KrishiRaksha – A Disease and Pest Control App

Ronit Pathak,
B. Tech CSE,
Presidency University,
Bengaluru, India.
ronit.20211cai0010@presidencyuniversity.in

Chakradhar Reddy,
B. Tech CSE,
Presidency University,
Bengaluru, India.
duggi.20211cai0156@presidencyuniversity.in

Sohith N. R
B.Tech CSE,
Presidency University
Bengaluru, India.
sohith.20211cai0006@presidencyuniversity.in

Shambhavi K. M,
B. Tech, CSE,
Presidency University,
Bengaluru, India.
shambhavi.20211cai0036@presidencyuniversity.in

***Abstract* -Agriculture remains at the forefront of human civilization, driving economies and providing sustenance. However, challenges like plant diseases and pests significantly reduce productivity, causing economic losses and threatening food security. Traditional mitigation methods, including manual inspections and chemical treatments, are often inefficient, costly, and unsustainable. Leveraging advancements in artificial intelligence (AI), this paper presents Krishi Raksha, an AI-powered application powered by Gemini AI, offering real-time diagnostics and actionable insights for farmers. By employing advanced image processing, real-time cloud-based analytics, and intuitive design, Krishi Raksha bridges the technological gap, empowering even those with minimal digital literacy. This comprehensive solution not only boosts productivity but also aligns with sustainable agricultural practices, marking a transformative step in smart farming. Through detailed analysis, this study explores the methodologies, results, and broader impacts of Krishi Raksha in combating agricultural challenges effectively.**

Key Words *- Pests, Artificial Intelligence, Gemini AI, Real Time Diagnosis, Image Analysis, Sustainable Farming, Crop Loss Mitigation, Actionable Insights.*

I.INTRODUCTION

Agriculture has always been considered to be the bedrock of human civilization, which enables societal building through food production and a stable economy. Despite the progress in the technique of farming, agriculture faces the challenges of climate variability, soil health degradation, and pest infestation. It is well-known that the agricultural fraternity across the world is acutely aware of the importance of technology in meeting most of these adversities agriculture faces today.

The prime reason for important crop losses across the world are plant diseases and pests. They are also taken as accountable for a crop production loss in an amount of 20-40% each year by the Food and Agriculture Organization. Assuming their economic implications, such losses every year cause losses in the international trade in excess of $220 billion. To smallholder farmers, these are existential threats for they are the majority among agricultural workers in developing countries.

Conventional management of pests and diseases depends on either labor-intensive manual methods or blanket spraying of chemicals. However, these methods have various negative aspects. The heavy use of chemical treatments leads to environmental deterioration characterized by soil contamination, loss of biodiversity, and water pollution. In addition, the selection pressure favoring pesticide-resistant pest species complicates the management effort.

Accessible, accurate, and scalable plant disease and pest diagnostic tools are still absent in the agricultural sector. The common source of information for farmers is the local agricultural advisor or numerous identifications made by them through their own observation skills, which may not be very accurate. This condition is exacerbated by a general shortage of professional consultation, especially in rural and resource-poor areas.

Delays in plant health diagnosis can quickly cause widespread crop damage and financial loss or, more importantly, food insecurity. Without an accessible, user-friendly diagnostic tool, farmers cannot act early or sustainably to resolve problems.

The objectives of Krishi Raksha are the backbone of the project in ensuring that applications will bring meaningful, measurable, transformative results for farmers and the agricultural industry at large. The succeeding sections explore deeply into the multifaceted goals and aspirations of the project.

To promote sustainable farming practices by reducing the overuse of chemical treatments through offering accurate diagnostics.
Recommend biological agents and cultural practices as environment-friendly pest control methods.
Use of pesticides in strategic terms may also result in reducing the spray to minimal level only to a targeted area as affected by diseases and pests.

Object is to Rebuild the role of AI in agriculture, and make it an indispensable tool for all farmers on the planet.
Incorporate advanced predictive models which pinpoint diseases in crops based on prevalent environmental conditions
Expand diagnostics to include abiotic factors like nutrient deficiency and soil imbalance.

