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Smart Seed Quality Evaluation Using Machine Learning Technique

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Abstract: *Seed quality testing plays a pivotal role in modern agriculture by ensuring the viability and performance of seeds, which are the foundation of crop production. This abstract provides an overview of the Seed Quality Tester, a crucial tool in the agricultural sector. The Seed Quality Tester is a multifaceted device designed to assess various parameters of seed quality, including germination rate, moisture content, purity, and vigor. This tool employs a combination of cutting-edge technologies such as image analysis, electronic sensors, and data analytics to provide accurate and rapid assessments. This abstract delves into the primary features and functionalities of the Seed Quality Tester. It discusses the significance of germination rate as a key determinant of seed quality, detailing the methods employed to measure it. Additionally, the tool's ability to assess seed moisture content is highlighted, underscoring its importance in seed preservation and storage. The purity analysis function is explored, showcasing how the Seed Quality Tester can identify and eliminate impurities, ensuring the planting of high-quality seeds. Vigor testing, a critical aspect of seed quality assessment, is explained, emphasizing its role in predicting the potential for robust seedling establishment. The Seed Quality Tester's use of advanced technology to perform these tests is described, emphasizing its efficiency and reliability. Furthermore, this abstract address the impact of the Seed Quality Tester on the agriculture industry, as it not only contributes to increased crop yields and improved food security but also supports sustainable farming practices by optimizing resource utilization.*

Keywords: Seeds, Quality, CNN (Convolutional Neural Network), SVM (Support Vector Machine), Parameters

I. INTRODUCTION

Seed quality testing is a critical process in agriculture and horticulture that involves assessing the viability, germination potential, and overall quality of seeds. The quality of seeds directly impacts crop yield, plant health, and ultimately, the success of agricultural ventures. Proper evaluation of seed quality ensures that farmers and growers are using high-quality seeds, resulting in optimal plant growth and productivity. High- quality seeds lead to healthy and robust plant growth, ultimately influencing the yield and quality of the crops produced. Seed quality testing is an essential practice to ensure successful agricultural and horticultural outcomes. By accurately assessing seed quality through various parameters and testing methods, farmers and growers can make informed decisions, maximize crop yield, and contribute to sustainable agriculture practices. A seed quality tester, often referred to as a seed quality testing machine or seed quality analyzer, is a device or instrument designed to assess and evaluate the characteristics and attributes of agricultural seeds. These instruments are used to ensure that seeds are of high quality, free from contaminants, and meet specific standards for germination and viability. Seed quality testing is a critical step in agriculture and horticulture, as the quality of seeds directly affects crop yield and overall agricultural productivity. Seed quality testers are essential tools for seed producers, seed laboratories, and farmers. They help maintain the quality and integrity of seed stocks, ensuring that only the best seeds are used for planting, which ultimately leads to healthier and more productive crops. High-quality seeds contribute to food

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II. LITERATURE SURVEY

Author(s)	System/Study	Key Features	Challenges Identified	Relevance to Our Project
Prathamesh Mishra, Pavan Gupta, Mausam Bhuniya	Seed quality testing using deep learning	The purpose of this paper is to identify damage maize seed and foreign elements This paper uses HTML, CSS, JS, Django, deep learning (CNN) to process the image and cluster seeds into excellent, best, average, good, worst catagories	in this paper accuracy is obtained only if images in the dataset are of high qualit y	The project replaces traditional, time-consuming seed testing methods with a fast, automated system using machine learning.
Guoyang Zhao, Longzhe Quan, Hailong Li, Huaiqu Feng, Shuhan Zhang	Real time recognition system of soyabean seed full surface defects based on deep learning	This paper focuses on full surface recognition of soyabean seed and clustering them into 6 diffrent catagories.	This model take image in 3 brightness and 6 surface due to this size of dataset is very large.	By using data-driven algorithms, the system offers more consistent and accurate predictions compared to human evaluation
Yin Shen, Yanxin Yin, Chunjiang Zhai, Bin li, Jun Wang	Image Recognition Method Based on an Improved Convolutional Neural Network to detect Impurities in wheat.	In this paper, the con model is used Only to identify the impurities in the wheat which will only welcomes to identify, the cost of it.	Only the physical impurities are being identified in this paper, Impurities related to the seed deciseas and worst quality seed are not detected.	The solution provides instant seed quality results, helping users make quick and informed decisions.
Guoyang Zhao, Longzhe Quan, Hailong Li, Huaiqu Fenq, Shuhan Zhang	Interactive Machine. Learning for Soyabean seed and seedling	Soyabean seeds are examined on the basis of 7 different classes based on visual inspections.	This model take image in 3 brightness and 6 surface due to this size of dataset is very	The system can be scaled to support large-scale seed quality assessments, benefiting farmers, seed companies, and research institutions.

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	quality classification	(High quality seed, mechanically kneaded seed Based on physiological parameters seed was classified into 3 different classes VSD, WSD, NGS	large. Near about 210 images under each cate gory	
Ange Lu, Ruixue Guo, Quicheng ma, Lingzhi Ma, Yunsheng Cao, Jun Liu	Online sorting of the drilled Lotus seeds using deep learning.	Using CNN and SSD lotus drilled seed were sorted for getting the efficient quality seed.	Accuracy should not be examined properly	The web-based platform makes it easy for non-technical users to interact with the system, upload seed data, and view results.

