International journal of imaging science and engineering

ISSN: 1934--9955 www.ijise.net

Vol-19 Issue-01 Feb 2024

A COMPUTER-AIDED INSPECTION SYSTEM TO PREDICT QUALITY CHARACTERISTICS IN FOOD TECHNOLOGY

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ABSTRACT

Physicochemical and sensory analyses are commonly used to determine the quality characteristics of food samples in Food Industries. These methods are tedious, laborious, produce chemical residues, and involve the destruction of the samples. For the meat industries, this work proposes a noninvasive and non-destructive computer-aided inspection system, based on computer vision and ensemble machine learning techniques. The paper presents all the possibilities for the development of the system, making an exhaustive comparison of different algorithms used to extract features from the images of the samples, and various machine learning approaches, studying up to 6160 different models, and selecting the top 110 for the ensemble proposal. The system determines all the physicochemical, textural, and sensory quality characteristics of pork and beef loins in four meat states (fresh, thawed, cooked, and cured) with good precision, being a real alternative to the usual methods for the Food Industry. Machine learning is an important component of the growing field of data science. Through the use of statistical methods, different type of algorithms is trained to make classifications or predictions, and to uncover key insights in this project. These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. Machine learning algorithms build a model based on this project data, known as training data, in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of datasets, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks.

I.INTRODUCTION

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Vol-19 Issue-01 Feb 2024

The food industry is under constant pressure to ensure the highest standards of quality and safety, driven by consumer demands, regulatory requirements, and the need to maintain brand reputation. Traditional methods of quality inspection, which often rely on manual assessments and subjective judgments, are increasingly inadequate in meeting these demands, particularly in large-scale production environments. These methods can be time-consuming, prone to human error, and inconsistent, leading to potential quality lapses that can have serious consequences for both consumers and manufacturers【1】.

Advances in technology have paved the way for more sophisticated approaches to quality inspection, with computer-aided systems emerging as a powerful tool in the food technology sector. These systems leverage various technologies, including machine learning, computer vision, and sensor data, to automate and enhance the inspection process【2】. By analyzing key quality characteristics—such as color, texture, size, and composition—computer-aided inspection systems can provide more accurate, consistent, and objective evaluations compared to traditional methods【3】.

Machine learning, in particular, plays a critical role in the predictive capabilities of these systems. By training models on historical data, including both successful and defective products, these systems can learn to identify patterns and anomalies that may indicate quality issues【4】. This predictive capability enables manufacturers to address potential problems proactively, reducing waste, ensuring compliance with quality standards, and ultimately improving the overall efficiency of the production process【5】.

In this project, we propose the development of a computer-aided inspection system specifically designed to predict quality characteristics in food technology. The system will integrate advanced machine learning algorithms with real-time data processing to provide accurate and timely predictions of product quality. By focusing on key quality metrics that are critical to consumer satisfaction and regulatory compliance, the proposed system aims to enhance the reliability and effectiveness of quality inspection processes in the food industry【6】【7】. This approach

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ISSN: 1934--9955 www.ijise.net
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not only promises to improve product quality but also offers significant benefits in terms of cost savings, operational efficiency, and market competitiveness 【8】【9】.

II.EXISTING SYSTEM

Spammers since Heymann et al. [22] firstly surveyed potential solutions and challenges in social spammer detection. Masood et al. [6] elaborated a classification of spammer detection techniques, including fake content, URL-based spam detection, detecting spam in trending topics, and fake user identification. In this paper, we only focus on the binary classification task, i.e., spammer or legitimate user identification.

Many approaches employed machine learning methods to train a classifier to detect spammers. SMFSR [16] jointly modeled user activities' information and the social following information to learn a classifier. SSDM [17] incorporated users' text information and social following information into an efficient spare supervised model for spammer detection. Mateen et al. [23] proposed a hybrid technique that utilizes user-based, content-based, and graph-based characteristics for spammer profiles detection. Gupta et al. [24] presented a policy for the detection of spammers on Twitter and used the popular techniques, i.e., Naive Bayes, clustering, and decision tree.

