IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.12450

FOOD IMAGE RECOGNITION FOR INVENTORY TALLY: A SURVEY

Bhrungeesh C[1], Chiranth M[2], Deepak N[3], Fardeen Ahmed Mansur[4]

B.E Student, CSE, Vidyavardhaka College of Engineering, Mysore, India[1-4]

Abstract: Food image recognition for inventory tally is a technology that allows for the automated identification and quantification of food items in a given inventory using image recognition algorithms. By analyzing images of food items and comparing them to a database of known food items, the system is able to accurately identify and count the number of each type of food present in the inventory. This technology has the potential to greatly improve the efficiency and accuracy of inventory management in food-related industries, such as restaurants, supermarkets, and food distribution centers. It can also potentially be used to help with food waste reduction efforts by allowing for more accurate tracking of expiration dates and helping to ensure that all food items are used before they go bad.

Keywords: CNN, Object Detection, Food Detection, Inventory Tally, Deep Learning.

I. INTRODUCTION

One of the major tasks in the field of computer vision is object detection and identification in images, which can contain a variety of different objects. While humans are able to easily perform this task due to the natural development of our visual system, it is more challenging for machines to do so, as we do not fully understand how the human visual system works. In a computer, an image is represented as a group of pixels or vectors in a designated space. It can be difficult for machines to understand that small changes in these pixels can alter the appearance of the image. Developing the ability for machines to perform simple tasks like object detection and identification requires significant creativity, skill in calculus, and ingenuity. One rapidly growing application of this technology is in the detection of food. Object detection is a task in computer vision that involves identifying the presence, location, and type of objects in an image or video. It is a key technology in many applications, such as self-driving cars, security systems, and robotics.

Food is the most essential intake of humans. Even though it is shown to provide necessary nutrients or supplements to the body. Food is an important element in human life. It is imbibed in a once-natural life cycle. That's the reason it gives a way to research more on food image recognition.

Food image recognition is a technology that allows computers to identify and classify different types of food in images and videos. This technology has a wide range of applications, including inventory tally in the food industry. In inventory tally, food image recognition can be used to quickly and accurately count the number of individual food items in a storage facility or warehouse. This can be done by training a machine learning model to recognize different types of food and then using this model to analyze images of the food items in the warehouse. One of the main benefits of using food image recognition for inventory tally is that it can significantly reduce the time and effort required to manually count and track food inventory. It can also improve accuracy, as it eliminates the risk of human error in counting and recording the inventory. Overall, food image recognition is a valuable tool for the food industry, as it can help streamline inventory management and improve efficiency in a range of tasks, including inventory tally.

II. EXISTING SYSTEM

There are several existing systems that can be used for inventory tally. These include,

Manual tally: This is the most basic method, where inventory is counted and recorded by hand.
Barcode scanners: These devices can scan barcodes on products and automatically add them to the inventory count.

RFID (radio-frequency identification) systems: These use radio waves to automatically identify and track inventory items.

Inventory management software: This type of software allows users to input and track inventory levels, set reorder alerts, and generate reports.

Mobile apps: There are also various mobile apps available that can be used for inventory management, including those specifically designed for food inventory tracking.

III.LITERATURE REVIEW

[1] In this paper, The aim of this study was to develop Korean food image detection and recognition model for use in mobile devices for accurate estimation of dietary intake. The author uses Deep Convolutional Neural Network (DCNN) for the complex recognition model and compared the results with those of other networks: AlexNet, GoogLeNet, Very Deep Convolutional Neural Networks, VGG, and ResNet, for large-scale image recognition. The results showed that K-foodNet achieved better performance in detecting and recognizing Korean food compared to other state-of-the-art models.

[2] In this paper, the author is attempting to solve the issue of unfair and inconsistent food prices being charged for economy rice or mixed rice that is widely seen in the café of hawker stalls in Malaysia. Hence, the authors decided to propose this project by utilizing a convolutional neural network (CNN) algorithm and developing a web application to ease the vendor as well as to provide transparency to the buyer on the food price being charged. The food price will be stored in a database of the web application in order to calculate the food price with the recognized food in the machine learning model. The outcome of this project is a customized web application for Village 3 Café, UTP with a trained CNN classification model at the backend.

