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A Deep Learning-based System for Classification and Quality Evaluation of Seeds

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Abstract— **Farmers and agro-industries must automate seed segregation because it is a time-consuming and labor-intensive task when performed manually. Deep learning (DL) and Machine Learning (ML) based algorithms have exhibited promising results in object recognition, classification, and pattern recognition. Despite this, no research has been conducted on the classification of seed types for crops grown with several crop kinds and varying quality criteria. The objective of this research is to develop a system based on deep learning dubbed the Mixed Cropping Seed Classifier and Quality Tester (MCSCQT). This system will be capable of analyzing the quality of seeds based on their shape, color, and texture. The system is trained with labelled images of healthy and damaged pearl millet and maize seeds, and it has a recall and accuracy of 98.9%. The MCSCQT is an essential piece of equipment in the food sector since it can distinguish between healthy and damaged maize seeds.**

Keywords— Object Detection, Mixed Cropping Seed Classifier and Quality Tester (MCSCQT), Image-Net, Alexa-Net.

I. INTRODUCTION

Maintaining soil fertility while attaining high crop yields and maximizing the use of resources such as manure and water is crucial in agriculture. To attain these objectives and increase food production and economic consequences, farmers utilize crop rotation and mixed cropping [1]. Planting maize and pearl millet together is common practice due to the two crops' shared harvesting season, low fertilizer requirements, and drought resistance. Seed quality and packaging are important for crop quality and output, but the combined yield of both crops is not enough for the food and agro-industries. [2]. The software requirements outline the essential hardware and software frameworks, such as operating systems and programming languages, for maximum application functionality [3]. Compatibility with operating systems is a fundamental necessity, and backward compatibility is often maintained. In addition to hardware requirements and compatibility lists, many programs and operating systems also provide a list of required components [4]. Hardware requirements are a crucial part of the operation of software and operating systems. These requirements explain the physical resources required for the best performance of the application, such as processing power, memory, and storage. In addition, hardware compatibility lists (HCLs) are often published to show which hardware devices have been evaluated and are compatible with a certain operating system or application [5]. Platforms are also a crucial aspect of software and application functioning. Platforms are the software or hardware frameworks that enable the execution of programs [6]. Common platforms consist of operating systems, programming languages, and the runtime libraries associated with them. When designing system requirements for software, operating systems are one of the first considerations. It is normal for multiple versions of the same operating system to be incompatible, although some degree of backward compatibility is often maintained [7].

The hardware and software requirements, hardware compatibility lists, and platforms are crucial determinants of effective application functioning. To guarantee proper installation and functioning of the application, certain prerequisites must be carefully evaluated and addressed [8]. One problem that mixed cropping brings to the food and agro-industrial sectors is the need to separate seeds of different crops and sort seeds based on quality requirements. The deep learning-based MCSCQT can properly recognize and score seeds based on form, color, and texture. Solved. The system had 98.9% recall and accuracy after training on labelled images of healthy and damaged maize and pearl millet seeds [9]. Ultimately, addressing the issues of agricultural sustainability and food production requires careful consideration of a number of aspects, such as resource use, crop selection, and technology innovation. By solving these difficulties with modern technology, such as seed categorization systems based on deep learning, the agriculture sector can continue to satisfy the requirements of customers while preserving soil fertility and environmental sustainability [10].

II. LITERATURE REVIEW

The purpose of this research is to develop a fully automated system for analyzing seeds using pattern recognition, as stated by O. Adjemoutet al [11]. Each of four seed species (corn, oat, barley, and lentil) is represented by 400 samples, and the study zeroes in on the pattern recognition aspects of the competition. The identification method has a low false-positive rate since it relies on form and texture clues separately. As a result of combining shape and texture features, however, recognition rates are significantly raised. The normal technique begins with capturing and preprocessing images, then moves on to feature space reduction using Principal Component Analysis and finally, grouping via the k-means algorithm. The phase of decision-making is determined by the closest Euclidean distance rule between an unknown seed's feature vector and the average feature vector across all clusters.