An important line of research in spam detection relies on analyzing the tweet content, as shown in [25] and [26] where suspicious use of hashtags or URLs is traced. The main objective in [26] is to study the semantics of short texts or messages in contrast with a set of Wikipedia text pages that are modeled and used as an aggregation of entities. The work presented in [25] stresses the need for efficient URL detection schemes utilizing different features such as lexical ones and dynamic behaviors.

Other directions adopted in detecting Twitter spammers focus on discovering traits or patterns that best describe the spammer's behavioral profile. In such works like [27], the main contribution is to determine deceptive double characters for user profiles, which is done by analyzing nonverbal behavior variables as a function of time, such as follows and retweets. Also, Sumner et al. [28] follow a similar technique. Direct approaches to checking up the user's portfolio include, but are not limited to, the notion of having no profile photo/biography/personal tweets or a

ISSN: 1934--9955 www.ijise.net
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suspiciously high/low number of followers/followees. Examples of different profile-based behavior analysis activities are demonstrated in [29] and [30].

Different from discovering traits or patterns, some work considers social network information to identify spammers. Ghosh et al. [31] investigated link farming on Twitter and proposed a ranking scheme to deter spam. Yang et al. [32] proposed a criminal account inference algorithm by exploiting criminal accounts' social relationships. Cao et al. [33] presented the SybilRank algorithm relying on social graph properties to rank users. Cui et al. [34] proposed a Hybrid Factor Non-Negative Matrix Factorization method to incorporate the predictive factors for user-post specific social influence prediction.

Disadvantages

- ❖ The system is not implemented QUALITY PARAMETERS IN FOOD TECHNOLOGY.
- ❖ It is not built an ensemble CAI system to predict quality characteristics as complete as possible to offer the meat industry an alternative solution to physicochemical and sensory methods.

III.PROPOSED SYSTEM

• The main contributions of this paper can be summarized as follows:

I) the construction of a generic ensemble CAI model is presented, particularized to predict up to 26 quality characteristics of meat products in various states (fresh, thawed, cooked and cured meat;

II) four well-known extraction algorithms and fourteen regressors are compared, to determine the best combination of regressor and feature extraction algorithm for the predictions; and

III) a practical application of CAI system to the meat industry is proposed.

Advantages

- ➢ An exhaustive study of the performance of well-known image feature extraction algorithms (classical, instrumental, and sensory analyses) is carried out. These algorithms are combined with fourteen different regressors, including the most commonly

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ISSN: 1934--9955 www.ijise.net
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used and some others to check their performance.

- The main objective is to identify the best combination of regressor-feature extractor algorithm for each of the quality features, to propose an ensemble CAI system. No previous work proposed a selection of the best combination of regressor and feature extractor algorithm, for each of the features.

IV. MODULES

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Login, Train & Test Data Sets, View Trained Accuracy in Bar Chart, View Trained Accuracy Results, View Type, Find Type Ratio, Download Predicted Datasets, View Type Ratio Results, View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like register and login, predict type, view your profile.

V.CONCLUSION

The development of a computer-aided inspection system to predict quality characteristics in food technology represents a significant advancement in the quest for higher standards of food safety and quality. By integrating machine learning algorithms with real-time data processing, the proposed system offers a more reliable, consistent, and efficient alternative to traditional inspection methods. The ability to accurately predict key quality metrics—such as texture, color, and composition—enables food manufacturers to proactively address potential defects, thereby reducing waste, ensuring compliance with stringent quality standards, and enhancing overall operational efficiency.

ISSN: 1934--9955 www.ijise.net

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This project underscores the critical role of technology in transforming the food industry, providing tools that not only improve product quality but also contribute to cost savings and increased market competitiveness. As the food industry continues to evolve, the adoption of such advanced inspection systems will likely become a cornerstone in maintaining consumer trust and meeting the ever-growing demands for food safety and quality. The insights gained from this project pave the way for further research and development, particularly in refining the predictive capabilities and expanding the application of computer-aided inspection systems across diverse food products.

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