Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 5, No.6, May : 2024

FOOD QUALITY DETECTION USING ML TECHNIQUES

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ABSTRACT

The food quality detection project is designed with the objective of advancing food quality assessment through the utilization of a random forest-based machine learning model. This sophisticated system harnesses the principles of ensemble learning to enhance accuracy in forecasting food quality parameters. By meticulously analyzing a diverse array of features inherent to food products, the model provides invaluable insights into their quality attributes. These insights serve as a cornerstone for making informed decisions in the realms of food safety and quality control, thereby bolstering consumer trust and confidence. Central to the project's methodology is the implementation of Random Forest, a robust ensemble learning technique renowned for its ability to mitigate over fitting and enhance predictive performance. This model functions by constructing a multitude of decision trees during the training phase, each independently analyzing subsets of the dataset's features. Through the amalgamation of these individual predictions, the Random Forest algorithm produces a consensus outcome that is both reliable and resilient to noise. Moreover, the system's capacity to assign ratings to each food item represents a pivotal aspect of its functionality. These ratings serve as quantitative indicators of the overall quality of the food products under scrutiny, facilitating a nuanced understanding of their attributes. Furthermore, the generation of graphical representations based on these ratings elucidates the true or false rates associated with the dataset's food items, offering stakeholders a clear and intuitive means of interpretation. In essence, the food quality detection project not only elevates the standards of quality assessment in the food industry but also fosters a culture of transparency and accountability. By leveraging cutting-edge machine learning techniques and insightful analysis, it equips stakeholders with the tools necessary to uphold the highest standards of food safety and quality, ultimately benefiting both producers and consumers alike.

Key Words: Random Forest, Naive Bayes, Data set.

INTRODUCTION

The essay focuses on Arabica coffee beans, which are prized for their flavor, aroma, and nutritional content. Arabica coffee's bio active ingredients, which include caffeine, lipids, polyphenols, vitamins, and minerals, are well known for their beneficial benefits on human health. By assisting in the neutralization of free radicals, these substances lower the chance of developing chronic illnesses such as liver disease, Alzheimer's, Parkinson's, and cardiovascular disease. Additionally, coffee beans contain antioxidants called chlorogenic acids (CGA), which alter metabolism and glucose absorption to help people lose weight and avoid disease. The food business uses artificial intelligence approaches, particularly deep learning techniques, to forecast food trends, monitor performance, optimize procedures, and evaluate quality. Deep learning techniques such as convolutional neural networks (CNNs) are used to analyses images and recognize patterns, forms, and textures. Research has employed CNNs to assess the quality of green coffee beans during harvest, taking into account flaws such as mildew, fermentation, insect bites, and broken beans. To identify flaws in coffee beans, researchers have created intelligent systems based on deep learning and computer vision, with detection quality scores ranging from 72.4% to 93%. These techniques have demonstrated promise in raising the efficiency of the coffee harvesting and roasting process as

well as in increasing the quality assessment of collected coffee beans. The development of twisted networks capable of classifying Arabica coffee beans according to color attributes is the aim of these investigations. Convolutional models, which are built for machine learning, are examples of contemporary techniques deployed in the Python 3 environment that are flexible and Scalable for use in the food business. Many players in the food business, such as manufacturers, distributors, retailers, and restaurants, are using this cutting-edge technology to cut expenses while offering customers safer, better-quality goods and services. Weed control, soil analysis, irrigation, weather forecasting, crop genetic analysis, food sorting, classification, food spoilage and shelf-life prediction, food fraud detection, hygienic conditions improvement, and supply chain management optimization are a few applications of AI and ML technologies in the food industry.

LITERATURE SURVEY

Review articles about the application of machine learning in the food sector may be found in the body of current literature. Using deep learning, Zhou et al. (2019) reviewed dozens of articles on food recognition, calorie calculation, aquatic product quality detection, fruit and vegetable quality detection, food supply chain, and food contamination. Scholars point out that DL is a potential tool for food quality and safety, noting that it produces better results than manual feature extraction and traditional ML. Jiménez-Carvelo et al. (2019) used a thorough review of 79 research publications that concentrated on the use of machine learning techniques in the fields of food quality and authentication. In both domains, the researchers found that Support Vector Machine (SVM), Classification and Regression Tree (CART), and Random Forest (RF) consistently produced very positive results when compared to traditional techniques. When using ML techniques, these results highlight the efficacy and promise of SVM, CART, and RF algorithms as formidable tools for tackling issues with food quality and authentication. From 1998 to 2018, 123 studies in supply chain management—a crucial component of the food industry—that applied machine learning techniques were examined by Ni et al. (2020). Reputable databases like Science Direct, Wiley, Emerald Insight, IEEE Xplore, Scopus, Springer, and Google Scholar were the sources of the papers. The most popular algorithms were SVM, Logistic Regression, and Neural Networks. Sakinah Shaeeali et al. (2020) carried out an extensive analysis of 53 research projects that used data from social media platforms to apply ML approaches to customer analytics in the food business.