The rest of the paper is structured as follows: Section II presents a detailed review of related work, detailing traditional and AI-driven advancements in agricultural diagnostics. Section III details the proposed Krishi Raksha system, with emphasis on its AI integration, user-centric design, and cloud-first architecture. Section IV elaborates on the methodologies used, including technology stack choices, Gemini AI integration, and iterative development processes. Section V elaborates the features and functionalities of Krishi Raksha, which include real-time diagnosis, actionable insights, and user accessibility. Section VI gives the results and key findings by evaluating the system's performance and comparative strengths. Section VII outlines the challenges faced during the development phase, and Section VIII outlines the future scope to enhance the app's capabilities. Finally, Section IX concludes by identifying key accomplishments, broader impacts, and the long-term vision of Krishi Raksha to transform agriculture with AI..

II.RELATED WORK

In the recent past, various AI-based agricultural diagnostic tools have emerged, each tackling different issues confronting farmers. PlantVillage [8] is one of the most renowned machine learning-based plant disease diagnostic platforms. The tool has a robustly developed database for labeled images to identify the diseases with maximum accuracy. This tool, however, is very sensitive and requires high quality images and excellent internet connectivity to operate, limiting its applicability in low resource settings.

Likewise, Plantix [5] applies AI-based image recognition in identifying plant diseases but lacks adaptability to real-time changes localized to the area. The method requires manual preprocessing of data and reliable internet for optimal

Table-1: Gemini vs ML models

Feature	Gemini AI	PlantVillage	TensorFlow Model
Type	Pre-trained, API-based	Pre-trained, ML-based	Customizable, ML-based
Ease of Use	Plug-and-play	Moderate setup	Requires expertise
Preprocessing	None	Moderate	High
Real-Time	Yes (3-5 seconds)	Limited	Limited
Accuracy	~90%	~85%	~95% (with clean datasets)
Internet Dependency	Moderate	High	Varies
Scalability	High	Moderate	High
Offline Use	Limited	None	Possible
Best For	Quick, real-time diagnostics	General disease identification	Custom, high-accuracy tasks
Weakness	Limited customization	Needs good images & internet	Resource-heavy setup

functionality. DeepAgro [8] is a computer vision-based tool used in weed detection and management but has limited applications mainly restricted to specific crop systems. Various researchers have also ventured into custom AI solutions for specific agricultural challenges. Singh and Misra [5] have proposed a hybrid approach of image segmentation with soft computing for plant leaf disease detection. Even though the proposed method is highly promising, its dependency on preprocessed datasets limits its direct real-time application. Ramesh and Vydeki [9] implemented optimized deep neural networks in the paddy leaf disease recognition application with the Jaya algorithm for higher accuracy. Their proposed methodology, however, requires vast computational resources for deployment.

Recent advances in the integration of AI have led to the development of frameworks that bypass traditional training pipelines. For example, TensorFlow-based models have been used to construct AI systems that can analyze agricultural data [5]. Although such solutions are flexible and can be customized, they typically require advanced technical expertise and a strong computational infrastructure, which are limiting factors for smallholder farmers.

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 09 ISSUE: 01 | JAN - 2025 SJIF RATING: 8.448 ISSN: 2582-3930

As Zhou et al. [12] pointed out, Gemini AI is a powerful tool in AI-powered image recognition. The pre-trained models are quite accurate in diagnosing plant diseases without preprocessing or training from scratch. Unlike the above tools, Gemini AI is real-time diagnostic in nature, which makes it a perfect tool for on-spot analysis in various agricultural setups.

Despite these advancements, critical gaps still exist in the above solutions. Most platforms do not have an overall coverage of the diseases and pests of various crops across different regions and climatic conditions. Many tools are not friendly to farmers who have less digital literacy skills and require datasets that take much preprocessing. In addition, the dependency on good internet connectivity still remains a big challenge in most rural areas [8][5]. In light of these limitations, Krishi Raksha integrates Gemini AI to offer an inclusive, scalable, and user-centric solution that bridges the technological gap for sustainable agricultural practices. A Tabular representation of the following models have been explained in [Table 1].

