

CROPSHIELD AI: INTELLIGENT FARMING SYSTEM FOR CROP DISEASE DETECTION, PRICE FORECASTING & PESTICIDE MANAGEMENT

Abhishek G¹, Abinav k², Akshitha R³, Anubhav VK⁴, Savitha MS⁵

¹ Bachelor of Technology in CSE, NCERC

² Bachelor of Technology in CSE, NCERC

³ Bachelor of Technology in CSE, NCERC

⁴ Bachelor of Technology in CSE, NCERC

⁵ Assistant Professor, Department of CSE, NCERC

ABSTRACT - Crop Shield AI is designed to be an intelligent, easy-to-use farm management system to address the challenges that farmers face each day. These challenges often include crop disease, fluctuating market prices, and improper use of pesticides. Most current farming practices require farmers to rely on their own manual observation and previous experience to make crop-related decisions. This often leads to delays in taking action, making an incorrect decision on how to treat or sell the crops, or losing money. To address all of these issues, Crop Shield AI integrates several cutting-edge technologies (Artificial Intelligence (AI) and Machine Learning (ML)) to create a single platform that will provide accurate information in real time. The Crop Shield AI platform allows farmers to take advantage of several deep learning models (e.g. CNN, ResNet, and Efficient Net) to analyze images uploaded from their crops and make timely decisions based on the data collected. Additionally, the Crop Shield AI platform will inform the user of the extent of the disease and the areas affected so that the user can take action without delay and minimize any further damage to their crops. Another component of the system is a price forecasting module that applies algorithms (e.g. LSTM and ARIMA) to identify market trends so that farmers can determine when the best time to sell their crops will occur, which can increase the amount of revenue generated. Also, the pesticide management portion of the system will provide users with a list of recommended pesticides based on the disease present in their crops and the condition of their crops, along with instructions for proper and safe use of the pesticide. The crop health status and pesticide recommendation also help reduce incorrect use of pesticides or waste.

1. INTRODUCTION

Agriculture is an old and important part of our world. It helps make sure we have food supports the economy and helps billions of people make a living. In countries like India agriculture is the way people make money and it helps the country grow. A lot of people depend on farming. It is a big part of our society. Even though it is

so important agriculture still faces many big problems. These problems make it hard to produce food. They hurt the environment. The world's population is growing fast. Climate change is making things worse. We do not have resources and we are not using technology enough. This makes it hard for farmers to do their jobs. We need to find smart ways to help farmers.

One of the problems in agriculture is finding and managing crop diseases. Crop diseases can spread fast. Hurt the crops if we do not find and treat them on time. Farmers usually look at the crops. Use their experience to find diseases. This way is not good enough. It takes a lot of time. It is easy to make mistakes. Farmers may not know how to tell the difference between diseases so they may not treat them correctly. This means the diseases can spread and hurt the crops before we do anything. This can cause losses and hurt the farmers financially. We need a system that can help farmers find diseases fast and correctly.

Another big problem for farmers is that they do not know what price they will get for their crops. The market is always. Many things can affect the price. These things include how food we have, the weather how much it costs to transport the food what the government says and what is happening in the world. Farmers do not have information so they do not know when to sell their crops. They may have to sell them at a price, which can hurt them financially. Even though there are some tools that can help predict prices they are not good enough. They do not have the information and they are hard to use.

Farmers also have problems with using pesticides. Pesticides are necessary to control pests and diseases. Using them incorrectly can be bad. Farmers may use the pesticide or they may use too much or too little. This can increase costs. Hurt the environment. It can also be bad for people's health. If farmers do not use pesticides the pests may not be controlled and the crops can be hurt. Using pesticides incorrectly can also make the pests stronger so they will be harder to control in the future. We need a system that can tell farmers which pesticides to use and how to use them.

Technology is getting better fast and Artificial Intelligence and Machine Learning can help with many of the problems in agriculture. These technologies can analyze a lot of data find patterns and make predictions. We can use them for things, such as finding crop diseases predicting how much food we will have, analyzing the soil and predicting market trends. Some types of Artificial Intelligence such as Convolutional Neural Networks are very good at looking at pictures and finding diseases. Other types, such as Long Short-Term Memory and ARIMA are good at predicting what will happen in the future.

Even though we have these technologies most of the systems we have now only solve one problem. Some systems only help with finding diseases while others only predict prices or look at the environment. This means farmers have to use different tools, which can be time-consuming and hard to use. Many of these systems are also not made for farmers so they can be hard to use. We need a system that can do things and is easy to use.