According to their findings, consumers evaluate 28 different business-related factors. The experience, meal quality, service quality, and quality control are the four primary divisions into which the writers divided these 28 criteria. In the framework of evaluating food quality, Saha and Manickavasagan (2021) examined more than 50 studies. They gave a thorough examination of how different machine learning approaches are used to the processing of hyper spectral pictures. The researchers point out that ML approaches allow for the quick and precise analysis of hyper spectral food images, which results in reliable regression and classification models. 39 research that used machine learning and computer vision-based strategies for food security were examined by Sood and Singh (2021). Their aim is to tackle many obstacles such as scarcity of food, deteriorating quality, food waste, loss of product, and limitations caused by restricted natural resources. They note this led to better results from DL than from conventional image processing techniques. They also discovered that, following DL approaches (CNN, Transfer Learning Model, Alex net, and VGG16), SVM is the most used machine learning technique. Bhagya Raj and Dash (2022) looked into the application of machine learning techniques such as artificial neural networks (ANNs) in food engineering. ANNs can forecast outcomes even with incomplete data and map nonlinear relationships without requiring prior knowledge. In the realm of food processing, the authors claim that ANN is a unique technique that excels in processes including extraction, extrusion, drying, filtration, canning, fermentation, baking, dairy processing, and quality assessment. This study deviated from previous research by

giving priority to studies that used various machine learning algorithms in the food business. With a smaller research pool, this method allowed for a more comprehensive algorithmic comparison. The results of the analysis of 93 research are presented in the section that follows.
1. Only articles published between 2005 and 2021—which include the most recent developments in the field—were included in our search parameters. Google Scholar and Scopus are reputable academic databases that are well-known for their comprehensive coverage of scientific literature, and they serve as our main sources. 91 research (67 journal articles, 22 conference papers, and 2 dissertations) comparing multiple machine learning algorithms under different parameters within the given time frame have been collected. The Web of Science and Scopus indices include 72 out of 91 studies. At first, particular keywords were used to search for papers on Google Scholar and Scopus. The keywords we selected are: "machine learning in the food industry," "machine learning in food quality," "machine learning in customer experience," "machine learning in food security/safety," "machine learning in food processing," "machine learning multiple algorithms," along with "machine learning in food classification." After that, research using these keywords in the abstract, title, or between keywords was gathered and assessed. Excluded from consideration were those that only used one machine learning algorithm or concentrated on deep learning. Our attention was instead directed toward the selection and inclusion of studies that used multiple machine learning techniques so that results could be compared. After that, these chosen studies were added to our analysis. Without using any bibliometric software, the data for the study was collected manually and then compiled. To ensure that the selected studies met the selection criteria and that the data gleaned from the publications was accurate, the authors of the articles cross-checked the studies. With MS Excel2016, a graphical representation was produced.

EXISTING SYSTEM

The current prevailing model relies solely on manual inspection, sensory evaluation, and laboratory testing conducted by individual personnel. However, these traditional methods often face challenges in adequately addressing the complexity and non-linearity inherent in food quality data. By transitioning to image-based food quality detection, the proposed system offers a more comprehensive and efficient approach. Leveraging the power of computer vision and machine learning, this innovative solution can analyze intricate visual cues within food images to accurately assess quality attributes. This shift towards automated image analysis not only streamlines the evaluation process but also enhances accuracy and consistency, ultimately revolutionizing the landscape of food quality control.

PROPOSED SYSTEM

The proposed system employs the Random Forest algorithm, renowned for its ability to deliver precise results while simultaneously minimizing code complexity. By leveraging this advanced machine learning technique, the system effectively harnesses the diverse features inherent in food products, transforming them into a comprehensive data set for analysis. Through rigorous training of the algorithm, the system is primed to generate accurate and reliable results. This project operates primarily through datasets comprising various food items, allowing for systematic analysis and evaluation of their quality attributes.

