project will encompass data collection, modeling, application development, and continuous improvement processes.

* + 1. **Motivation**

The motivation for smart agriculture is to be able to create an efficient environment for farmers so to make agriculture a little easy. This is important for a number of reasons, including:

* Boosting Productivity: Improve crop yields and agricultural output through data-driven decision-making.
* Sustainability: Promote eco-friendly farming practices for long-term environmental and food security benefits.
* Economic Empowerment: Enhance the income and economic stability of farming communities.
* Crop Loss Mitigation: Early disease detection and management to minimize crop losses.
* Access to Technology: Bridge the digital divide by offering accessible tech tools to rural farmers.
* Data-Driven Decisions: Enable farmers to make informed choices using data-driven insights.
  + 1. **Project Objective**
* To study “Smart Agriculture” research area and different machine learning & deep learning models for the same.
* To apply crop recommendation, fertilizer recommendation, plant disease detection and crop price prediction on the related data sets.
* Evaluating the result through the process.
* To build a web based application using styling technologies.
  + 1. **Scope of the Project**
* User Registration and Authentication.
* Predicting the price of crop so that farmers can sell accordingly in the market.
* Send push notifications or emails to users for timely reminders, alerts about weather changes, disease outbreaks, or market price.
* Creating a mobile app version for this project.
* If the app serves regions with different languages, incorporate multi-language support.
  1. **Related Previous Work**

1. Durai, S. K. S., & Shamili, M. D. (2022):
   * This paper explores the application of machine learning and deep learning techniques in the context of smart farming. It likely discusses the use of these technologies for tasks such as crop yield prediction, pest detection, and soil analysis. The research may showcase the effectiveness of deep learning algorithms, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), in processing agricultural data. Additionally, it may delve into the integration of IoT devices and sensors for data collection in smart agriculture systems.
2. Gupta, S., Chopade, A., Jain, N., & Bhonde, A. (2022):
   * This paper introduces "Farmer's Assistant," an application based on machine learning. It is likely to discuss the design and functionalities of this application, such as crop recommendation, disease diagnosis, and weather forecasting. The research may emphasize the user-friendliness of the application for farmers with limited technical knowledge. It may also address the potential impact of such solutions on improving agricultural practices and increasing yields.
3. Kumar, T., & Prakash, N. (2020):
   * This paper explores the adoption of artificial intelligence (AI) in Indian agriculture, emphasizing its transformative potential. It likely discusses the socio-economic implications of AI adoption, including increased productivity, reduced resource wastage, and improved livelihoods for farmers. The research may also highlight case studies or examples of AI applications in Indian agriculture, ranging from crop monitoring to supply chain optimization.
4. Bondre, D. A., & Mahagaonkar, S. (2019):
   * This research focuses on the prediction of crop yield and the recommendation of fertilizers using machine learning algorithms. It likely includes discussions on the selection and optimization of machine learning models for accurate yield prediction. Additionally, the paper may address the importance of data collection and quality in training these models. The research may provide insights into how such models can aid farmers in making informed decisions regarding fertilizer application.
5. Pawar, S., Dere, S., Akangire, A., Kamble, H., & Shrawne, S. (2021):
   * This paper centers on the application of machine learning in smart farming. It is likely to discuss various use cases, including crop disease detection, irrigation management, and yield optimization. The research may highlight the role of data-driven decision-making in agriculture and the benefits of real-time data collection. Furthermore, it may explore challenges such as data privacy and scalability in implementing machine learning solutions in agriculture.
6. Kapoor, S., Aggarwal, I., & Kumar Ray, A. (2022):

* This research introduces the "Harvestify Web App" for smart agriculture. It likely provides an overview of the features and functionalities of the application, such as crop recommendation, pest management, and weather forecasting. The paper may also discuss user feedback and potential areas of improvement for the application. It may emphasize the role of user-friendly interfaces in ensuring the adoption of such technology among farmers.

1. Sachin Adulkar et al. (2022):

* This research paper presents the "Harvestify" system, which utilizes Convolutional Neural Networks (CNN) for crop disease detection and fertilizer recommendations. The use of CNNs for image-based disease identification showcases the application of deep learning in agriculture. This approach represents a significant stride toward early disease detection, potentially reducing crop losses and the need for chemical treatments. Additionally, the paper contributes to precision agriculture by suggesting suitable fertilizers based on soil and crop data. The integration of AI in agriculture exemplified in this paper is critical for sustainable and efficient farming practices.

