

AI Based Pest Attack Prediction Using Climate Change

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Abstract: *Agriculture is increasingly affected by climate variability, which influences pest population growth and distribution. Sudden changes in temperature, humidity, and rainfall often create favorable conditions for pest outbreaks that can damage crops and reduce yield. Traditional pest monitoring techniques depend on manual observation, which often detects pest infestations only after crops are already affected. This study proposes an Artificial Intelligence (AI) based pest attack prediction system that uses climate data to forecast potential pest outbreaks in agricultural fields. The proposed model collects environmental parameters such as temperature, humidity, rainfall, soil moisture, and wind speed. Machine learning algorithms analyse historical climate and pest occurrence data to identify patterns associated with pest infestations. Based on these patterns, the system predicts the probability of pest attacks and generates early alerts for farmers. The results demonstrate that AI-based prediction models can significantly improve early pest detection and reduce crop losses. The system contributes to sustainable farming by enabling timely pest control and reducing unnecessary pesticide usage.*

Keywords: Artificial Intelligence, Pest Prediction, Climate Change, Machine Learning, Smart Agriculture

I. INTRODUCTION

Agriculture plays a vital role in global food production and economic development. However, agricultural productivity is increasingly threatened by climate change. Variations in temperature, rainfall patterns, and humidity influence the behaviour and reproduction of pests that attack crops. These pests can spread rapidly under favorable environmental conditions and lead to significant crop damage.

Farmers traditionally detect pest attacks through manual field inspections. Although this method is widely practiced, it often fails to detect pests in the early stages. As a result, pest infestations may become severe before preventive measures are taken. Excessive use of pesticides to control these outbreaks also causes environmental pollution and increases production costs.

Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) offer new opportunities to improve agricultural decision-making. AI systems can analyse large datasets and detect complex patterns between environmental variables and pest outbreaks. Predictive models can be trained using historical data to forecast pest infestations before they occur.

The objective of this research is to design an AI-based pest prediction system that utilizes climate data to estimate pest attack probabilities. The proposed system aims to provide early warnings to farmers so that preventive measures can be implemented at the right time.



II. LITERATURE REVIEW

Several studies have investigated the application of artificial intelligence and data analytics in agriculture to improve crop monitoring and pest management. Machine learning models have been widely used to analyse agricultural data and predict crop diseases or pest infestations.

Previous research indicates that climate factors such as temperature, humidity, rainfall, and wind speed significantly influence pest population dynamics. When these environmental conditions become favorable, pest populations can increase rapidly and spread across large agricultural areas. Researchers have developed predictive systems that use these climate parameters to estimate pest outbreak probabilities.

Many studies have applied algorithms such as Decision Trees, Random Forest, Support Vector Machines, and Artificial Neural Networks for agricultural prediction tasks. These algorithms are capable of identifying complex relationships between environmental variables and biological processes.

In addition, mobile applications and web platforms have been developed to deliver prediction results and recommendations directly to farmers. Such systems enable farmers to receive early warnings and implement preventive pest control measures. Despite these advancements, many rural areas still lack accessible and affordable pest prediction systems. Therefore, there is a need for practical AI-based solutions that can assist farmers in managing pest risks effectively.

III. METHODOLOGY

A. Data Collection

The first stage of the proposed system involves collecting environmental and agricultural data from multiple sources. Climate data is obtained from weather stations, agricultural research databases, and meteorological services. The key parameters used for prediction include:

TABLE 1: CLIMATE PARAMETERS USED FOR PREDICTION

Parameter	Description
Temperature	Average daily temperature
Humidity	Atmospheric moisture level
Rainfall	Precipitation level
Soil Moisture	Water content in soil
Wind Speed	Air movement affecting pest spread

B. Prediction Process

Once the model is trained using historical data, it can analyze new climate data to predict the probability of pest attacks. If environmental conditions match patterns associated with previous pest outbreaks, the system generates an alert indicating a potential pest risk.

TABLE 2: EXAMPLE DATASET FOR PEST PREDICTION

Temperature	Humidity	Rainfall	Soil Moisture	Wind Speed	Pest Attack
30	75	12	45	10	Yes
28	60	5	40	8	No
32	80	20	50	12	Yes
27	55	3	35	6	No
31	78	18	48	11	Yes



C. Machine Learning Model

After preprocessing, machine learning algorithms are applied to build predictive models. Several algorithms can be used to analyse the relationship between climate variables and pest outbreaks. Among these algorithms, Random Forest is often preferred because it provides high prediction accuracy and can handle complex datasets effectively.