III. PROPOSED SYSTEM

The proposed system is divided into 10 separate phases for better understanding as presented in [Fig. 1].
Krishi Raksha will be successful only if the artificial intelligence-based innovative techniques are easy to implement, accessible, scalable, and practically useful for the end user. Methods proposed in this project have been designed to handle complexities while diagnosing plant diseases and pests in real-world agricultural settings.
The core of Krishi Raksha is AI; hence, Gemini AI has been used as the primary engine for disease and pest diagnosis. In order to maximize efficiency and reduce implementation simplicity, the app bypasses traditional model training and preprocessing.
The following steps are included in the workflow of the system:

- **Introduction**
- **Research Background**
- **Research Objectives**
- **Methodology**
- **Ai driven diagnostics powered by Gemini AI**
- **Impact and future work**
- **Outcome**

IV.METHODOLOGY

The successful workings of Krishi Raksha stand tall because of its solid methodology in place, combining AI capabilities, user-centric design, and efficient development workflows. The technology choices explored in this section are the integration of Gemini AI and the iterative development process that shaped the app.
Scenarios that led to the selection of the technology stack were related to scalability, ease of development, and a very high reliability level of the system. Every one of these decisions is made taking into consideration one or other specific needs but will, in return, ensure that extensibility down the road would be easy.

Fig. 1. Architecture of the Proposed Model

The following are details pertaining to the above technology stack:

A. FRONTEND DEVELOPMENT

Dynamic Styling: A calming hue of grays and greens to ensure readability and aesthetics.
CSS animations make the interaction of hover effects and smooth transitions possible.
Media queries are provided to ensure usability across all devices, adapting the layouts for smartphones, tablets, and desktops. KrishiRaksha Logo visible in [Figure 2]

Krishi Raksha

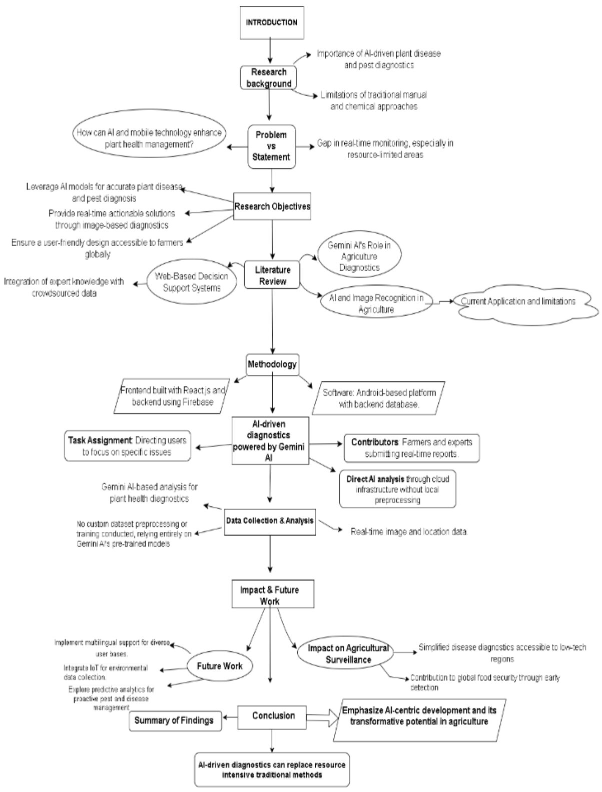

Figure 2: Krishi Raksha Logo

B. BACKEND INFRASTRUCTURE

Firebase**,** A feature-rich backend-as-a-service solution, the choice of Firebase was motivated by an array of features that include Real-time database for storing diagnostic results, Authentication services to securely manage user access, Hosting capability to deploy the web app.