According to M. Agarwalet al [12] that Magnetic Resonance Imaging (MRI) offers crucial information for the identification of illnesses and disorders; however, low contrast and poor picture quality may impede interpretation and diagnosis. Conventional approaches, such as intensity histogram equalization, may over-enhance, add noise and undesirable artefacts, and fail to maintain brightness and optimize entropy. The authors propose a new model for double threshold weighted limited histogram equalization that uses particle swarm optimization, adaptive gamma correction, and Wiener filtering to fix these problems. The suggested approach intelligently selects a threshold value for image segmentation, keeping all relevant data intact for rapid cancer detection in enhanced MRI scans.

At the ImageNet LSVRC-2010 contest, Krizhevsky et al. [13] said that they were able to divide 1.2 million high-resolution images into 1,000 classes using a deep convolutional neural network. Our model made mistakes 37.5% of the time in the top 1 category and 17.0% of the time in the top 5 category. This is better than the previous state-of-the-art. The neural network consisted of five convolutional layers followed by three fully connected layers. In order to speed up the training process, we employed non-saturating neurons, dropout regularization, and an efficient GPU implementation. At the ILSVRC-2012 competition, our model's 15.3% test error rate put it in the top five, and it beat the runner-up by a large margin.

According to Ali et al [14] presented that six types of maize seeds were classified using machine learning on the basis of digital photos captured in a natural setting. A correlation-based approach for feature selection was used to extract and improve hybrid features. Four classifiers were evaluated, with the Multilayer Perceptron attaining the greatest accuracy (98.93%) for the 150*150pixel ROI size. MLP also obtained great levels of precision for each of the six types of maize seed.

Altuntaset al. [15] used a computer vision technique based on a convolutional neural network to choose haploid maize seeds (CNNs). A dataset of 1230 images of haploid maize seeds and 1770 images of diploid maize seeds was used to compare four convolutional neural network (CNN) models. VGG-19 was the best model. It had an accuracy rate of 94.22%, a sensitivity rate of 94.58%, a specificity rate of 93.97%, a quality index of 94.27%, and an F-score of 93.17%. This method is faster, more efficient, and cheaper than both machine learning-based techniques and classical selection.

III. PROPOSED WORK

The goal of this work is to create the MCSCQT, a system that uses deep learning technology to reliably identify and analyse the quality of seeds based on their texture, shape, and colour. Photographs of both unharmed and damaged pearl millet and maize seeds are included in the training dataset. The system's accuracy and recall both are 99 percent. The system's ability to tell the difference between pearl millet and maize seeds might have major ramifications for the food industry. Furthermore, it is useful in the food business since it can tell the difference between healthy and damaged maize seeds.

A. System Analysis

To deal with the problems that come with mixed cropping, there is a growing need to automate the process of separating and classifying seeds using new methods like deep learning and machine learning. Traditional methods, such as sieving and handpicking, take a lot of work, time, and skill. These methods can't tell the difference between seeds of different crops or separate the bad ones from the good ones. Deep learning and machine learning can be used to automate the classification of seeds, which can speed up, be more accurate, and be easier to repeat. Because of this, automated seed classification at harvest time is becoming more and more important, and it may help farmers and the food industry deal with their problems better.

B. UML

Both a meta-model and a notation form the backbone of Unified Modeling Language (UML). It aims to standardize the vocabulary used to describe models of object-oriented software. Although its major application is in software engineering, UML may also be used for modelling in the realms of business and other non-software systems. UML is a collection of the best engineering practices for representing systems of any size and complexity. Its graphical notations play a significant role in conveying the program design during the development process. Also, UML's capabilities might be expanded in the future by incorporating an additional method or process.

