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Convolutional Neural Network (CNN) Method Food Detection with Image Processing

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***Abstract*— Image recognition of food products is typically difficult due to the large variety of sorts of food available. Food detection is used in this article to make restaurant payments easier, and automatic food pricing calculation is done with the help of the network. We used image processing techniques to apply AlexNet to tasks such as food identification and recognition. In kaggle, we created a dataset of the most common food products and used it to test recognition. The network categorises the train and test data and outputs the categorised results. Deep learning, on the other hand, has recently been demonstrated to be a highly strong picture identification technology, and it is a cutting-edge approach to deep learning. This network outperformed current techniques in terms of accuracy.**

***Keywords:* Image recognition, Food detection, deep learning.**

INTRODUCTION

The restaurant is one of the ways in which the Food Service Industry operates, as well as a type of tourism lodging that caters to customer needs. One of the restaurant's several types is the canteen. Employees and students eat lunch, take brief breaks, or study during work hours at a canteen found in businesses, industries, and schools. Due to a large amount of clients at some times, food payments must be queued. Queuing is a common problem in society and in product and service manufacturing [1].

The Convolutional Neural Network (CNN) is a type of Artificial Neural Network (ANN) that categorises, segments, and recognises objects with high accuracy and performance. By defining what food is in one frame of an image shot, the food detection system, which employs the Convolutional Neural Network (CNN) classification, reflects sophisticated levels of knowledge. In restaurants, this technology is utilised for food analysis and automatic billing, and the cashier is entirely responsible for invoicing [1].

[1]Image processing and object identification have advanced, as have machine learning approaches, notably deep learning and the use of convolutional neural networks in this context (CNN).

In recent years, CNN has gained popularity in food recognition applications, outperforming standard machine learning methods. [2] Many aspects of a food identification system have been researched, but given the wide diversity of food products and combinations of food items present in many dishes, a complete solution to accurate food classification and recognition is still needed. As a result, correctly recognising each food item is exceedingly challenging, as many food products are identical in terms of shape or colour, and many food characteristics are even impossible to notice via simple sight.

One of the challenges with lunch payment is at Telkom University's Canteen of Engineering. Food payment is split into two stages: purchasing food at one of the stores, manually calculating the food, and obtaining a receipt. The consumer pays at the cash register, obtains a receipt, and then must return to the previous business to present a stamped note; this is an awkward step. This situation demands the creation of applications that can identify various types of food and calculate their total cost [1].

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Concentrate on restaurants; food identification algorithms can aid in pricing monitoring and service simplification. By defining what food is in one frame of an image shot, the food detection system, which employs the Convolutional Neural Network (CNN) classification, reflects sophisticated levels of knowledge. This approach is utilised in restaurants for food analysis and automatic billing, with the cashier just having to finish the final bill [2].

In this Article, we'll take a look at a payment example. Because we pay using a food detecting gadget, we don't need receipt paper any longer. Food images are identified using the CNN method. We generated a food dataset from items often purchased in the engineering canteen. Here's what we've contributed:

- We created a dataset for food detection using commonly purchased foods, and
- We used the CNN technique to recognise a food image using partition training and test data, as well as epoch and learning rate.

RELATED WORKS

Restaurant payment procedures are still laborious and inefficient due to the usage of a cash register. The order will be verified and counted by a cashier. It's a waste of time to go through all of this. Food detecting sensors and computerised food pricing calculations are thus the solution to these problems. To assist with restaurant payment and automated meal pricing prediction, food identification employs the Convolutional Neural Network (CNN) classification technique. The detection accuracy of 6 varieties of food using the CNN technique was 100% with epoch 9000 and learning rate 0.0002, and a detection time of less than 10 seconds [1].

In this paper, we offer a unique deep convolutional neural network (CNN) configuration for identifying and recognising local food images. Because there are so many different types of food with different colours and textures, food picture identification is a challenging challenge. Deep learning, on the other hand, has been widely embraced as a reliable technique of image recognition, with CNN being the most current implementation approach. CNN has been tweaked slightly to improve food recognition and identification. We provide a new dataset of the most popular local Malaysian culinary goods, which was gathered utilising publicly available Internet sources, including but not limited to photo search engines [2].

Mangosteen is an important export fruit for Indonesia. On the other hand, mangosteen is not a fruit without faults. Sorting professionals inspect mangosteen export quality by hand. As a result, the outcomes may be inconsistent and untrustworthy. The outcome was caused by human error. Image processing technology is needed to help in the sorting process. One of the deep learning architectures used in this study is the Convolutional Neural Network (CNN). As a result, CCN is used to identify mangosteen. CNN [4] was quite good at categorising images.