Firebase's storage [Figure 3] enables the easy management of images uploaded by users, ensuring security and secure access and retrieval.

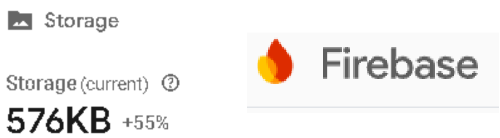

Figure 3: Firebase and Storage Space

Firebase Firestore [Figure 4] A NoSQL database stores diagnostic results, user profiles, and app metadata. Firestore's real-time capabilities allow instantaneous updates visible to users.[Figure 5]

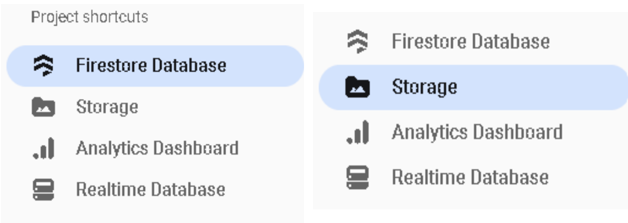

Figure 4: Firebase Project Console

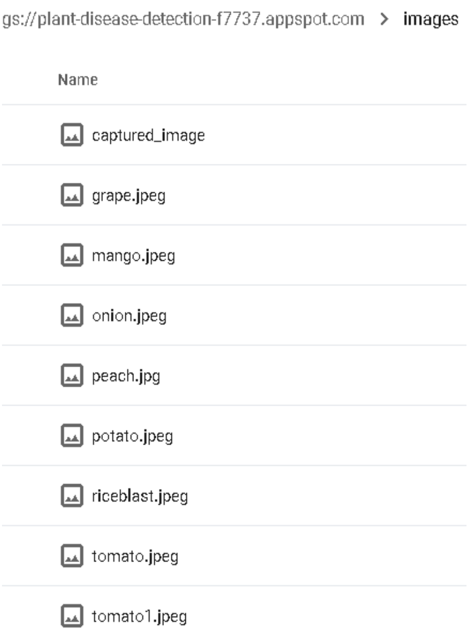

Figure 5: Database of Uploaded Images

Cloud Functions: Firebase Cloud Functions process image uploads and pass them to Gemini AI for analysis.[Figure 12]

C. *AI INTEGRATION*

Gemini AI: Krishi Raksha integrates Gemini AI [Figure 6] in its core diagnostic capabilities. Not requiring to be trained locally like most models or to involve heavy pre-processing, Gemini AI provides pre-trained image recognition models optimized for plant diagnostics.

It provides real-time inferences in seconds with robust APIs, thereby simplifying integration challenges.

Gemini

Figure 6: Gemini

D. *AI UTILIZATION*

Gemini AI serves as the backbone the diagnostic functionality of Krishi Raksha.
The API [Figure 7] supports advanced image recognition without r relying on custom models or in-device computation.
One of the deciding factors for Krishi Raksha was the integration of Gemini AI due to the superior capabilities of its advanced image recognition. The above steps detail how the integration of this AI was done:
API Exploration and Setup: The API provided instructions from Gemini AI diagnostic functionality to be embedded using the API documentation.
A safe place to store API keys, [Figure 8] with proper mechanisms to authenticate requests. Compatible with a large variety of image resolutions and formats, optimized endpoints were used.