C. Data Flow Diagram

Data flow diagrams (DFDs) illustrate a system's functioning by depicting how data flows through and is transformed by processes. DFD may be used to describe a systemat any degree of abstraction, and it can be segmented into many layers to depict increasing information flow and functional detail. The DFD of the proposed model as shown in Fig. 1

D. Modules

Several modules will be used to accomplish the system's aims. Initially, the data will be loaded into the system using the data exploration module. The processing module will then read the data in preparation for further processing. Using the selected module, the data will be separated into train and test sets. Models such as YOLOV5, RCNN, MobileNet, ResNet18, Alexnet, NasNetlarge, Xception, InceptionV3, and Densenet201 will be created during the creation stage. Furthermore, the user registration and login module will facilitate user registration and login. The user input module will allow users to submit data for prediction, while the prediction module will present the ultimate result that has been forecasted.

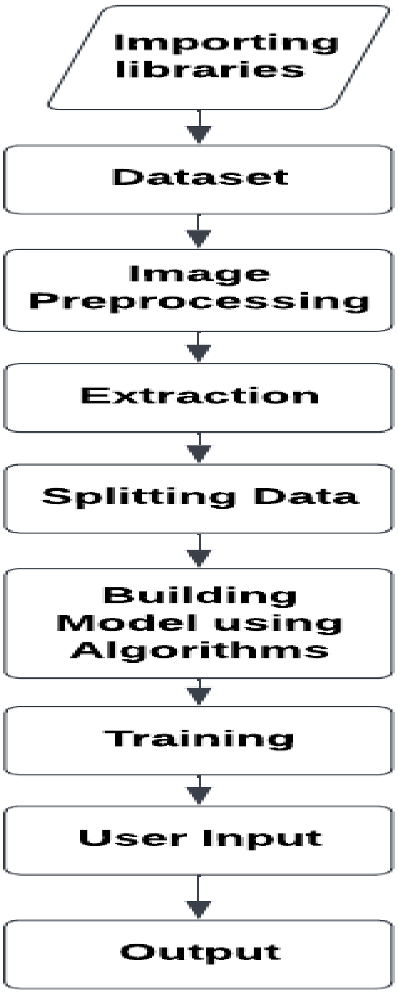

Fig. 1. Data flow diagram of proposed model

E. Algorithm

The following models were utilized for item identification and categorization in this project:

- YOLOV5: This method detects objects in photos using a grid structure and is renowned for its speed and accuracy.
- RCNN: This two-stage detection approach, RCNN, finds areas in an image that may contain an item, and then classifies the object in each region. It has uses for driverless vehicles.
- Mobile-Net: This form of convolutional neural network is developed for mobile and embedded vision applications. It employs depth-wise separable convolutions to construct lightweight neural networks with minimal latency for mobile devices.
- ResNet18: A 18-layer convolutional neural network capable of categorizing photos into 1000 item classes.
- NasNetlarge: A neural network that can sort illa into 1000 different classes, trained on over a million images from the ImageNet database.
- Xception: The network is a 71-layer deep convolutional neural network that was taught to recognize objects in over a million images from the ImageNet database..
- InceptionV3: This is a model for image recognition that has shown great accuracy on the ImageNet dataset.
- Densenet201: This is a 201-layer convolutional neural network capable of classifying photos into 1000 item categories. The project used each of these models for item identification and categorization.

Fig. 2 depicts the working model of the trained model and last it predicts the output and gives the result.