[4]A 4-fold Validation Cross is used to guarantee data correctness in this CNN method. The network training method is sped up by initialising parameter values when building the CNN architecture model. The CNN algorithm successfully identified flaws in the mangosteen fruit at a rate of 97 percent in the trials.

[3] As people become more aware of their eating habits, the field of computerised food analysis is gaining traction. Automatic food analysis, focusing on the self-service restaurant environment, is not only useful for extracting nutritional information from foods selected by customers, but it is also of great interest for speeding up service by eliminating the bottleneck created at the cashiers during peak demand periods.

In this paper, the issue of automated food tray analysis in canteens and restaurants is discussed, which includes anticipating several meals placed on a tray image. We offer a unique food analysis approach [3] based on convolutional neural networks.

[3]We call it Semantic Food Detection because it integrates food location, recognition, and segmentation into one system. We demonstrate that our method outperforms state-of-the-art food detection by a considerable margin on the public dataset UNIMIB2016, achieving about 90% in terms of F-measure, and therefore marks a substantial technological step towards autonomous invoicing in restaurant situations

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN COMPUTER SCIENCE AND ENGINEERING TECHNOLOGIES

ISSN : 2454-9924

[6] A food picture usually includes a range of various culinary items. To recognise food photos with numerous plates, we must first detect each dish in each image. Meanwhile, in recent years, the advent of CNN has considerably improved the accuracy of object identification. In this paper, we analyse food images of a range of meals using Faster R-CNN, a common object identification technique. In order to validate our findings, we examined two types of food photo databases. This food detector is also used to estimate food calories for a variety of dish pictures.

[6] In order to identify each dish in a food image, a faster R-CNN is utilised as a food detector, and image-based food calorie estimation is employed to estimate the food calories of each recognised dish. Using this approach, we can compute the number of calories in food from a picture of many plates. We're collecting food photos of a range of dishes, as well as total food calorie counts for each dish, for this project. The food detector is then used with image-based food calorie estimates to estimate food calories from food photographs of diverse meals.

METHODOLOGY

A. PROCESSING ON IMAGES

Image processing is a method for converting analogue images to digital images, conducting operations on them, improving photos, or extracting data to be used for a specific purpose. Image processing is a form of signal processing that takes photos as input and outputs changed images using certain processes. Image processing techniques such as sampling, quantization, and noise are only a few examples [5]. Sampling is the process of determining the colour of individual pixels in a continuous image. Quantization is the process of connecting average colours to particular colour intensities. Noise is a term used to describe a picture or pixel that affects image quality (noise).

B. Food

Food is a processed product derived from animals or plants that is ingested by living creatures for the purpose of obtaining energy and nutrition. Food has a variety of colours, shapes, textures, and other qualities. Calories, for example, are one type of nutrient found in food. Food classification is required to avoid illness, maintain a healthy lifestyle, apply diet to diabetics and food allergy sufferers, and assist in the search for food calories, nutritional content, and as a food reference. Food classification is challenging due to the wide variety of meals available. Food classification may be done using existing computer vision systems (Jahan, Kekha, & Quadri).

C. Convolutional Neural Network (CNN)

The Convolutional Neural Network (CNN) is a deep learning method for classifying pictures, semantically partitioning them, recognising objects, and extracting features. CNN is a type of deep neural network that is frequently used to process image data due to its extensive network depth. CNN is a machine learning method that can categorise pictures and locate objects.

CNN provides information to the computer via the convolution approach, which enables object detection. Object detection may be used to categorise both food and disease-related objects including mangosteen, tomatoes, and mushrooms. The fully connected layer and the extraction layer are the two most basic components of a convolutional neural network. CNN's Layers feature extraction technique consists of a convolutional layer and a pooling layer.

D. Alex Net

Alex Net utilised a convolutional neural network to identify a brand-new batch of images. Alex Net has been trained on over a million images and can classify them into 1000 distinct categories (such as keyboard, coffee mug, pencil, and many animals). The network learned detailed feature representations for a wide range of images. The network takes in an image and outputs a label for each object in the image, as well as probabilities for each of the object categories. Transfer learning is used a lot in deep learning applications. Using a pre-trained network as a starting point, you may begin learning a new activity.