[3] In this paper, the author has attempted to compare the different food recognition algorithms and identify the best-suited algorithm under a particular circumstance. Deep learning is considered one of the state-of-the-art approaches in the field of food image recognition. It is an active and wider approach in the research area. In deep learning for food image detection, CNN is considered one of the most important methods for acquiring accurate results. However, the time, the limitations of CNN were developed in R-CNN and furthermore developed in Fast RCNN and in Faster R-CNN to overcome the former's limitations. Even YOLO is also one of the quick approaches used in the recent research area for food image recognition. Taking this technique to even furthermore, it has been quite successful in applying these techniques to modern areas of application such as nutritional facts of food from food images, food calorie estimation of food intake, Diet intake, etc.

[4] Traditional manual pricing is prone to errors, the speed of closing is reduced, and other problems. For customers with special needs, such as diabetes patients, obese patients, and dietary taboo needs, the food in public canteens can't fully meet their needs, which may affect their health without awareness of customers. In this paper, an intelligent billing system based on Cascade R-CNN algorithm and computer vision technology is proposed. Using the mobile device to collect food images, using the depth neural network to identify the food in the image, and finally return the price calculation results of each food to the user.

[5] This paper focus on self-service restaurants, food recognition algorithms could enable both the monitoring of food consumption and the automatic billing of the meal grabbed by the customer. The latter is quite relevant because removes the need for a manual selection of the chosen dishes, allowing to speed up the service offered by these restaurants. Internet users are becoming huge nowadays; in concern with time-saving and manual billing features to be avoided, we propose an automatic billing alert system with the globalization of restaurant menus.
The proposed design uses an Android application to enable the user to select the menu which is globalized in the IoT screen or android database. The selected image of the food recipe is processed using image processing. The image processing is done using MATLAB. Whereas the food recognition is done using Deep Neural Network and bill estimation is transferred to an android application based display screen in which a pop-up message can bring out the payable amount.

[6] This article focus on the self-service restaurant environment, automatic food analysis is not only useful for extracting nutritional information from foods selected by customers, it is also of high interest to speed up the service solving the bottleneck produced at the cashiers in times of high demand. In this paper, we address the problem of automatic food tray analysis in canteens and restaurants environment, which consists in predicting multiple foods placed on a tray image. We propose a new approach for food analysis based on convolutional neural networks, which we name Semantic Food Detection, which integrates the same framework for food localization, recognition, and segmentation. We demonstrate that our method improves the state-of-the-art food detection by a considerable margin on the public dataset UNIMIB2016 achieving about 90% in terms of F-measure, and thus provides a significant technological advance towards automatic billing in restaurant environments.

[7] AI is used for applications such as sorting perishables, supply chain management, monitoring compliance with food safety standards, effective on-site cleaning, predicting consumer preferences, and developing new products. They have

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁘ Impact Factor 8.102 ⁘ Vol. 12, Issue 4, April 2023
DOI: 10.17148/IJARCCE.2023.12450

been successful in increasing efficiency and saving time and resources. However, there are challenges in adopting AI technology, including cost, cultural change, expertise requirements, transparency issues, and one-track thinking. Despite these challenges, research continues into optimized production processes using AI, but it is important to note that the benefits of AI applications in the food industry far outweigh the challenges.

[8] This article presents a comprehensive overview of research on segmentation methods used for food computing. A related survey of 66 research papers were conducted to provide a variety of food image segmentation techniques. Comparative studies between these methods are also conducted based on various parameters such as algorithm type, segmentation method, data set, and accuracy. Furthermore, this paper focuses on food detection research questions. The paper also proposed a framework to overcome the problems of watersheds and his OTSU algorithm.

[9] In this paper, the author has applied Convolutional Neural Network (CNN) to food image recognition and recognition tasks. Food image recognition is generally very difficult due to a large number of food types. However, deep learning has recently proven to be a very powerful image recognition technique, and CNN is his approach to deep learning at the cutting edge. They have applied CNN to the task of food detection and detection by parameter optimization. They have created a data set of the most common foods in publicly available food tracking systems and used it to evaluate detection performance. CNN showed significantly higher accuracy than traditional support vector machine-based methods with hand-crafted features. Additionally, They found that the convolution kernels show that color dominates the feature extraction process. For food image recognition, CNN also showed significantly higher accuracy than traditional methods.