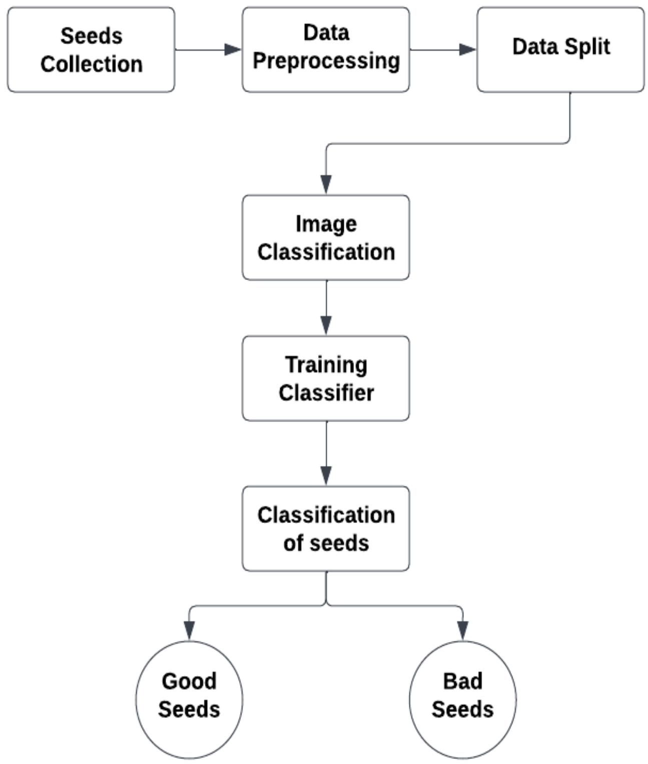

Fig. 2. Working of the proposed model

F. Software Testing

System testing, which is also called system-level testing or system-integration testing, is a detailed look at how the different parts of an application work together. At this stage, the quality assurance team checks whether the program can do the tasks it was made to do. Functional testing is a type of black box testing that analyses how an app really works. For instance, system testing can verify that the expected application outcomes occur for a wide variety of user inputs. The test cases are listed in Table I.

Table. I Testing the test cases

INPUT	**IF PRESENT**
User Sign-up	User get registered into the application
User Sign-in	User get login into application
User input prediction	Predicted result is displayed

IV. RESULTS

By Fig. 3 it is seen that it depicts sign-in page, Fig. 4 displays the image upload web page, Fig. 5 displays the predicted image web page and Fig. 6 shows the predicted output in the web page.