TABLE 3: MODEL ACCURACY COMPARISON

Algorithm	Accuracy
Decision Tree	78%
Support Vector Machine	82%
Neural Network	86%
Random Forest	91%

IV. DIAGRAMS

AI Based Pest Attack Prediction System Architecture

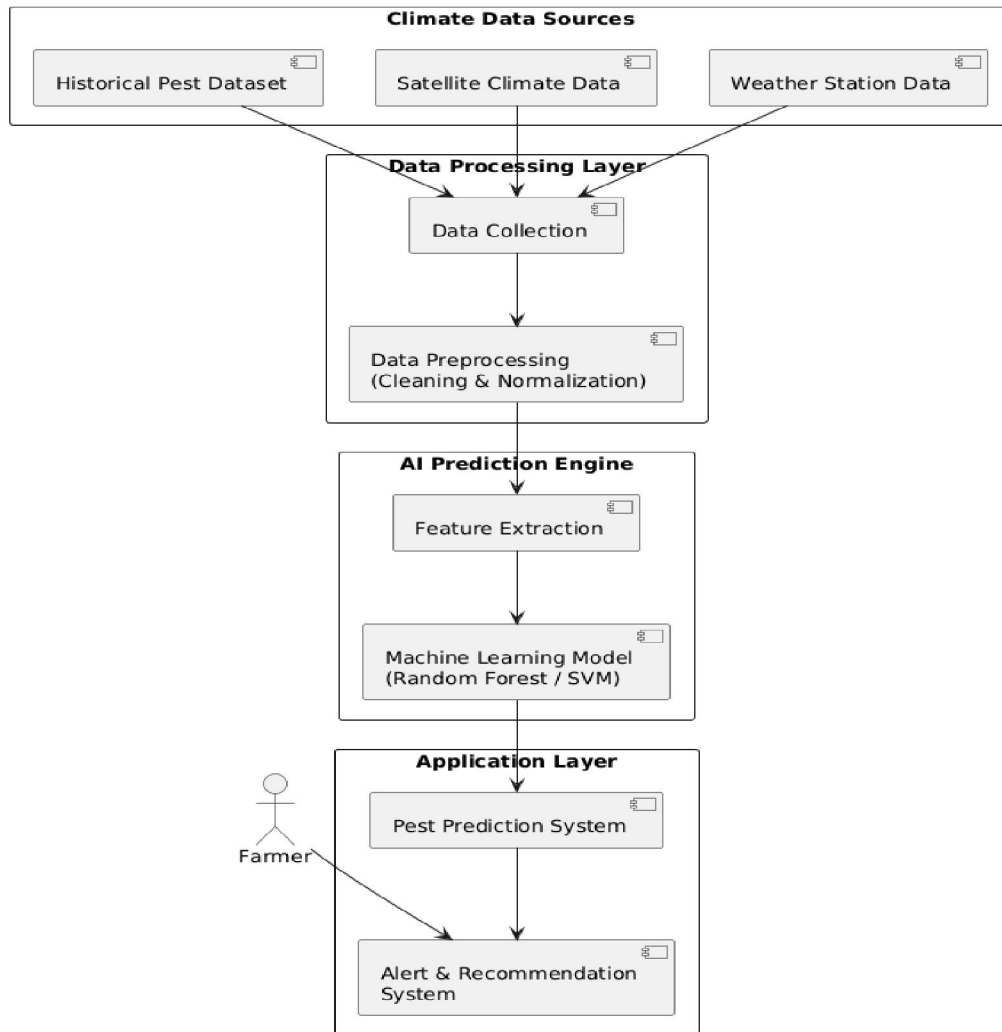


Fig 1: System Architecture Diagram



Use Case Diagram - AI Based Pest Prediction System

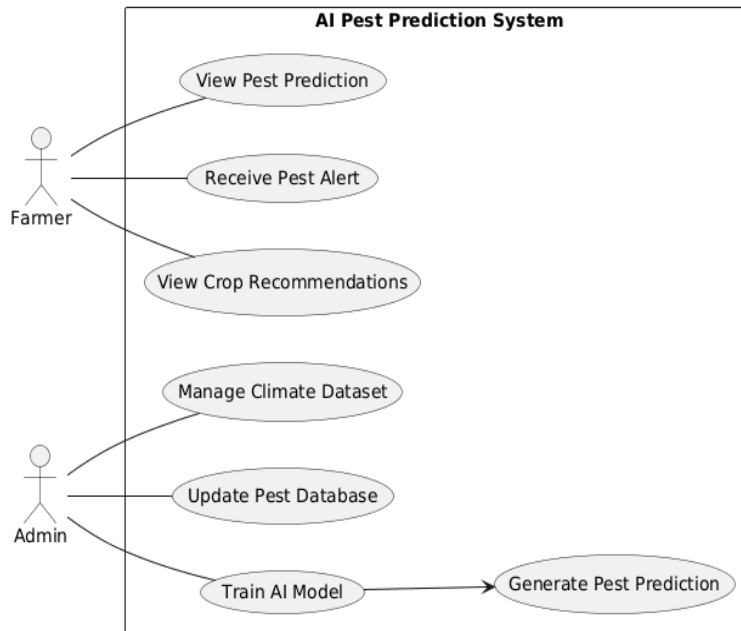


Fig 2: Use Case Diagram



Machine Learning Workflow for Pest Prediction

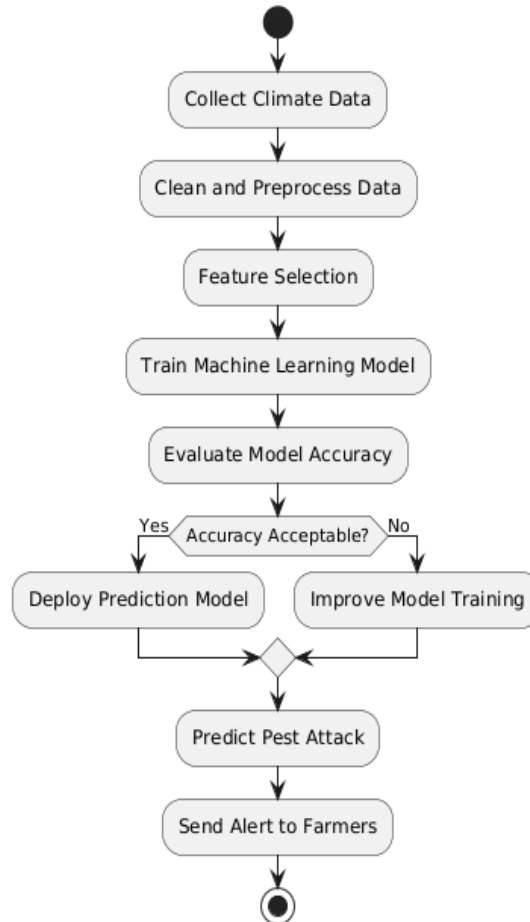


Fig 3: Machine Learning Workflow

V. RESULTS AND DISCUSSION

The proposed AI-based pest prediction model was evaluated using historical climate and pest occurrence datasets. The machine learning algorithms were trained to identify relationships between environmental variables and pest attack events.

Experimental results indicate that the model can successfully detect patterns in climate data that are associated with pest outbreaks. Among the evaluated algorithms, the Random Forest model demonstrated the highest prediction accuracy due to its ability to handle multiple input variables and complex relationships.

The system can generate early warnings when climatic conditions become favorable for pest development. By receiving these alerts, farmers can apply preventive pest management strategies such as biological control methods or targeted pesticide applications.

The use of AI-based prediction systems can significantly reduce crop losses and improve agricultural efficiency. Furthermore, early pest detection helps minimize excessive pesticide usage, which benefits both the environment and human health.



VI. CONCLUSION

Climate change has significantly influenced pest populations and increased the frequency of pest infestations in agricultural fields. Traditional pest monitoring methods are often slow and reactive, leading to delayed responses and crop damage.

This research proposed an AI-based pest attack prediction system that uses climate data to forecast pest outbreaks. By analyses environmental parameters using machine learning algorithms, the system can identify patterns associated with pest activity and provide early warnings to farmers.

The integration of artificial intelligence with agricultural data can support smarter decision-making and improve crop protection strategies. In the future, the system can be enhanced by incorporating satellite imagery, Internet of Things (IoT) sensors, and deep learning techniques to further improve prediction accuracy and expand its applicability in precision agriculture.

VII. ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Department of Computer Applications, K.R.T. Arts, B.H. Commerce & A.M. Science College, Nashik, for providing the necessary academic environment and resources required to complete this research work successfully.

The authors are also deeply thankful to the faculty members and mentors of the department for their valuable guidance, continuous support, and constructive suggestions throughout the research process. Their encouragement and insights greatly contributed to the improvement and completion of this study.

Special appreciation is extended to the agricultural and climate data sources that provided the environmental datasets used in this research for pest attack prediction. These datasets played an important role in developing and evaluating the proposed machine learning model.

Finally, the authors would like to thank everyone who directly or indirectly contributed to the successful completion of this research work.

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