[10] In this paper, they have tried to classify food images using convolutional neural network (CNN). Convolutional neural network extracts spatial features from images so it is very efficient to use convolutional neural network for image classification problem. Recently people are sharing food images in social media and writing review on food. So there is a lot of food image in social media but some image may not be labeled. It will be very helpful for restaurants if they can advertise their food to those people who is looking similar kind of foods they offer. Food classification system can help social media platform to identify food. Food classification system can enable an opportunity for social media platform to offer advertisement service for restaurants and beverage companies to their targeted users. It will be financially beneficial for both social media platform and beverage companies. Food classification is very difficult task because there is high variance in same category of food images. They have developed a convolutional neural network model to classify food images in food-11 dataset. They have also used a pre-trained Inception V3 convolutional neural network model to classify food images.

[11] Here, food image recognition tasks are evaluated against fixed datasets. However, in real-world conditions, there are cases in which the number of samples in each class continues to increase and samples from novel classes appear. In particular, dynamic datasets in which each individual user creates samples and continues the updating process often has content that varies considerably between different users, and the number of samples per person is very limited. A single classifier common to all users cannot handle such dynamic data. Bridging the gap between the laboratory environment and the real world has not yet been accomplished on a large scale.
Personalizing a classifier incrementally for each user is a promising way to do this. In this paper, they address the personalization problem, which involves adapting to the user's domain incrementally using a very limited number of samples. They propose a simple yet effective personalization framework, which is a combination of the nearest lass mean classifier and the 1-nearest neighbor classifier based on deep features. To conduct realistic experiments, they made use of a new dataset of daily food images collected by a food-logging application. Experimental results show that their proposed method significantly outperforms existing methods.

[12] The purpose of this paper is to develop an automatic camera phone-based multi-view food classifier as part of a food intake assessment system. Food intake assessment is important for obesity management, which has shown significant impacts in public healthcare. Conventional dietary record-based food intake assessment methods exhibit insufficient popularity due to their low accuracy and high dependence on human interactions. Image-based food recognition appears recently. But it is still under development and far away from field applications. This paper presents DietCam, a camera phone-based application to evaluate food intakes automatically from multiple perspectives. Food recognition from images is afflicted currently with a low recognition accuracy caused by the uncertainties of food appearances. The deformable nature of food items together with the complex background environment makes the problem even harder. DietCam separates every food item by evaluating the best perspective and recognizing each of them from multiple images with a probabilistic method. The recognition accuracy is increased through an enhanced joint distribution from every viewpoint. A prototype of DietCam has been implemented on iPhone. In the field experiments, it shows an accuracy of 84% for regular shape food items.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁙ Impact Factor 8.102 ⁙ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.12450

IV. Overview of different Methods

4.1. Data Augmentation

Different techniques such as cropping, padding, and flipping are used to train large neural networks in a strategy called data augmentation. It helps to increase the range of data without actually collecting new data.

4.2 Scale-invariant Feature Transform (SIFT)

Scale Invariant Feature Transform (SIFT): It is a technique for detecting salient, stable feature points in an image. for each such point, it also provides a group of "features" that "characterize/describe" a little image region around the point. These features are invariant to scale and rotate.

4.3 Speeded Up Robust Features (SURF)

This is a quick and robust algorithm for local feature detector for comparison of images. The main feature of this approach is its fast computation of tasks such as tracking and object detection, image classification, etc.

4.4 Principal Component Analysis (PCA)

PCA may be a process consisting of orthogonal conversion to rework a group of observations of correlated variables into linearly uncorrelated variables which are called principal components. it's considered together of the simplest statistical procedure and it also reduces 2 dimension data to 1 dimension data.

4.5 Linear Discriminant Analysis (LDA)

It is a dimensionality reduction algorithm to find a linear combination of features that classifies or divides multiple classes of objects and the results are used as a linear classifier.

4.6 Support Vector Machine (SVM)

Support Vector Machine (SVM): A SVM may be a discriminative classifier generally referred to as supervised machine learning algorithm which may be wont to create a decision boundary called a hyperplane. It is often utilized in both classification and regression problems.