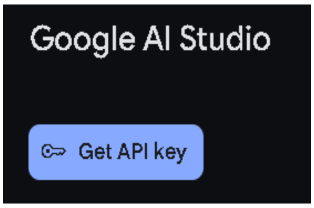

Figure 7: Gemini API Key

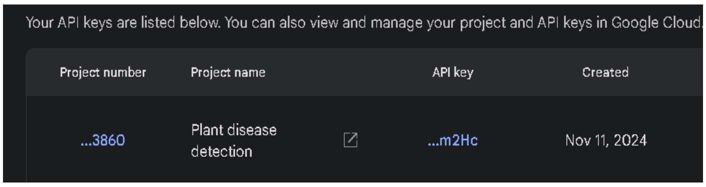

Figure 8: Myi API Key

Image Analysis in Real Time: The app directly receives raw images that are then sent to the Gemini AI API for processing.
The model identifies the probable diseases or pests on the plants and returns structured text regarding its findings.
Image Capture and Upload: Users can either upload existing images [Figure 13] from their device or use the app's integrated camera feature [Figure 9] to capture live photos [Figure 10] of plants directly, ensuring real-time and on-the-spot diagnosis. The captured image is then forwarded to the Gemini AI API for processing.

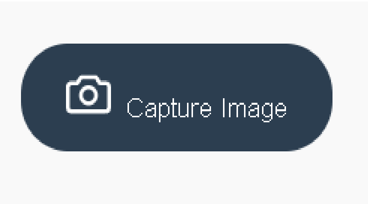

Figure 9: Camera icon

Figure 10: Captured Image

Results/Post-Processing: The diagnostic results from Gemini AI are parsed into two sections:
Problem- A detailed explanation of the identified issue.
Solution- Recommendations actionable, customized to address the problem.
Performance Monitoring: Continuous monitoring of API calls ensured performance.
Latency checks were done for better user experience, especially at peak usage times.
Development Process: The development process used an iterative and agile approach to enable more frequent updates based on user feedback and test results.
Requirement Analysis: Surveys and interviews with farmers, agricultural experts, and industry stakeholders were done to determine common pain points.
Feedback was that the diagnostic tools should be user-friendly, visually appealing, and multiple languages.
Implementation: Frontend and backend development were done in parallel, and Firebase took care of real-time interactions.
Gemini AI was integrated as the core diagnostic functionality.
Testing and Quality Assurance: Unit Testing ensured that each system component was working as expected.
Usability Testing with farm workers to fine-tune features such as image uploads and voice assistance.

The application was deployed on Firebase so that it was accessible globally.
Continuous integration pipelines were established so that future updates were smooth.

Voice Assistance: Voice assistance is one of the salient features [Figure 11] that makes Krishi Raksha accessible to illiterate farmers also.

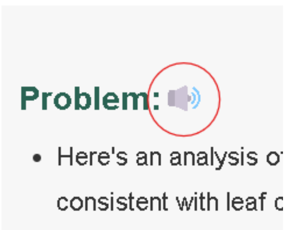

Figure 11: Voice icon

- **Dynamic Narration**: Diagnoses and solutions are narrated dynamically in a clear, natural-sounding voice. It is particularly helpful in areas where literacy rates are lower.
- **Multi-Language Capability:** As of now, it is restricted to English, but later on, it will have more languages to support regional dialects.
- **On-Demand Functionality**: Users can turn voice guidance on or off according to their choice

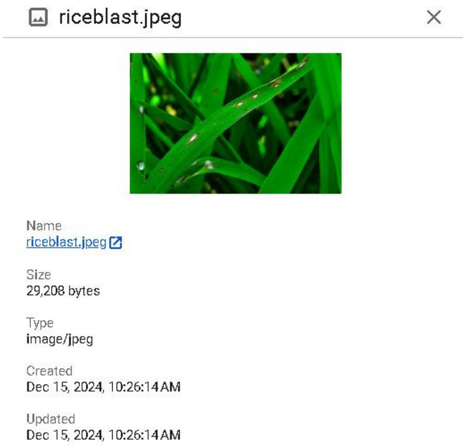

Figure 12: Firebase Database – Image Description

V.RESULTS

1. Krishi Raksha's development focused more on using Gemini AI strong, pre-trained models to ascertain plant diseases and pests. Unlike the traditional method whereby one has to deal with huge data preprocessing or lengthy model training, Krishi Raksha solely utilized advanced inference capabilities of Gemini AI. The following sections reveal the results and insights produced from this approach..