1. Elbasi et al. (2022):

* This systematic literature review examines the extensive use of artificial intelligence (AI) technology in agriculture. The paper underscores the growing importance of AI-driven solutions in optimizing various aspects of farming, including crop monitoring, pest management, and resource allocation. The review highlights the diversity of AI techniques employed in agriculture, including machine learning, deep learning, and computer vision. Moreover, it emphasizes the need for robust data collection and integration to harness the full potential of AI in agriculture, reflecting a broader trend in leveraging technology for sustainable and productive farming.

1. Steenwerth et al. (2014):

* This research paper focuses on the concept of climate-smart agriculture (CSA) and establishes a global research agenda for its implementation. CSA seeks to address the challenges posed by climate change by making agriculture more adaptive, resilient, and sustainable. The paper outlines the scientific basis for CSA and emphasizes the importance of interdisciplinary research and collaboration. It underscores the need for innovative approaches to enhance soil health, conserve water resources, and improve crop management. This research is instrumental in aligning agricultural practices with the imperatives of climate change mitigation and adaptation.

The summary of the above papers is:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year | Paper | Author | ML/DL Techniques | Application | Challenges |
| 2022 | Smart farming using machine learning and deep learning techniques | Durai, S. K. S., & Shamili, M. D. | Decision trees, support vector machines, random forests, neural networks | Crop yield prediction, pest and disease detection, irrigation scheduling, nutrient management, precision farming | Lack of data, high cost of data collection, need for domain knowledge, need for specialized hardware and software |
| 2022 | Farmer's Assistant: A Machine Learning Based Application for Agricultural Solutions | Gupta, S., Chopade, A., Jain, N., & Bhonde, A. | Machine learning | Provides farmers with information about their crops, such as the amount of water they need, the pests they are susceptible to, and the best time to harvest | Lack of access to accurate and timely information about crops |
| 2022 | Smart Agriculture Farming Using Harvestify Web App | Kapoor, S., Aggarwal, I., & Kumar Ray, A. | Machine learning | Provides farmers with information about their crops, such as the amount of water they need, the pests they are susceptible to, and the best time to harvest | Lack of access to accurate and timely information about crops |
| 2022 | Harvestify - Crop Disease Detection and Fertilizer Suggestion using CNN | Adulkar, S., Pawar, V., Choudhari, A., Kothekar, S., & Agrawal, S. | Convolutional neural network (CNN) | Crop disease detection and fertilizer recommendation | Lack of data, need for domain knowledge |
| 2022 | Artificial intelligence technology in the agricultural sector: a systematic literature review | Elbasi, E., Mostafa, N., AlArnaout, Z., Zreikat, A. I., Cina, E., Varghese, G., ... & Zaki, C. | Systematic literature review | Provides an overview of the use of AI in the agricultural sector | Lack of data, need for domain knowledge, lack of infrastructure |
| 2021 | Smart farming using machine learning | Pawar, S., Dere, S., Akangire, A., Kamble, H., & Shrawne, S. | Machine learning | Improve crop yields, reduce water consumption, and increase profits | Lack of data, need for domain knowledge |
| 2020 | Adoption of ai in agriculture: the game-changer for indian farmers | Kumar, T., & Prakash, N. | Artificial intelligence (AI) | Improve crop yields, reduce water consumption, and increase profits | Lack of infrastructure, low literacy rates among farmers |
| 2019 | Prediction of crop yield and fertilizer recommendation using machine learning algorithms | Bondre, D. A., & Mahagaonkar, S. | Machine learning | Predict crop yield and recommend fertilizer application rates | Lack of data, need for domain knowledge |
| 2014 | Climate-smart agriculture global research agenda: scientific basis for action | Steenwerth, K. L., Hodson, A. K., Bloom, A. J., Carter, M. R., Cattaneo, A., Chartres, C. J., ... & Jackson, L. E. | N/A | Provides a global research agenda for climate-smart agriculture | Lack of data, need for domain knowledge, lack of infrastructure |

* 1. **Software and Hardware requirements**

1.3.1 Software Requirement

* + Operating System - Windows (7 and greater)
  + Front End – HTML, CSS, JavaScript, React
  + Programming Language - Python
  + IDE – Jupyter Notebook