4.7 Convolutional Neural Network (CNN)

A CNN consists of an input and an output layer and multiple hidden layers. The hidden layers in CNN contain a series of convolutional layers that convolve with multiplication or other dot product. The RELU layer is the activation function, followed by pooling layers and fully connected layers, generally called hidden layers because their inputs and outputs are combined by the activation function and final convolution.

4.8 R-CNN

In this algorithm and image is divided into 2000 regions and they are selected with the help of a selective search process. Henceforth CNN (Convolutional Neural Network) extract features over 2000 regions that may ascertain an object in an image. Moving further it is passed through SVM(Support vector machine) to classify an object over the proposed region.

4.9 Fast R-CNN

The image in fast R-CNN is passed through CNN to produce a convolutional feature map. With the help of this feature map, it detects a region proposals and framed in to square using RoI polling layer. It is reframed into a fixed sized so that it can be feed into the fully connected layer form RoI layer, a class of proposed region is forecasted using SoftMax layer. Henceforth, it creates a set values for the bounding box. With the support of offset values it helps to locate an object in an image.

4.10 Faster R-CNN

In order to surmount the problem of fast R-CNN, faster R-CNN approach was developed, same as in fast R-CNN, a conventional feature map is generated out of an image using CNN. Here the difference in the working of faster R-CNN is : it uses different network to speculate region proposal and then follows the same procedure of fast R-CNN of reshaping to a definite size to be put up into fully connected layer. Henceforth, using SoftMax layer a class of proposed region is predicted which creates offset values of the bounding boxes hereby detecting an object.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.12450

4.11 YOLO

A part from above three different types of CNN, YOLO is quite different and quick approach. While the other types uses CNN to divide an image, YOLO uses a single convolutional network for anticipating bounding boxes and class probability of bounding boxes. And images divided into SxS grid. Amidst each grid, N number of bounding boxes are taken into account and it yields to network output that is class probability and offset values for bounding boxes. Here the bounding boxes having class probability above pre-decided value is chosen and gradually use to find the object within an image.

V. LIMITATION

- It can be challenging to accurately identify food objects in an image if the image is not of good quality, such as if it is blurry or has poor lighting. In these cases, it may be difficult for a computer or a person to accurately recognize the food object.

- As the take-away food items are usually packed and we cannot capture the image of the food item that is placed inside the takeout container, which leaves us incapable of determining the exact particular food item.

- It can be challenging to accurately determine the different variants and flavors of the same food item, especially if the variants have significantly different ingredients or preparation methods and they also differ in prices.

VI. CONCLUSION AND FUTURE WORK

Food image recognition for inventory tally is a task that involves using computer vision and machine learning techniques to automatically identify and count different types of food items in images or video. This technology has a number of potential applications in the food industry, including inventory management, nutrition tracking, and food safety monitoring.

To perform food image recognition for inventory tally, a computer system typically needs to be trained on a large dataset of labeled images of food, with each image labeled with the type of food it contains. This training process usually involves using machine learning algorithms, such as convolutional neural networks, to learn patterns and features in the images that are indicative of different types of food. Once the system has been trained, it can be used to automatically identify and classify different types of food in new images, allowing for quick and accurate inventory tallying.

Overall, food image recognition for inventory tally is a promising area of research and development, with many potential applications in the food industry and beyond. It is likely to continue to evolve and improve as advances are made in machine learning and computer vision technologies.

There are a number of potential enhancements that could be made to food image recognition for inventory tally in the future:

- Improving accuracy: One area of focus could be on improving the accuracy of food image recognition algorithms, particularly in challenging situations such as low lighting or when food items are partially occluded.

- Real-time processing: Another potential enhancement could be the development of systems that are able to process images and perform recognition in real-time, rather than relying on batch processing.

- Increased automation: There may be opportunities to further automate the process of inventory management using food image recognition, such as by integrating the technology with inventory management software or implementing systems that can automatically reorder items when stock levels get low.

- Expanding the range of food items: Currently, food image recognition systems may be limited in their ability to recognize a wide range of food items, particularly those that are less common or unfamiliar. Further research could help to expand the range of food items that can be accurately recognized by these systems.