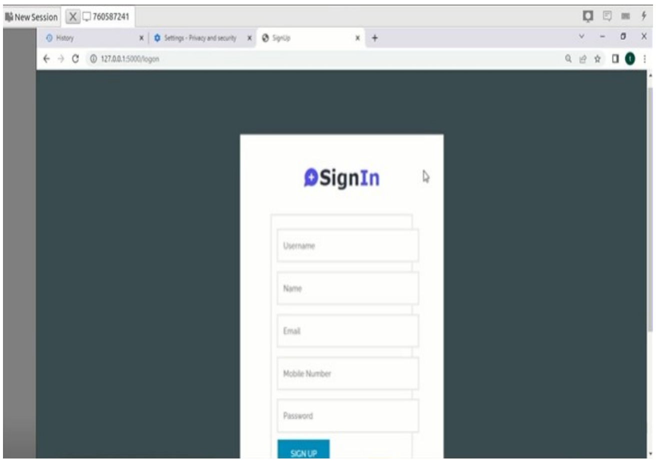

Fig. 3. Sign in page

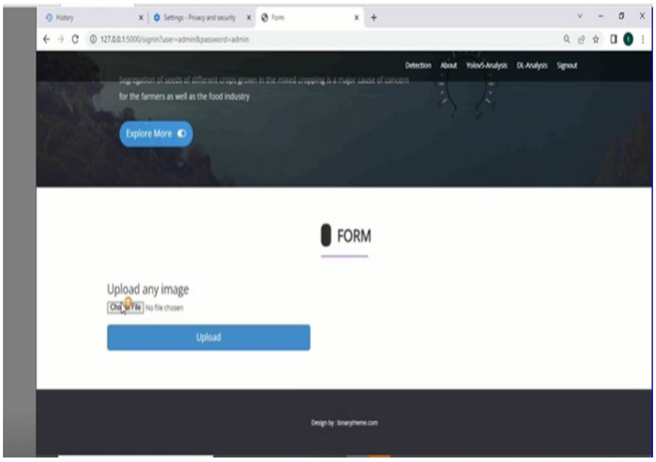

Fig. 4.Image upload option page

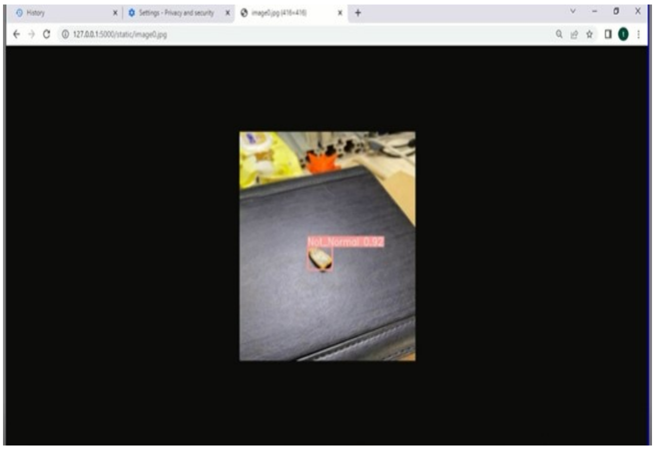

Fig. 5.Image prediction page

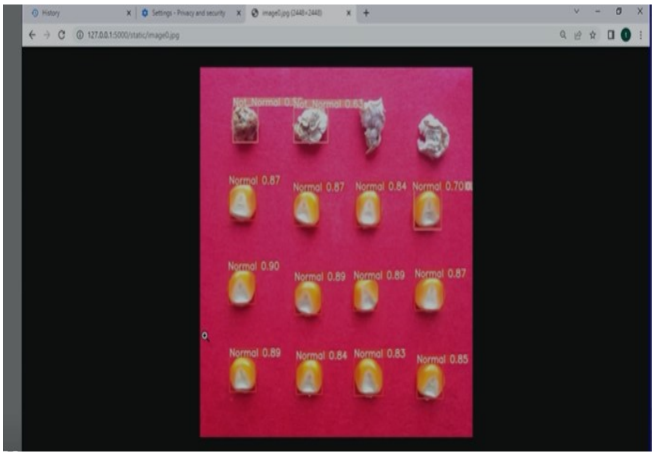

Fig. 6.Predicted output page

Table. II Comparison between proposed and existing method

	Accuracy
Proposed Method	98.9%
Ali aqab et al. [14]	96.93%
Aluntas et al [15]	94.22%

The proposed method has accuracy of 98.9% shown in the Table II and Fig. 7. The proposed method has best accuracy as other existing methods.

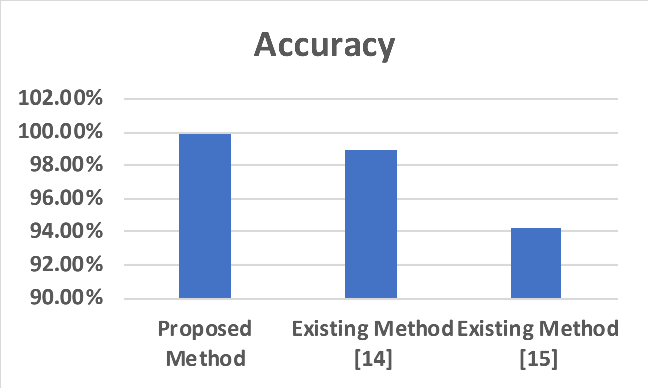

Fig. 7. Accuracy comparison for existing and proposed method

V. CONCLUSION

The proposed system, called "Mixed Cropping Seed Classifier and Quality Tester (MCSCQT)," would use deep learning to make the process of testing and classifying seeds automatic. The YOLO v5 algorithm is used to find objects, and 3,954 images of pearl millet and maize seeds from a real dataset are used to train the system. There are 504 pictures of pearl millet seeds, 144 pictures of maize and pearl millet mixed together, and 1806 pictures of healthy maize seeds in the dataset. Changing images in ways like flipping and rotating can make the size of a dataset bigger. After being taught, the system could sort pearl millet and maize seeds with 99.9% accuracy and recall, and it could tell sick maize seeds from healthy ones. The MCSCQT system reliably classifies mixed crop seeds and automatically packages them based on quality, which might revolutionize food, farming, and seed packing. Because it saves time and labor, it's crucial for agricultural firms' revenues. Seeds from vast harvesting zone stacks may be recognized with improved DL and object recognition algorithms.