This is why we need a system like Crop Shield AI. It is a system that helps with finding crop diseases predicting prices and managing pesticides. It uses learning models to find diseases and predict prices. It also gives farmers information about their crops and the market so they can make decisions. The system is easy to use, for farmers who do not know much about technology. It can be used on devices, including smartphones and computers.

Crop Shield AI can also be made better in the future. We can add features, such as using IoT sensors, drones and blockchain. This can help us get information and make the system even better. It can help us monitor the fields in time make sure the data is correct and make the supply chain more transparent.

In conclusion agriculture is changing fast because of technology. Systems like Crop Shield AI are a step, towards making farming better. By helping with finding diseases predicting prices and managing pesticides the system can make farming more productive reduce losses and help the environment. If we use these systems, we can help farmers make better decisions and contribute to the worlds food production.

2. LITERATURE SURVEY

1. AI-Based Hybrid CNN-LSTM Model for Crop Disease Prediction

Sonal Jain and Dharavath Ramesh (2021) developed a system that uses both CNN and LSTM models to detect crop diseases, especially in rice plants. CNN helps in analyzing images of crops, while LSTM helps in understanding patterns over time. By combining these

two models, the system was able to improve accuracy in disease prediction. This approach showed better results compared to traditional methods. However, the system mainly focused on a specific crop and required a large amount of data, which makes it difficult to use in all types of farming conditions.

2. Agricultural Price Prediction Using LSTM-ARIMA Hybrid Model

Y. Guo et al. (2022) worked on predicting crop prices using a combination of LSTM and ARIMA models. LSTM helps in understanding complex patterns in data, while ARIMA is useful for analyzing past trends. By combining both models, the system was able to give more accurate predictions compared to using a single model. Even though the results were good, the system only focused on price prediction and did not include other important features like disease detection or farming recommendations.

3. Deep Learning Approach for Crop Yield Prediction Using CNN-BiLSTM

P. Saini et al. (2023) proposed a method to predict crop yield using CNN and BiLSTM models. The system used environmental data and past crop information to estimate how much yield a farmer could expect. CNN was used to extract features, while BiLSTM helped in analyzing sequences of data. The model performed well and provided accurate predictions. However, the study mainly focused on yield prediction and did not address other farming problems such as disease detection or pesticide usage.

4. Plant Disease Detection Using Convolutional Neural Networks

Abade A. S. et al. (2020) studied how CNN models can be used to detect plant diseases from leaf images. The research showed that deep learning techniques can achieve high accuracy in identifying diseases. The system works by analyzing patterns in images such as color and texture. Although the model was effective, it only focused on identifying diseases and did not provide additional support like treatment suggestions or severity analysis, which are important for farmers.

5. Comparative Analysis of ARIMA and LSTM for Price Forecasting

Chenxi Xia (2024) compared ARIMA and LSTM models for predicting agricultural prices. The study found that ARIMA works well for simple and linear data, while LSTM is better for complex and non-linear patterns. The research suggested that combining both models can improve prediction accuracy. However, the study only

focused on price forecasting and did not include other features needed for a complete farming solution.

3. PROPOSED SYSTEM

The proposed system, Crop Shield AI, is designed to help farmers solve common problems in agriculture such as crop diseases, changing market prices, and improper use of pesticides. In many cases, farmers depend on experience or guesswork, which can lead to wrong decisions and losses. To overcome this, the system uses modern technologies like Artificial Intelligence (AI) and Machine Learning (ML) to provide accurate and real-time support. The main idea is to bring all important farming tools into one platform so that farmers can easily access everything in one place without using multiple applications.

The system includes a crop disease detection feature where farmers can upload images of their crops using a mobile phone or computer. The system then analyzes the image using deep learning models like CNN, ResNet, and Efficient Net to identify the disease. It also shows how serious the disease is and which parts of the plant are affected. This helps farmers take action at the right time and prevent the disease from spreading, which improves crop health and yield.

Another important part of the system is price forecasting. Farmers often face problems because they do not know the right time to sell their crops. Crop Shield AI solves this by analyzing past price data using models like LSTM and ARIMA to predict future prices. The results are shown in simple graphs so that farmers can easily understand market trends and make better decisions. This helps them avoid losses and increase their income.

The system also provides pesticide recommendations based on the crop type and detected disease. It suggests the right pesticide along with clear instructions on how to use it safely and effectively. This reduces the misuse of chemicals and helps protect both the environment and human health. In addition, the system includes a small marketplace where farmers can find pesticide products from trusted suppliers.

Crop Shield AI is developed as a web-based application with a simple and easy-to-use interface. It supports different languages and provides real-time alerts and updates, making it suitable for farmers with different levels of technical knowledge. The system also allows different types of users such as farmers, experts, and administrators to access features based on their roles.

