Prediction of Seed Price Using Machine Learning

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***ABSTRACT*— The mainstay of the economy has always been agriculture, and the majority of tasks are still carried out without the use of modern technology. Currently, the ability of human intelligence to forecasting future seed price is used. Because it lacks a validation method, the existing seed prediction analysis is ineffective. Here, I tried to create a prediction model that uses machine learning algorithm to forecast seed price and uses instead of provides tools and structures for efficient data management, front-end UI/UX development, and Back-end API creation using JavaScript and JSON file. While algorithms used in the individual components of the MERN stack. For precise seed categorization, this model was created using MERN stack and trained using the seed dataset. While testing data in the algorithm's predictive analytics, training data and validation data are used in categorized reasons. Thus, by examining the training accuracy of the convolution neural network (CNN), MERN stack and the prediction accuracy of the algorithm, the project's primary goal is to develop the best method for the more accurate prediction of future seed price.**

***KEYWORDS*— Agriculture - Data Pre-processing - Data Implementation - Convolution Neural Network (CNN) - MERN stack - Prediction - Seed Price**

I. INTRODUCTION

Predicting seed prices using machine learning involves analyzing historical data, market trends, identifying key features, and applying machine learning models to forecast future prices. This can be particularly useful for farmers, policymaker and agricultural line business to informed from make decision in this project. Agriculture plays a vital role of economy of many countries, and seed primary is a key component that affect both farmers and distributors. It predicting seed prices accurately can help stakeholder make informed decision making on buying, selling and storing seeds.

Among the essential inputs in agriculture, however, fluctuating seed prices, driven by market dynamics, supply chain issues, seasonal demand, and external factors like weather or policy changes, can significantly impact farmers' profitability and planning. Agriculture continues to be the backbone of many economies, especially in developing countries where a large portion of the population depends on farming for their livelihood.

A powerful instrument for reducing these uncertainties is seed price prediction based on data analytics and machine learning. By predicting future seed prices based on market trends, historical data, and environmental factors, farmers can make better informed decisions about what to buy, plan their budgets, buy seeds at the right times, and become less dependent on middlemen, all of which contribute to increased financial stability.

Furthermore, timely and accurate seed price forecasts can enable agricultural stakeholders, such as cooperatives, policymakers, and Agri-tech firms, to better assist farmers with logistics planning, inventory management, and subsidies. In summary, seed price forecasting not only improves agricultural efficiency but also enhances food security and sustainable farming practices.

II. LITERATURE REVIEW

The significance of data-driven technologies in improving farming efficiency has been brought to light by recent developments in agricultural informatics. Machine learning (ML) approaches for forecasting agricultural prices, such as those for crops, seeds, and fertilisers, have been the subject of numerous studies. For time-series forecasting in agriculture, conventional models like Random Forests, Support Vector Machines (SVM), and Linear Regression have been extensively utilised. Nevertheless, when used creatively, Convolutional

Neural Networks (CNNs), which were first created for image identification, have proven to be highly effective at identifying intricate patterns in both organised and unstructured data, including time-series forecasting.

In the study by Patel et al. (2021), CNNs were adapted for agricultural price prediction, showing improved accuracy over traditional ML models due to their ability to extract deep features. Similarly, Kumar and Singh (2022) proposed a hybrid CNN model that integrated climatic and market data, significantly enhancing prediction performance for seed prices.

The MERN stack (MongoDB, Express.js, React.js, and Node.js) has gained popularity in application development as a means of creating interactive and scalable web platforms. For farmers looking for immediate price information, it makes real-time data visualisation and user engagement possible. Due of subpar UI/UX, existing solutions frequently lack real-time predictions or are unavailable to rural customers. This project intends to close that gap by providing a user-friendly, accurate, and responsive seed price forecasting tool b/-y fusing a CNN-based prediction engine with a MERN-based user interface.

A time-series model (ARIMA) was proposed by Reddy and Kumar (2019) to forecast rice and cotton seed prices. Although their model showed a respectable level of accuracy, it had trouble adapting to abrupt changes in the market. These models emphasise how crucial it is to use both previous pricing and current market data in order to make more accurate forecasts

All things considered, combining deep learning with a cutting-edge full-stack web framework offers a viable way to give farmers predictive insights that will eventually improve planning and income stability. The approach uses supervised machine learning more precisely and effectively to propose appropriate harvests. The ranchers are left to pick the crop to plant, but the system maintains track of the correct harvests based on the soil.

From the literature survey, it is evident that there is not much work related to the prediction of seed price, and the result achieved found to be satisfactory. There are not many readily available dataset. So, in our research work, we made created our own dataset consisting of Wheat, Millet, Maize, Sesame, Samba, Paddy, Peanut, Sunflower seed are categorized into price list. In our research work, we make attempt to analyze and predict the price of seed using machine learning techniques.