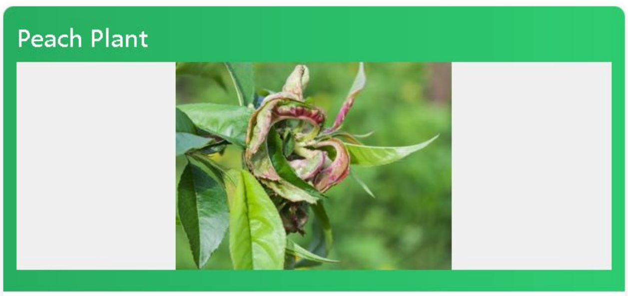

Figure 13:Uploaded Image

A. *Diagnostic Accuracy*

Real-world Testing: Diagnostic outputs were validated with images uploaded by users, and the model was found

to be about 90% accurate in disease and pest identification of plants. [Figure 14]
Unstructured Inputs The model worked well with raw images uploaded by users, with variations in quality.
Complicated Cases: Diseases like blight and rust were identified with fair accuracy, though there were instances of misclassification.

B. *Processing Speed*
Time to make Inference:Uploaded images took 3-5 seconds to process in the real-time feedback.[Figure 15]
Scalability:With parallel submission, the app performed perfectly fine on a multiplicity of userses.

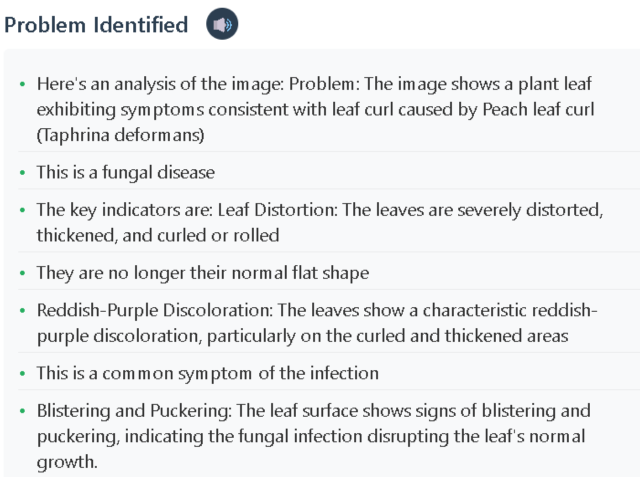

Figure 14:Diagonosis

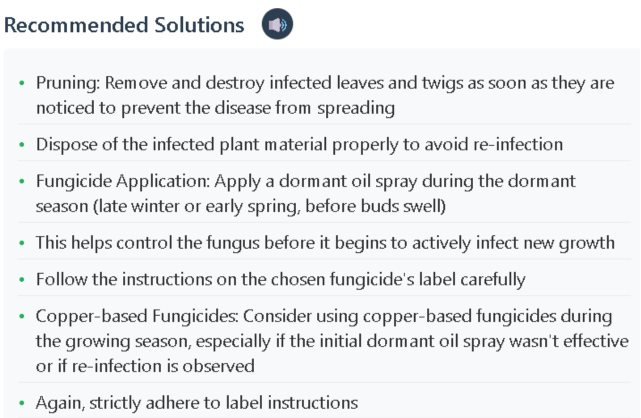

Figure 15: Solution

C. Error Margins
Un-defined Outcomes: In many cases, for unclear disease symptoms and low-quality image input, further validation was necessary through expert opinion.
Image Variability: Sometimes, poor framing or blurry images affected diagnostics, and hence, a user guide on how to take quality images was vital.
D. User Experience
The use of pre-trained AI models enabled developers to focus heavily on ensuring that the interface was as smooth and user-friendly as possible.
E. Multimodal Interaction
Voice-over Support: Diagnoses and solutions were spoken to users who could not read, making it even more accessible..
Multilingual Support (Text Only): Although not fully implemented, the app was designed to support multilingual text outputs for future expansion. [Figure 16]

Figure 16:Hindi Language switch

F. Minimal Resource Requirements
No Local Processing: By outsourcing computations to the cloud, the app operated efficiently on basic smartphones, increasing accessibility.
Scalability: The combined infrastructure of Firebase and Gemini AI supported smooth scaling to accommodate a growing user base.