- Integration with other technologies: Another potential enhancement could be the integration of food image recognition with other technologies, such as sensor networks or RFID systems, to provide a more comprehensive view of inventory management.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁓ Impact Factor 8.102 ⁓ Vol. 12, Issue 4, April 2023
DOI: 10.17148/IJARCCE.2023.12450

REFERENCES

[1]. The development of a food image detection and recognition model of Korean food for mobile dietary management. Department of Food and Nutrition, College of BioNano Technology, Gachon University, 1342 Seongnam-aero, Sujeong-gu, Seongnam-si, Gyeonggi 13120, Korea. Journal of National Library of Medicine (Biotechnology).

[2]. Food Image Recognition for Price Calculation using Convolutional Neural Network. 80-85. 10.1145/3316551.3316557. Nordin, Md Jan & Xin, Ooi & Aziz, NorShakirah. (2019). The 2019 3rd International Conference, Malaysia.

[3]. Deep Learning Based Food Image Recognition. Tejaskumar Patel, Dr. Chirag Patel, Prof. Ankita Gandhi MTech Student of CSE, H.O.D of Computer Department of Parul Institute of Technology, Professor of Computer Department of Parul Institute of Engineering &Technology Parul University, Limda, Waghodia, Vadodara, India. International Journal of Research and Analytical Reviews (IJRAR).

[4]. Food object recognition and intelligent billing system based on Cascade R-CNN. Huimin Yuan, Ming Yan School of Information and Telecommunications Engineering Communication University of China Beijing 100024, China. ICIIBMS 2018, Track 2: Artificial Intelligent, Robotics, and Human-Computer Interaction, Bangkok, Thailand.

[5]. Smart Restaurant Billing System With Globalized Menu Using Android IoT. R.Sandhiya Student, Dept of Computer Science and Engineering Gojan School Of Business And Technology, Redhills, Chennai. Mrs.L.Karthika Assistant Professor, Dept of Computer Science and Engineering Gojan School Of Business And Technology, Redhills, Chennai. Special Issue Published in Int. Jnl. Of Advanced Networking & Applications (IJANA).

[6]. Grab, Pay and Eat: Semantic Food Detection for Smart Restaurants. Eduardo Aguilar, Beatriz Remeseiro, Marc Bolanos, and Petia Radeva, Fellow, IAPR. IEEE Transactions on MultimediaVolume 20Issue 12Dec. 2018 pp 3266–3275 *https://doi.org/10.1109/TMM.2018.2831627*.

[7]. Application of artificial intelligence (AI) in food industry : Agbai, Chidinma Mary. (2020). Application of artificial intelligence (AI) in the food industry. GSC Biological and Pharmaceutical Sciences. 13. 171-178. 10.30574/gscbps.2020.13.1.0320.GSC Biological and Pharmaceutical Sciences were accepted on 15 October 2020.

[8]. Segmentation Techniques for Food Recognition :Megha Chopra, Archana Purwar, Jaypee Institute of Information Technology, Noida, India. CIMNE, Barcelona, Spain 2021, Accepted: 24 April 2021.

[9]. Food Detection and Recognition Using Convolutional Neural Network : Hokuto Kagaya Graduate School of Interdisciplinary Information Studies The University of Tokyo, Kiyoharu AizawaDept. Information and Communication Eng. The University of Tokyo. The 22nd ACM international conference on Multimedia

[10]. Food Detection and Recognition Using Convolutional Neural Network : Hokuto Kagaya Graduate School of Interdisciplinary Information Studies The University of Tokyo, Kiyoharu AizawaDept. Information and Communication Eng. The University of Tokyo. The 22nd ACM international conference on Multimedia.

[11]. Personalized Classifier for Food Image Recognition Shota Horiguchi, Member, IEEE, Sosuke Amano, Makoto Ogawa, and Kiyoharu Aizawa, Fellow, IEEE. IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 20, NO. 10, OCTOBER 2018

[12]. DietCam: Regular Shape Food Recognition with a Camera Phone Fanyu Kong and Jindong Tan Michigan Technological University, Houghton, Michigan. 2011 IEEE DOI 10.1109/BSN.2011.19