REFERENCES

[1] X. Yu, T. W. Kuan, Y. Zhang and T. Yan, "YOLO v5 for SDSB Distant Tiny Object Detection," 2022 10th International Conference on Orange Technology (ICOT), Shanghai, China, 2022, pp. 1-4

[2] L. Ting, Z. Baijun, Z. Yongsheng and Y. Shun, "Ship Detection Algorithm based on Improved YOLO V5," 2021 6th International Conference on Automation, Control and Robotics Engineering (CACRE), Dalian, China, 2021, pp. 483-487.

[3] D. Peng, J. Pan, D. Wang and J. Hu, "Research on Oil Leakage Detection in Power Plant Oil Depot Pipeline Based on Improved YOLO v5," 2022 7th International Conference on Power and Renewable Energy (ICPRE), Shanghai, China, 2022, pp. 683-688.

[4] Y. Xiao, A. Chang, Y. Wang, Y. Huang, J. Yu and L. Huo, "Real-time Object Detection for Substation Security Early-warning with Deep Neural Network based on YOLO-V5," 2022 IEEE IAS Global Conference on Emerging Technologies (GlobConET), Arad, Romania, 2022, pp. 45-50.

[5] Y. Jiang, "COTS recognition and detection based on Improved YOLO v5 model," 2022 7th International Conference on Intelligent Computing and Signal Processing (ICSP), Xi'an, China, 2022, pp. 830-833.

[6] Monika Agarwal, Geeta Rani, and Vijaypal Singh Dhaka. 2020. Optimized contrast enhancement for tumor detection. Int. J. Imaging Syst. Technol. 30, 3 (2020), 687–703. DOI:https://doi.org/10.1002/ima.22408

[7] Khan MF, Khan E, Abbasi ZA. Image contrast enhancement using normalized histogram equalization. Optik Elsevier. 2015; 126:4868-4875

[8] Chen SD, Ramli AR. Contrast enhancement using recursive mean-separate histogram equalization for scalable brightness preservation. IEEE Trans Consumer Electron. 2003;49(4):1310- 1309.

[9] Kim M, Chung GC. Recursively separated and weighted histogram equalization for brightness preservation and contrast enhancement. IEEE Trans Consumer Electron. 2008;54(3):1389- 1397.

[10] Haung S, Cheng F, Chiu Y. Efficient contrast enhancement using adaptive Gama correction with weighting distribution. IEEE Trans Image Process. 2013;22(3):1032-1041.

[11] S. Navaneethan, P. Siva Satya Sreedhar, S. Padmakala and C. Senthilkumar, "The human eye pupil detection system using bat optimized deep learning architecture," Computer Systems Science and Engineering, vol. 46, no.1, pp. 125–135, 2023

[12] Monika Agarwal, Geeta Rani, and Vijaypal Singh Dhaka. 2020. "Optimized contrast enhancement for tumor detection". Int. J. Imaging Syst. Technol. 30, 3 (2020), 687–703.

[13] Krizhevsky, Alex et al. "ImageNet classification with deep convolutional neural networks." *Communications of the ACM* 60 (2012): 84 - 90.

[14] Ali, Aqib et al. "Machine learning approach for the classification of corn seed using hybrid features." *International Journal of Food Properties* 23 (2020): 1110 - 1124.

[15] Altuntas, Yahya et al. "Identification of haploid and diploid maize seeds using convolutional neural networks and a transfer learning approach." *Comput. Electron. Agric.* 163, 2019.