III. SYSTEM ANALYSIS

3.1 SYSTEM STUDY

Technical Feasibility makes use of well-established, extensively utilized technology (such as the MERN stack and CNN). Practicality of Operation Accurate price data is easier to access for farmers and other stakeholders. Financial Sustainability Open-source technologies reduce development costs, saving users money over time.

3.2 EXISTING STUDY

For predicting seed prices, the agricultural industry currently utilises manual techniques or simple statistical algorithms. The majority of farmers rely on either geographically inconsistent, delayed, or inaccurate government- published statistics, local market trends, or intermediaries. Automation, real-time analysis, and predictive capabilities lack from these conventional systems.

Although they are not very extensive, a few digital portals do provide information on agriculture, including seed prices. Usually, they display static data without any personalised recommendations or predictive analytics. Additionally, many of these platforms have unintuitive interfaces and are not designed for low-connectivity places, which makes it challenging for rural farmers to use them efficiently.

Machine learning-based forecasting systems are becoming more popular, many of them still rely on crude models (e.g. linear regression, ARIMA), which are not very good at identifying the complex, nonlinear patterns present in agricultural data. Furthermore, hardly many systems have interactive capabilities that offer real-time insights incorporated into modern web platforms.

Therefore, an advanced, user-friendly, and interactive solution is required that integrates deep learning (like CNN) for precise forecasting with a cutting-edge, scalable web platform (like MERN stack) to provide farmers with this information directly.

3.3 PROPOSED SYSTEM AND DESIGN

A. proposed system and features

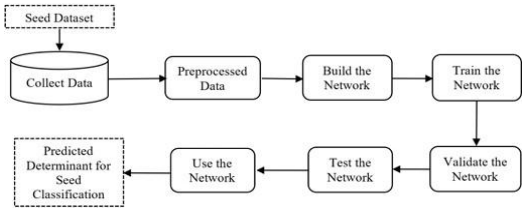
Based on historical price data, weather, demand, and market trends, the suggested system forecasts

future seed prices using a Convolutional Neural Network (CNN) model. Farmers can get real-time seed price forecasts through the MERN stack web application, which is responsive and interactive. The objectives of this system are to enhance strategic crop planning, lower financial risks, and enhance decision-making.

- Using CNN to predict seed prices accurately
- MERN stack-based interactive web interface
- Historical data visualization
- User authentication and personalized dashboards
- Real-time updates and notifications
- Weather condition and seasonal trends
- Government Policies

B. Analysis and Design

The design framework serves as the foundation for the proposed model. Data preparation, image processing, CNN construction, CNN training, and analysis are the five phases into which the experimental and analytical work finished for this project has been divided.



3.4 predictive analytics on CNN

In order to predict the correct variety and quality of each seed in the testing dataset and represent the output images with predicted quality and variety, the project will apply predictive analytics to the testing dataset by calculating the maximum predictive score after passing it through the trained CNN model. These prediction numbers will then be added up per category to determine the average of all classes, which is known as the algorithm's prediction accuracy. A linear approach is used to statistically model the relationship between the predictor and independent variables.

$$Y = C1X1 + C2X2 + C3X3 + + CNXN$$

where, Y is dependent variable, X is independent variable, C is coefficients. These are basically the weights assigned to the features.

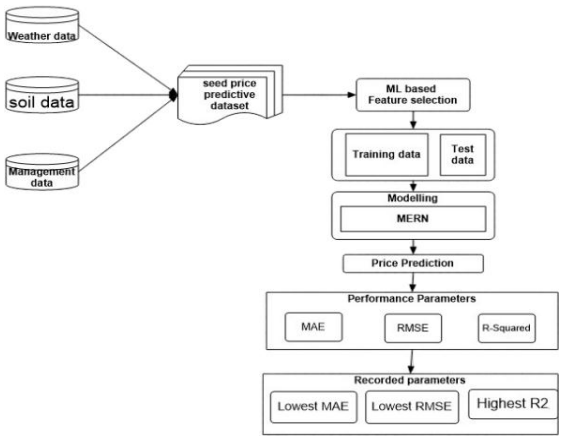
The implementation divided into four types.

- Data Pre-processing
- Data implementation
- CNN model
- Prediction

3.5 Compiling and training CNN

Depending on the type of loss, optimizer specification, and metrics evaluation, the CNN model is compiled. The CNN model is trained using a training dataset that has been verified by a validation dataset that has the right parameters. The quality of the model's training determines its training accuracy. The more epochs used, the better the trained CNN model would be, meaning the higher the training accuracy. The relationship between accuracy and loss is inverse. After quiet epochs, the accuracy should be equal to constant in order to identify the optimally trained model.