1.3.2 Hardware Requirement

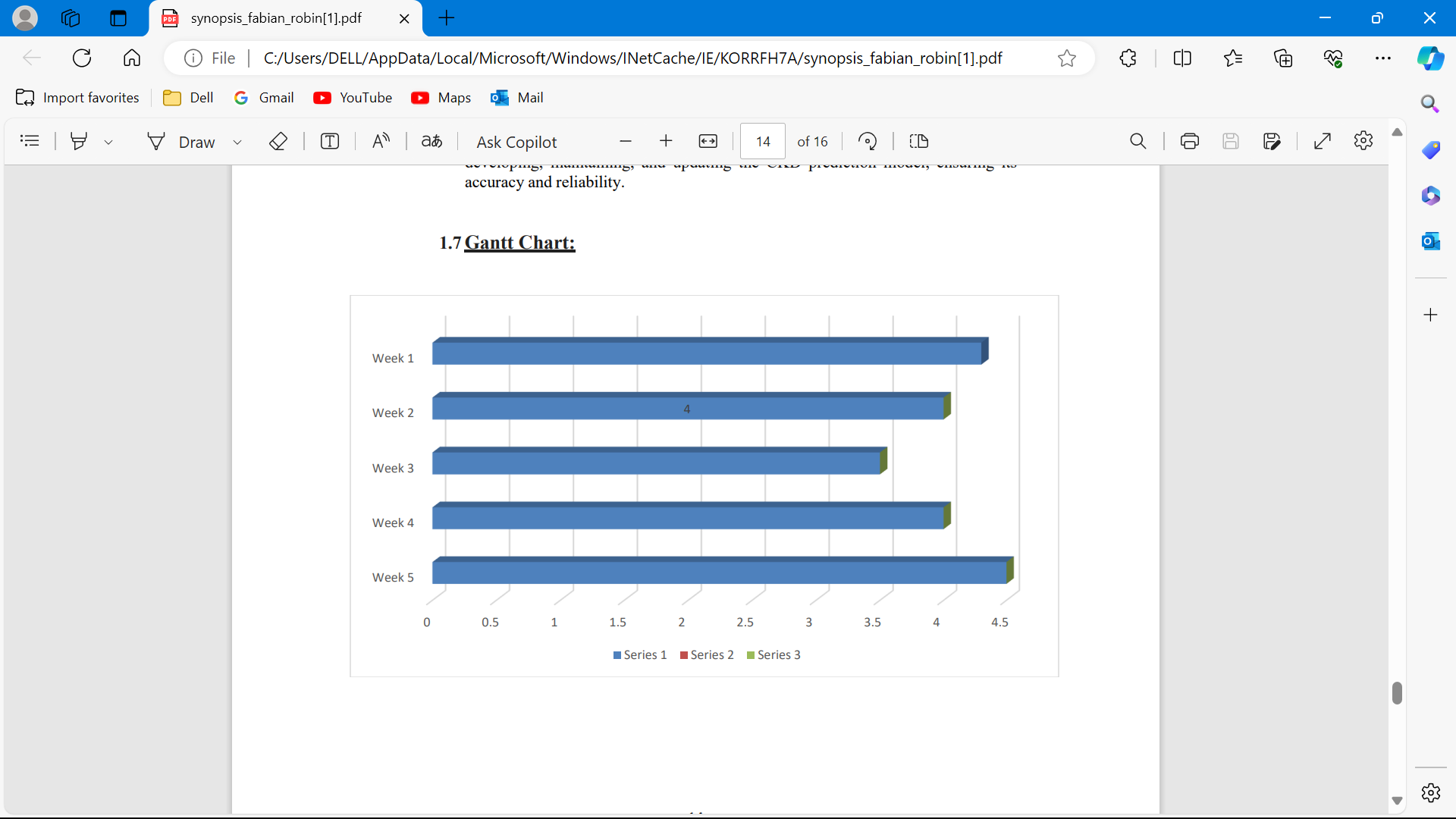
* + Processor - Intel core i3 or greater
  + Speed - 2. 5 Gigahertz
  + RAM - 1 GB minimum
  + Hard Disk - 50 GB minimum
  1. **Proposed Method**

Below is the process flow we are going to follow:

* **Data Collection:**
  + - Collect diverse and high-quality data relevant to agriculture, including soil data, crop data, weather data, historical crop prices, and images of diseased plants.
    - Establish data pipelines to ensure data is continuously updated and reliable.
* **Preprocessing and Data Cleaning:**
  + - Perform data preprocessing tasks like data cleaning, normalization, and handling missing values to ensure data quality.
    - Prepare data for specific machine learning and deep learning models.
* **Machine Learning and Deep Learning Models:**
  + - Develop machine learning and deep learning models tailored to each application:
    - Crop Recommendation: Use supervised learning techniques to build a model that predicts suitable crops based on soil characteristics.
    - Fertilizer Recommendation: Employ regression models to determine the appropriate type and quantity of fertilizers based on soil and crop data.
    - Plant Disease Prediction: Implement convolutional neural networks (CNNs) for image-based disease classification.
    - Crop Price Prediction: Utilize time series forecasting models like ARIMA or LSTM for predicting crop prices.
* **Training and Validation:**
  + - Train and validate the models using appropriate datasets, ensuring model accuracy and generalization.
    - Fine-tune hyperparameters and optimize model performance.
* **Application Development:**
  + - Create user-friendly web or mobile applications for farmers to access and utilize the developed models.
    - Implement intuitive user interfaces for inputting data (soil data, images, crop details) and receiving recommendations or predictions.
    - Ensure real-time or near-real-time data processing and results delivery.
* **Integration with External Data Sources:**
  + - Integrate external data sources, such as weather APIs, for up-to-date information to enhance the accuracy of recommendations and predictions.
* **Education and Training:**
  + - Provide training and support for farmers to effectively use the applications.
    - Offer resources and guides on interpreting model recommendations.
  1. **Deliverables**