Overall, the proposed system provides a complete and practical solution for modern farming. By combining disease detection, price prediction, and pesticide management into one platform, Crop Shield AI helps farmers make better decisions, improve productivity, and move towards more sustainable and efficient farming practices.

4. SYSTEM DESIGN

The Crop Shield AI system is designed to be simple and easy for farmers to use. The main goal of the Crop Shield AI system is to put all the features in one place, such as finding diseases in crops guessing future prices and selling products. This way farmers do not have to use different apps for different things. The Crop Shield AI system is made up of parts that work well together. This makes it easy to fix, update and add to the Crop Shield AI system in the future.

The Crop Shield AI system has three parts to make sure everything works smoothly. The first part is the user interface, where farmers interact with the Crop Shield AI system. The second part is the application part, where data is processed and the main logic happens including machine learning models. The third part is the data part, where all the information is stored, like user data, pictures of crops and prediction results. This structure helps the Crop Shield AI system work well and makes sure all the parts talk to each other properly.

5. MODULE DESCRIPTION

1. User Management Module

The User Management Module takes care of all the things that have to do with users in the Crop Shield AI system. It lets users sign up log in and manage their profiles in a way. The Crop Shield AI system has types of users like farmers, experts and people in charge each with their own roles and permissions.

This module also has a dashboard where users can see all the results, like disease detection, price predictions and recommendations all in one place. It also sends notifications and alerts to keep users updated on things. This makes it easy for users to use the Crop Shield AI system and get all the information they need without getting confused.

2. Crop Disease Detection Module

The Crop Disease Detection Module helps farmers find diseases in their crops quickly and accurately. Farmers can upload pictures of their crops using their phones or computers and the Crop Shield AI system looks at these pictures using models like CNN, Resnet and Efficient Net. The Crop Shield AI system finds the type of disease how bad it's and shows the parts of the plant that are affected. This helps farmers understand what is going on with their crops and take action to stop the disease from getting worse.

3. Price Forecasting Module

The Price Forecasting Module helps farmers understand what prices will be like in the future and what is

happening in the market. It uses models like LSTM and ARIMA to look at price data and guess future trends. The results are shown in graphs making it easy for farmers to understand. This helps them decide when to sell their crops avoid losing money and make income.

4. Pesticide Management Module

The Pesticide management module gives recommendations on which pesticides to use, based on the type of crop and the disease that is found. It suggests which pesticides are good to use and how to use them including how much to use and how to stay safe. This helps farmers use chemicals in a way that's safe for the environment and good for their crops. It also helps farmers use chemicals and promotes good farming practices.

5. Store Module

The Store Module lets farmers buy things they need for farming, like pesticides, seeds, fertilizers and equipment all in one place. Of looking in many places farmers can find everything they need in the Crop Shield AI system. The module gives information, about products, including prices, how to use them and if they are available. It is also connected to the disease detection module so it can suggest products based on the condition of the crops. Trusted suppliers are used so farmers can be sure they are getting good products. This module makes buying things easier. Helps farmers work more efficiently.

SUMMARY

The design of the Crop Shield AI system is simple and easy to use. Each module does a job and all the modules work together to help farmers. This design helps farmers work better use effort and make good decisions. Overall, the Crop Shield AI system is a way to make farming better by putting many things in one place.