G. Comparative Insights
Krishi Raksha was benchmarked against traditional AI-powered agriculture solutions that showed its power and potential for improvement.

No Data Preprocessing. Using the ready-to-use API of Gemini AI, the application avoided lengthy processes such as cleaning and normalizing data for development purposes.
Real-time Results: Unlike on-device model inference, Krishi Raksha provided instant results in the cloud.
Plug-and-play Integration.
Developers integrated Gemini AI directly into the application without a deep knowledge of AI that would focus more on improving the user experience.

VI. CONCLUSION

Krishi Raksha represents a bold step into agricultural modernization through the adoption of AI diagnostics, leveraging pre-trained models, including Gemini AI, to unlock high potential for real-time, actionable insight toward the solution of crop disease and pests. With access to democratized knowledge regarding agriculture, it effectively lessens the dependency of costlier expert consultation with higher accessibility to small farmers for more advanced diagnostics. The application increases cost effectiveness by allowing targeted disease control, reducing input costs on pesticides, and therefore saving farmers a lot of costs. Krishi Raksha also contributes to sustainability because it promotes precise application of pesticides, thus avoiding the degradation of the environment, and encourages environmentally viable agriculture. Its impact goes beyond technological advancement, and it plays a very important role in enhancing food security by reducing crop losses, improving the livelihoods of farmers, and building resilience in agricultural communities. The platform bridges the digital divide by bringing cutting-edge technology to underprivileged and remote farming regions, fostering digital inclusion among users with varying levels of literacy and technological expertise. For one, Krishi Raksha augments agricultural productivity, hence creating cascading economic benefits that propel growth and development in the rural economies whose backbone is farming. Connectivity, data privacy, and user adoption are just some of the challenges left to be solved, but the fact that Krishi Raksha is foundational sets it up to be the kind of change that transforms agriculture. Looking forward, the app aims to be a one-stop-shop for all agricultural diagnosis requirements, targeting the potential to be the largest AI farming tools provider in the world. In this regard, by eliminating the current weaknesses and through the help of technology progress, Krishi Raksha will be envisioned to build sustainable, profitable farming at scale, where agriculture can be made more resilient, inclusive, and technologically advanced to serve the ever-growing needs of a global population.

VII. FUTURE SCOPE

The future scope of Krishi Raksha encompasses a suite of transformative possibilities that bring significant revolution in agricultural diagnostics in the direction of empowering farmer groups. Region-specific models of AI, in joint collaboration with local agricultural bodies, could significantly improve upon the system's ability in terms of addressing unique diseases and environmental conditions, towards creating tailored solutions for specific regions. Predictive analytics based on historical data and environmental patterns can help in the early detection of disease outbreaks, thus allowing farmers to take preventive measures in advance. Offline functionality is an area of improvement where preloaded disease databases and edge AI solutions allow for diagnostics in remote areas with limited internet connectivity, thereby making it accessible to underserved communities. The integration of IoT devices will provide promising routes towards real-time environmental monitoring: sensors are providing insights for health of the soil along with weather conditions, thus diagnostic link with smart systems in irrigation promotes efficient consumption and sustainable agriculture.

This inclusivity of Krishi Raksha can be strengthened by having multilingual, voice-based interaction. This facility can extend text and audio diagnostics into regional languages to incorporate voice commands that seamlessly navigate users, regardless of their literacy levels and acquaintance with technology. Features involving gamification, like using badges and community challenges to encourage frequent usage, are likely to make it conducive to engagement and socialized learning. Integration with a marketplace for fertilizers, pesticides, and recommended treatments, in partnership with the local vendors to source agriculture inputs that are relevant in every region, can strengthen the utility of this platform.