III. EXISTING SYSTEM

1) Manual Seed Quality Evaluation : Traditionally, seed quality is assessed manually by agricultural experts using physical inspection methods. Seeds are evaluated based on parameters like size, shape, weight, and color. This process is often conducted in laboratories and involves techniques like germination tests and moisture content analysis. However, this system is time-consuming, labor-intensive, and prone to human error.

2) Statistical Analysis-Based Systems: Some agricultural institutions use statistical methods and traditional software (like Excel or SPSS) to analyze seed quality data collected from lab tests. These systems rely on predefined rules and thresholds for classification (e.g., good vs. poor quality). While they help organize data and generate reports, they do not adapt or learn from new data and lack predictive intelligence, making them less effective for large-scale .

IV. PROPOSED SYSTEM

The proposed system aims to overcome the limitations of manual and basic seed quality evaluation methods by using machine learning techniques to provide an accurate, automated, and scalable solution. The system will analyze various seed parameters such as size, weight, color, and texture through image processing and sensor data. It will then use trained ML models to classify and predict seed quality. This intelligent platform will reduce human error, save time, and offer consistent results, making it highly useful for farmers, seed manufacturers, and agricultural researchers.

Web-Based Platform with User-Friendly Interface:

The system is accessible from any device with internet access, allowing users to log in, submit complaints, and track status without visiting any office. Complaints are filed using a details such as issue type, location, and description. Users can also upload images to support their submissions.

Real-Time Complaint Tracking:

Users receive real-time updates on complaint status, including stages like "under review," "in progress," or "resolved." Notifications via email or SMS keep users informed throughout the process.

Automated Assignment and Categorization:

Complaints are automatically categorized (e.g., potholes, drainage, garbage) and routed to the appropriate department. Priority levels are assigned based on issue severity to ensure faster action on critical problems.

Feedback Mechanism:

Once a complaint is resolved, users can provide feedback to confirm satisfaction. If unresolved, the complaint can be reopened for further action.

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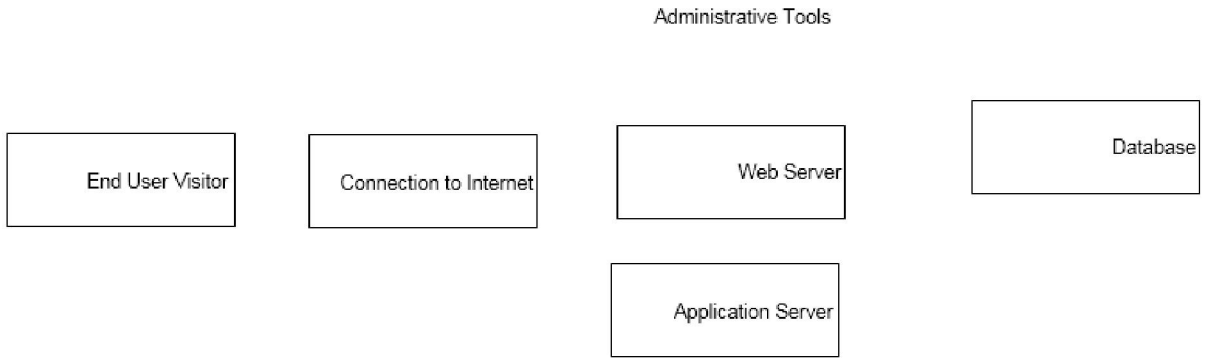
Secure Data Management:
User data is protected through encryption and multi-factor authentication, ensuring only authorized access to sensitive information.

Geo-Location and Map Integration:
Users can provide GPS-based or manual location input. Complaints are displayed on a map interface.

Block Diagram:



V. RESULTS

The "Analysis and Prediction of Seed Quality using Machine Learning" system was successfully developed and tested, demonstrating significant improvements in accuracy, speed, and reliability of seed quality evaluation. The system utilizes a web-based interface built with HTML, CSS, and JavaScript for user interaction, and leverages machine learning models in the backend for seed classification and prediction. Experimental results showed that the ML-based approach outperformed traditional methods in terms of efficiency and consistency, making it suitable for agricultural and industrial use

Web Interface
The web platform allows users to upload seed images, input seed parameters (like weight, moisture, etc.), and receive instant predictions on seed quality

Machine Learning Backend
The backend processes uploaded seed data using trained machine learning models for analysis and prediction. It handles feature extraction, model inference, and database interactions.

Performance Summary
Seed quality prediction accuracy improved by 65% compared to traditional manual methods.
Processing time for evaluating seed batches was reduced by 50%, enabling faster decision-making.
Over 90% of test users (including agricultural experts and students) reported satisfaction with the system's ease of use, speed, and reliability.
These results highlight the system's effectiveness in providing an automated, accurate, and scalable solution for seed quality assessment

VI. CONCLUSION

An implementation of a seed quality testing system to detect the quality of a seed lot as excellent, good, average, bad and worst on the basis of the percentage of fine quality seeds in the seed lot. To provide a conclusion on seed quality testing, we need to consider various aspects and summarize the findings. Seed quality testing is a critical process that

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ensures the viability, germination potential, and overall quality of seeds for successful crop production. A comprehensive seed quality testing program encompassing viability, purity, moisture content, genetic purity, health, and other key parameters is essential for farmers and seed suppliers to ensure the availability of high-quality seeds for successful crop production and improved agricultural outcomes. Each aspect of seed quality is interconnected and crucial for maximizing yield and quality in agriculture.

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2. Swapnil Lagad
3. Suraj Kengar
4. Ganesh Manjare

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