CONCLUSION

Our study's conclusions show that there was a noticeable growth in ML use after 2008, 2012, and 2016. These results are consistent with those of Sakinah Shaeeali et al. (2020) and Ni et al. (2020). However, a reduction after 2016 is shown in the study by Sood & Singh (2021), which covers 39 publications and focuses on the topic of food security. The fact that their research included fewer

trials could be the cause of this discrepancy in outcomes. Our research indicates that SVM and Random Forest algorithms ought to be the first options that scientists consider when solving issues related to the food business. Algorithms for machine learning are suitable for complex datasets with numerous attributes and robust in high-dimensional spaces. Its kernel method works effectively with nonlinear data in the food business. Performing well in precise classifications is essential for food applications that prioritize accuracy. Large datasets and over fitting are also well handled by it , making it perfect for quality analysis and agriculture.

REFERENCES

1. Bhagya Raj, G. V. S., & Dash, K. K. (2022). Comprehensive study on applications of artificial neural network in food process modeling. Critical Reviews in Food Science and Nutrition, 62(10), 2756–2783. https://doi.org/10.1080/10408398.2020.1858398
2. Boehmke, B., & Green well, B. (2020). Hands-On Machine Learning with R. CRC Press - Taylor & Francis Group.
3. Cas Proffitt. (2017). Top 10 Artificial Intelligence Companies Disrupting The Food Industry. Disruptor Daily. https://www.disruptordaily.com/top-10-artificial-intelligence-disrupting- food-industry/
4. Castro, W., Oblitas, J., De-La-Torre, M., Cotrina, C., Bazan, K., & Avila-George, H. (2019). Classification of Cape Gooseberry Fruit According to its Level of Ripeness Using Machine Learning Techniques and Different Color Spaces. IEEE Access, 7, 27389–27400. https://doi.org/10.1109/ACCESS.2019.2898223
5. Cho, B.-H., Koyama, K., Olivares Díaz, E., & Koseki, S. (2020). Determination of "Hass" Avocado Ripeness During Storage Based on Smartphone Image and Machine Learning Model. Food and Bioprocess Technology, 13(9), 1579–1587. https://doi.org/10.1007/s11947- 020-02494-x
6. Cui, H., Huang, D., Fang, Y., Liu, L., & Huang, C. (2018). Webshell Detection Based on Random Forest– Gradient Boosting Decision Tree Algorithm. 2018 IEEE Third International Conference on Data Science in Cyberspace (DSC), 153–160. https://doi.org/10.1109/DSC.2018.00030
7. De-la-Torre, M., Zatarain, O., Avila-George, H., Muñoz, M., Oblitas, J., Lozada, R., Mejía, J., & Castro,
8. W. (2019). Multivariate Analysis and Machine Learning for Ripeness Classification of Cape Gooseberry Fruits. Processes, 7(12), 928. https://doi.org/10.3390/pr7120928
9. Erban, A., Fehrle, I., Martinez-Seidel, F., Brigante, F., Más, A. L., Baroni, V., Wunderlin, D., & Kopka, J. (2019). Discovery of food identity markers by metabolomics and machine learning technology. Scientific Reports, 9(1), 9697. https://doi.org/10.1038/s41598-019-46113-y
10. Insights, S. (2022, January 31). 5 Top AI Startups impacting the Food Industry. StartUs Insights. https://www.startus-insights.com/innovators-guide/ai-startups-impacting-the-food-industry/
11. Jiménez-Carvelo, A. M., González-Casado, A., Bagur-González, M. G., & Cuadros-Rodríguez, L. (2019). Alternative data mining/machine learning methods for the analytical evaluation of food quality and authenticity – A review. Food Research International, 122, 25–39. https://doi.org/10.1016/j.foodres.2019.03.063
12. Kovalenko, O. (2021, July 23). Machine Learning and AI in the Food Industry. SPD Group. https://spd.group/machine-learning/machine-learning-and-ai-in-food-industry/
13. Kwasek, M. (2012). Threats to Food Security and Common Agricultural Policy. Economics of Agriculture, 59(4), 701–713.

14. Lantz, B. (2015). Machine learning with R: Discover how to build machine learning algorithms, prepare data, and dig deep into data prediction techniques with R (Second edition). Packet Publishing.
15. Lewis, N. D. (2017). Machine learning made easy with R: An intuitive step by step blueprint for beginners. AusCov.
16. Li, H., Lee, W. S., & Wang, K. (2014). Identifying blueberry fruit of different growth stages using natural outdoor color images. Computers and Electronics in Agriculture, 106, 91–101. https://doi.org/10.1016/j.compag.2014.05.015
17. Martinho, V. J. P. D., Cunha, C. A. D. S., Pato, M. L., Costa, P. J. L., Sánchez-Carreira, M. C., Georgantzís, N., Rodrigues, R. N., & Coronado, F. (2022). Machine Learning and Food Security: Insights for Agricultural Spatial Planning in the Context of Agriculture 4.0. Applied Sciences, 12(22), 11828. https://doi.org/10.3390/app122211828