Fig 1



Fig 2

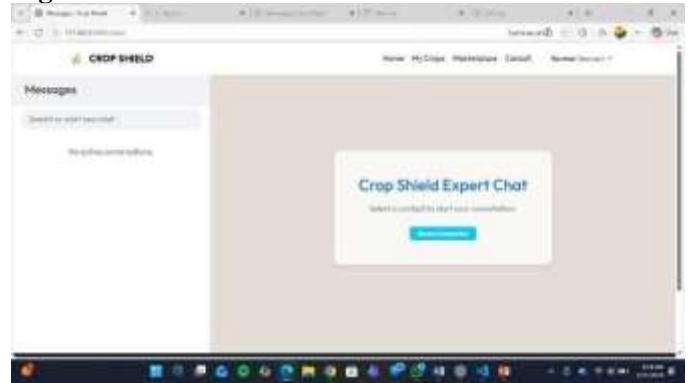


Fig 3

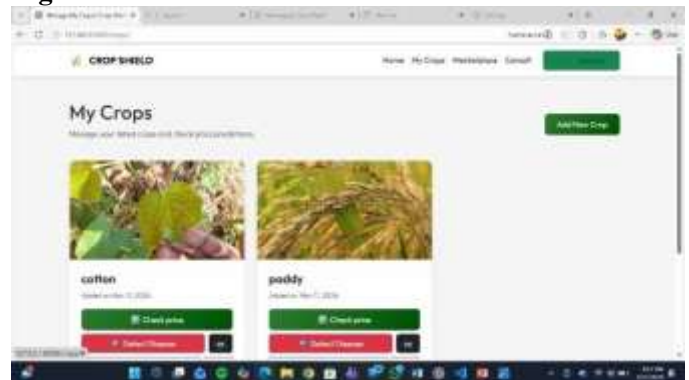


Fig 4

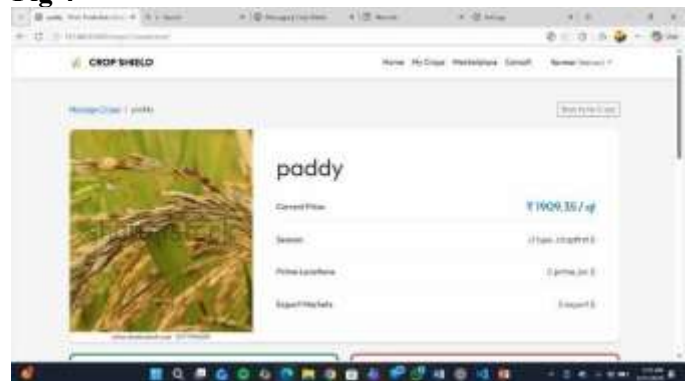


Fig 5



Fig 6

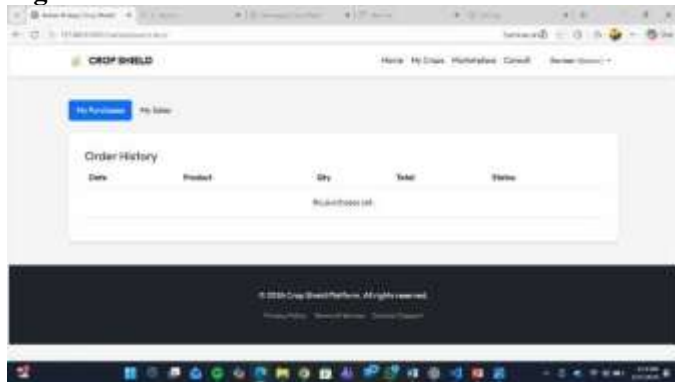
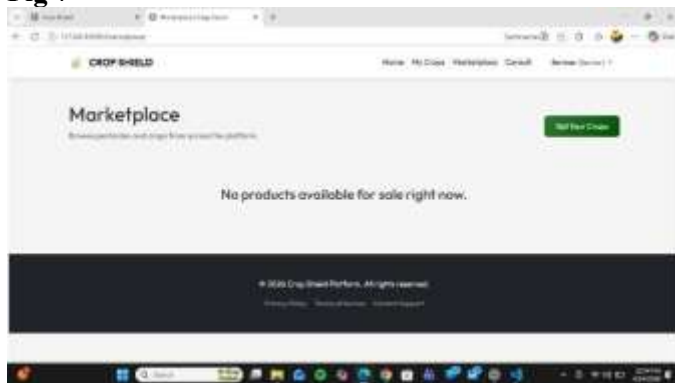


Fig 7



5. DISCUSSION AND ANALYSIS

The Crop Shield AI system is an example of how Artificial Intelligence and Machine Learning can be used to solve real problems in farming. It combines tools into one platform, including disease detection, price forecasting and pesticide management. This helps farmers make decisions and improves their overall farming experience. Unlike methods that rely on manual observation Crop Shield AI provides data-driven insights that enable farmers to take more accurate and timely actions.

One of the features of Crop Shield AI is the disease detection module. It uses learning models like CNN, ResNet and Efficient Net to identify diseases from images of crops. This allows farmers to catch problems early reducing damage to their crops and improving their yield. The module also includes severity analysis and affected region identification, which provides detailed information than just basic classification. However the performance of this module depends on the quality and diversity of the training data, which needs to be improved for better real-world accuracy.

The price forecasting module is also very useful as it helps farmers make financial decisions. By combining LSTM and ARIMA models Crop Shield AI can analyze trends and predict future crop prices. This reduces

uncertainty. Allows farmers to choose the best time to sell their produce. The system also uses representations like graphs to make the information easy to understand. It is worth noting that price prediction can be influenced by external factors like market changes, climate conditions and policy decisions which may affect accuracy.

The pesticide management module plays a role in promoting safe and efficient farming practices. By recommending pesticides and providing proper usage guidelines Crop Shield AI helps reduce the misuse of chemicals. This not saves farmers money but also minimizes the environmental impact and health risks associated with pesticide use. The effectiveness of this module depends on disease detection and updated pesticide data, which should be maintained regularly.

