

## I. INTRODUCTION

In this contemporary era of rapid technological development, social media has become an indispensable component of the everyday life of individuals worldwide. Social media has facilitated more accessible access to various forms of content, one related to gastronomy or culinary arts. The study of culinary arts will continue to be relevant in our modern society due to its intrinsic link with the basic biological needs of humans. The act of uploading photos and reviews of food and beverages consumed by social media users, as well as the indirect inspiration of their audience to try these culinary delights, exemplifies the profound impact of social media on the culinary arts. One of the social media platforms that has been utilized in this regard is X, which was previously known as Twitter.

X is an online social networking platform launched in July 2006 [1]. This social media post is made by tweeting and can contain up to 140 characters [2]. X users generate more than 300 million tweets every day. The impact of this is the possible difficulty of users in receiving and processing the amount of information available and the number of people they can interact with [1]. In the context of culinary-related topics, the impact can also lead to the difficulty of users finding culinary recommendations that suit their preferences and tastes from the many information intensities that exist. Based on these problems, a recommendation system is needed to help users find culinary items that fit their preferences.

A recommendation system is a system that analyses user behavior or opinions as input, which is then processed to provide tailored recommendations directly to the user [3]. Recommendation systems have been used in various works of literature. Due to the basic working principles of recommendation systems that depend on data, some previous studies have utilized data from platform X to improve the performance of recommendation systems [4]. One widely used method in recommendation systems is content-based filtering (CBF). CBF algorithms provide recommendations to users based on item descriptions and users' personal preferences. In addition, CBF algorithms use profile information or ratings only for active users, thus allowing them to generate accurate recommendations even if the number of ratings provided by other users is limited [5].

In the study of Ortakci, O.U.Y. and Albayati, A.N.K. [4], machine learning-based NLP techniques are blended with CBF. The accuracy value of the developed recommendation system is 0.8624, or 86.24%. These findings demonstrate the possibility of developing recommendation outcomes from the system created by attempting to use deep learning-based techniques, which are actually more capable than machine learning.

CBF has been combined with several deep learning-based classification methods, including deep convolutional neural networks (CNN) [6]. CNN models can classify text and achieve better prediction accuracy using less computational power [7]. The architecture of deep CNN [8] itself consists of a series of layers, including convolutional, pooling, and fully connected layers. Each layer extracts unique features, which undergo sub-sampling before being classified [9].

Besides being combined with classification methods, some studies also add optimization methods for better accuracy results. One example is the particle swarm optimization (PSO) method [10], [11]. PSO is an optimization method that mimics the behavior of a swarm or group of particles to find the best solution in a search space [12]. The addition of this optimization method succeeded in providing a higher fitness value than the comparative recommendation results [11]. Combining this method with classification algorithms, such as K-Means, has also resulted in better accuracy [10].

This research is based on various references from previous studies on recommendation systems. In the research by Suvarna, B. and Balakrishna, S. [6], deep CNN was used for a product recommendation, and its performance was evaluated using a fashion product dataset. The proposed model has results that outperform existing models using deep neural networks in terms of accuracy and precision values. The accuracy value generated from this model is 89.02%. However, this research has not applied the optimization method.

Another study by F. E. Fernandes Junior and G. G. Yen [13] focused on using the PSO algorithm to find an efficient deep CNN architecture in image classification. Although this study used a small dataset, the results successfully showed that PSO-CNN is a solution that can find an optimized CNN architecture. The models found by PSO-CNN successfully outperformed state-of-the-art models in six out of the nine datasets used. PSO-CNN was able to find models with significantly fewer parameters compared to other models.

This research proposes a recommendation system model that is more fully developed using CBF and deep CNN classification and optimized using the PSO method to obtain a better performance value in rating prediction. To the best of my knowledge, no research has used a combination of methods similar to the one that will be used in this research. In the process, feature extraction and word embedding are also utilized to improve the results.