The project encompasses several key deliverables aimed at revolutionizing agriculture through the integration of advanced technologies. These deliverables include a multifaceted web-based platform that provides a range of applications. First, a "Crop Recommendation" application delivers tailored suggestions based on user-provided soil data, facilitating optimal crop selection. Second, the "Fertilizer Recommendation" application utilizes soil data and crop type to recommend nutrient enhancements, promoting efficient resource management. Additionally, a "Crop Price Prediction" application offers real-time pricing insights based on crop type, season, quantity, and production area. Lastly, the "Plant Disease Prediction" application employs deep learning and computer vision to identify and offer remedies for plant diseases from uploaded images. These deliverables collectively empower farmers with data-driven decision-making capabilities, promoting sustainable agriculture, economic stability, and improved livelihoods in farming communities.

* 1. **Stakeholders**
* Farmers: End-users benefiting from crop recommendations, fertilizer guidance, and disease management.
* Agricultural Researchers: Utilize project data for research into crop performance and soil health.
* Government and Agricultural Agencies: Support, regulate, and use project data for policy decisions.
* Environmental Organizations: Promote eco-friendly farming practices.
* Agricultural Suppliers: Influence farmers' purchasing decisions.
* Financial Institutions: Provide loans and services to farmers.
* Consumers: Benefit from increased productivity and potentially lower prices.
* Educational Institutions: Use the project for teaching and research.
* Non-Governmental Organizations (NGOs): Focus on rural development and poverty alleviation.
* Marketplaces and Agribusinesses: Use project data for market analysis.
* Weather Services: Collaborate to enhance applications with real-time weather data.
* Rural Communities: Benefit from improved agricultural practices, leading to development in farming regions.
  1. **Gantt Chart**

****

* 1. **References**

1. Durai, S. K. S., & Shamili, M. D. (2022). Smart farming using machine learning and deep learning techniques. Decision Analytics Journal, 3, 100041.
2. Gupta, S., Chopade, A., Jain, N., & Bhonde, A. (2022). Farmer's Assistant: A Machine Learning Based Application for Agricultural Solutions. arXiv preprint arXiv:2204.11340.
3. Kumar, T., & Prakash, N. (2020). Adoption of ai in agriculture: the game-changer for indian farmers. In Proceedings of the 13th IADIS International Conference ICT, Society and Human Beings 2020, ICT 2020 and Proceedings of the 6th IADIS International Conference Connected Smart Cities 2020, CSC 2020 and Proceedings of the 17th IADIS International Conference Web Based Communities and Social Media 2020, WBC 2020-Part of the 14th Multi Conference on Computer Science and Information Systems, MCCSIS 2020 (pp. 204-208).
4. Bondre, D. A., & Mahagaonkar, S. (2019). Prediction of crop yield and fertilizer recommendation using machine learning algorithms. International Journal of Engineering Applied Sciences and Technology, 4(5), 371-376.
5. Pawar, S., Dere, S., Akangire, A., Kamble, H., & Shrawne, S. (2021). Smart farming using machine learning. Smart Comput.
6. Kapoor, S., Aggarwal, I., & Kumar Ray, A. (2022). Smart Agriculture Farming Using Harvestify Web App. Available at SSRN 4157630.
7. Sachin Adulkar, Vivek Pawar, Aniket Choudhari, Shubham Kothekar, Shruti Agrawal."Harvestify - Crop Disease Detection and Fertilizer Suggestion using CNN", Volume 11, Issue IV, International Journal for Research in Applied Science and Engineering Technology (IJRASET) Page No: 3596-3604, ISSN : 2321-9653, www.ijraset.com
8. Elbasi, E., Mostafa, N., AlArnaout, Z., Zreikat, A. I., Cina, E., Varghese, G., ... & Zaki, C. (2022). Artificial intelligence technology in the agricultural sector: a systematic literature review. IEEE Access.
9. Steenwerth, K. L., Hodson, A. K., Bloom, A. J., Carter, M. R., Cattaneo, A., Chartres, C. J., ... & Jackson, L. E. (2014). Climate-smart agriculture global research agenda: scientific basis for action. Agriculture & Food Security, 3(1), 1-39.