The Store Module makes the system more practical by providing easy access to agricultural products like pesticides, seeds, fertilizers and equipment. By connecting recommendations with product availability Crop Shield AI simplifies the process of selecting and purchasing the inputs. The inclusion of verified suppliers ensures product quality. Builds trust among users making the system more reliable for real-world use.

From a design perspective Crop Shield AI is well-structured and scalable. The use of a three-layer architecture ensures processing and smooth communication between components. The modular structure allows each component to function independently while contributing to the system. The web-based interface improves accessibility enabling farmers to use Crop Shield AI on devices.

Key Observations:

Crop Shield AI successfully integrates agricultural tools into one platform.

- It improves decision-making through real-time insights and predictions.
- It reduces dependency on methods and guesswork.
- It enhances productivity and supports farming practices.

Despite its advantages Crop Shield AI has some limitations. It requires internet connectivity, which may not always be available in areas. The accuracy of predictions depends on data quality and model performance. Additionally, world agricultural conditions can vary, which may affect system results. These limitations can be addressed in the future by improving

datasets adding capabilities and integrating technologies like IoT and real-time sensors.

Overall Crop Shield AI demonstrates an effective approach to modern farming. By combining technologies with a user-friendly design, the system provides a reliable solution that helps farmers make better decisions reduce losses and improve productivity. With enhancements Crop Shield AI has strong potential to contribute to the development of smart and sustainable farming systems and that is what Crop Shield AI is all about helping farmers, with Crop Shield AI.

9. FUTURE SCOPE

The Crop Shield AI system is a start for smart farming but it can be made even better in the future to help farmers. One way to do this is to add sensors to the fields that can send information about the soil and weather to the Crop Shield AI system. This information can help the Crop Shield AI system give farmers advice on when to water their crops and how much fertilizer to use. The Crop Shield AI system can also use pictures from drones and satellites to check on the crops and find any problems early. This would be very helpful for farms. The Crop Shield AI system can also be improved by adding features that can predict the weather and how well the crops will grow. This can help farmers plan what to do and avoid problems. The Crop Shield AI system can also be used to make sure that farmers get a price for their crops and that customers get good quality crops. To make the Crop Shield AI system more useful a mobile app can be made that can be used without the internet. The app can also be made to understand voice commands and different languages so it is easy for everyone to use the Crop Shield AI system. To make the Crop Shield AI system work better it can be trained with information so it can give more accurate answers. The Crop Shield AI system can also be made to work with types of crops and problems so it can help farmers in different areas. In the future the Crop Shield AI system can even be connected to machines that can water and spray crops automatically based on what the Crop Shield AI system says. The Crop Shield AI system has a lot of potential for the future. It can become a complete solution, for smart farming helping farmers grow more crops reduce waste and use more modern and sustainable methods. The Crop Shield AI system can really help farmers. Make their lives easier.

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11. CONCLUSION

The development of Crop Shield AI shows how modern technologies like Artificial Intelligence and Machine Learning can help solve problems in farming. Farming is very important. Farmers often face big challenges like crop diseases, unpredictable market prices and using too many pesticides, which affect how much they produce and earn. Traditional farming methods mostly rely on experience and manual checks which can cause delays and wrong decisions. In this context Crop Shield AI offers an practical solution by bringing together many important features in one easy-to-use platform. The system uses models like CNN, ResNet and Efficient Net to detect crop diseases from images accurately. It also provides information like disease severity and affected areas, which helps farmers take action on time. The price forecasting module, using models like LSTM and ARIMA helps farmers understand market trends and make decisions about selling their crops. This reduces losses. Improves profits. The pesticide management module recommends pesticides and proper usage instructions.

This ensures efficient application reducing environmental impact and health risks. The store module is very useful as it allows farmers to easily buy products like pesticides, seeds and equipment from trusted suppliers. The system has an user-friendly interface making it accessible to farmers with limited technical knowledge. Its modular design ensures it can grow and improve in the future. Although the system has some limitations like needing internet and good data quality these can be improved with datasets and new technologies. Overall Crop Shield AI provides a efficient and integrated approach to modern agriculture. It helps farmers make decisions reduce crop losses improve productivity and adopt more sustainable farming practices. Crop Shield AI has potential to bridge the gap between traditional farming and modern

technology. It paves the way for an advanced data-driven and intelligent agricultural system in the future. Crop Shield AI and farming go hand in hand to create a future. The use of Crop Shield AI in farming is a step, towards a tech-savvy and productive agricultural sector.

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