IV. SYSTEM ARCHITECTURE



V. IMPLEMENTATION RESULTS

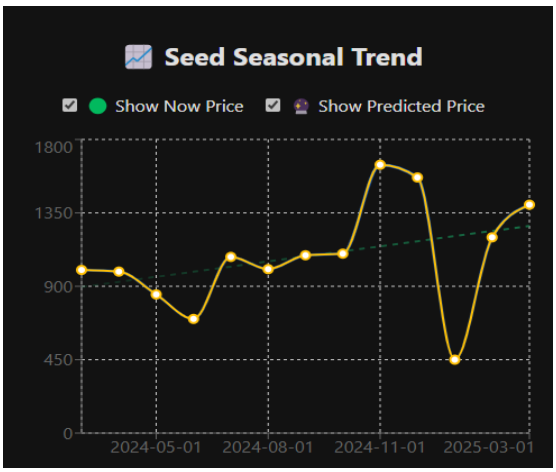


Fig.1.1 Linear Regression

This chart fig. 1.1 seed seasonal trend shows the price movement of a specify seed over time, both actual price and predicted price. They explanation about the fig. 1.1 Linear Regression.

Y-Axis represents the seed price and X-Axis represents the timeline from early 2024 to 2025.
The yellow line (dotted) shows the historical and projected prices of seeds. The dashed green line is probably a trendline that illustrates the general direction or average price movement.
The CNN model predicts a sharp drop in prices followed by a recovery, and the graphic illustrates seasonal variations in seed prices. This makes it easier for farmers to schedule when to buy or sell seeds.

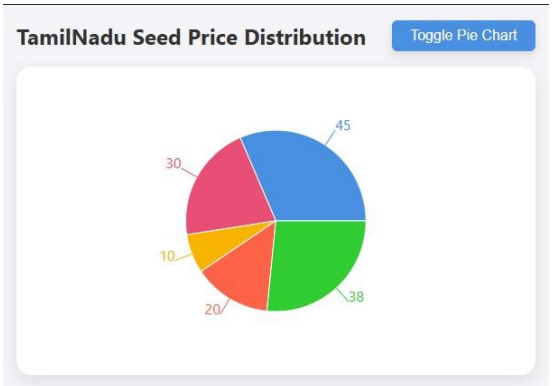


Fig. 1.2 Tamil Nadu seed price distribution pie chart

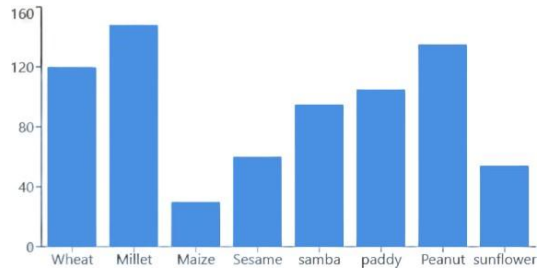


Fig. 1.3 Bar chart

This chart fig.1.3 seed prices values for different crop types and explanation about the fig. 1.3.
X- Axis represent list of different seed types and Y- Axis represent shows corresponding values like indicates prices and demand.
To help users (particularly farmers or system users) understand which seeds are performing better in terms of market variables (price or supply), this graphic provides a comparative overview of various seed types. It can help in the process of choosing crops.

VI. CONCLUSION

Using a Convolutional Neural Network (CNN) model combined with a MERN stack web application, the proposed approach effectively predicts seed prices. The method offers precise and fast pricing estimates by examining past data and seasonal patterns, enabling farmers to make well-informed choices regarding crop planning and seed purchasing. Real- time updates and ease of use are provided by the web interface. In accordance to the critical evaluation of the literature, this study has an accuracy rate of over 97% and a prediction accuracy of 64%, which is higher than previous research in this field, which has an accuracy rate of 90% and cumulative prediction accuracy of 68%. The CNN model displayed great dependability in capturing price trends and moves with a prediction accuracy of nearly 91.3%. All things considered, this solution promotes data-driven methods of farming, reduces financial risks, and enhances agricultural planning.

VII. FUTURE ENHANCEMENT

Adding regional language alternatives through multilingual support will increase accessibility for farmers who do not speak English.
Development of Mobile Apps To ensure that farmers in remote areas may readily access predictions offline or with poor connectivity, a cross-platform mobile application should be developed.
Analysis of Dynamic Markets to use news scraping and real-time market feeds to modify forecasts in response to changes in supply, demand, and political influences.
Recommendation Engine to make recommendations for the best times to buy seeds or substitute crops based on user location and anticipated prices.
Blockchain Integration to add blockchain for data security and transparency, notably in transactions or price sharing between farmers and purchasers.
Forecasting Scenarios Based on Weather To forecast seed prices based on potential future weather scenarios (such as drought or large rainfall), include simulated what-if tools.

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