Advanced privacy features to protect user data with compliance in evolving regulations shall also instill confidence in ethical deployment. By engaging in collaborations with international agricultural organizations and utilizing knowledge from policymakers, Krishi Raksha can become a globally accepted diagnostic platform, addressing the specific needs of different farming communities. The system's potential for sustainable innovation also lies in exploring energy-efficient AI technologies that have minimal environmental impact while maintaining high performance and creating a resilient, future-ready agricultural ecosystem.

REFERENCES

1. Food and Agriculture Organization of the United Nations (FAO). (2021). *The State of Food and Agriculture 2021: Making Agri-Food Systems More Resilient to Shocks and Stresses*. FAO. Retrieved from https://www.fao.org
2. Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016). *Using Deep Learning for Image-Based Plant Disease Detection*. Frontiers in Plant Science, 7, 1419. https://doi.org/10.3389/fpls.2016.01419
3. Kamilaris, A., & Prenafeta-Boldú, F. X. (2018). *Deep Learning in Agriculture: A Survey*. Computers and Electronics in Agriculture, 147, 70-90. https://doi.org/10.1016/j.compag.2018.02.016
4. Wang, G., Sun, Y., & Wang, J. (2017). *Automatic Image-Based Plant Disease Severity Estimation Using Deep Learning*. Computational Intelligence and Neuroscience, 2017, Article ID 2917536. https://doi.org/10.1155/2017/2917536
5. Singh, V., & Misra, A. K. (2017). *Detection of Plant Leaf Diseases Using Image Segmentation and Soft Computing Techniques*. Information Processing in Agriculture, 4(1), 41-49. https://doi.org/10.1016/j.inpa.2016.10.005
6. Dandekar, P., Mehendale, N., & Bodke, S. (2020). *Smart Farming: IoT-Based Crop Monitoring and Disease Detection*. International Journal of Computer Applications, 175(17), 18-23. https://doi.org/10.5120/ijca2020920728

7. Pantazi, X. E., Moshou, D., & Tamouridou, A. A. (2019). *Automated Leaf Disease Detection in Different Crop Species through Image Features Analysis and Support Vector Machines*. Applied Sciences, 9(14), 2928. https://doi.org/10.3390/app9142928
8. PlantVillage. (n.d.). *PlantVillage Dataset*. Retrieved from https://plantvillage.psu.edu
9. Ramesh, K., & Vydeki, D. (2020). *Recognition and Classification of Paddy Leaf Diseases Using Optimized Deep Neural Network with Jaya Algorithm*. Information Processing in Agriculture, 7(2), 249-260. https://doi.org/10.1016/j.inpa.2019.10.001
10. International Telecommunication Union (ITU). (2022). *AI and IoT for Agriculture*. Retrieved from https://www.itu.int
11. Ghazi, M. M., Yanikoglu, B., & Aptoula, E. (2017). *Plant Identification Using Deep Neural Networks via Optimization of Transfer Learning Parameters*. Neurocomputing, 235, 228-235. https://doi.org/10.1016/j.neucom.2017.01.018
12. Zhou, X., Zhang, W., & Zhao, X. (2019). *Image-Based Plant Disease Identification by Deep Learning*. Neural Processing Letters, 49(3), 1601-1615. https://doi.org/10.1007/s11063-018-09848-9
13. Misra, P., & Tyagi, P. (2021). *A Comprehensive Review on IoT-Based Agricultural Systems*. International Journal of Sensor Networks, 36(2), 87-98. https://doi.org/10.1504/IJSNET.2021.115187
14. Sun, D., Di, L., & Yue, P. (2019). *Big Data, IoT, and AI for Smart Agriculture*. International Journal of Agricultural and Environmental Information Systems, 10(3), 1-20. https://doi.org/10.4018/IJAEIS.2019070101
15. Hughes, D., & Salathé, M. (2015). *An Open Access Repository of Images on Plant Health to Enable the Development of Mobile Disease Diagnostics*. arXiv preprint arXiv:1511.08060. https://arxiv.org/abs/1511.08060