Transfer learning allows you to fine-tune a network faster and more simply than starting from scratch with randomly initialised weights. To quickly transfer learned features to a new task, a small

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number of training images might be utilised. The following diagram depicts Alex Net's architecture

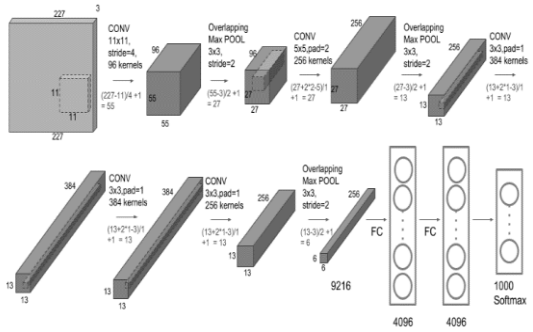


Figure: Architecture of AlexNet

The goal of this research is to enhance the identification of by training a larger number of pictures and estimating the overall price of the meal. AlexNet is used to train the dataset, and then classification is done. The proposed technique is depicted in the block diagram below.

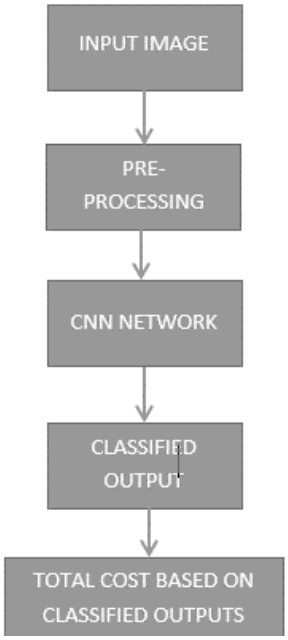
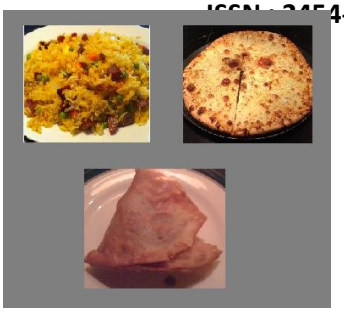


Figure: Block Diagram of Proposed Method

First we take the types of food datasets (from kaggle) individually in separate folder and each folder (dataset) consists of 15 images. Next, by using 'paint' we arrange the images as shown in below.



This process of arranging is done for all the images in the dataset. For training, we crop the individual images from above arranged images by using snipping tool and again placed in separate folders. These data is called as trained dataset. First we are consider the input image. And in this implementation of food detection the data is trained by using the ''AlexNet''. The input image is converted into binary image and labels are created for 8 connected objects for binary image.

The properties like area, bounding boxes are measured for binary image. The bounding boxes for input image is created for area which is above 3000 and classification is performed between the network and input image. It classifies the input image as samosa, fried rice and pizza. For a nonempty array, after classification we will assign the prices for each (food). And finally, total cost is calculated for the detected objects of input image.

RESULTS & DISCUSSION

The below figure represent the input image. If we are given the any of the food item present in the image then it shows like given the below image.

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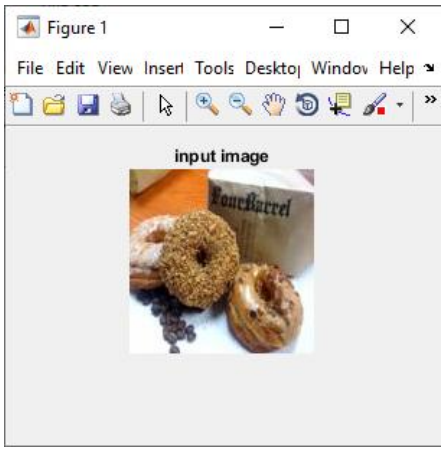

Figure: Input Image

Already we have gave the input image that image have present the item is displayed in the classified image. To show the given below image of the classified image.

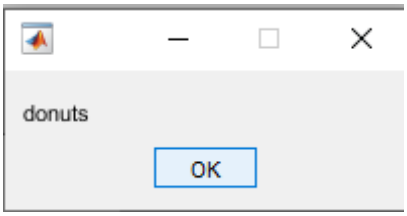

Figure: Classified Output.

The below Figure is the food item present in the image. To show the given below.

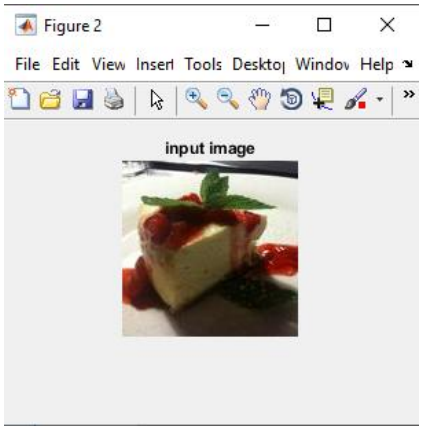

Figure: Input Image

Above figure have present the item is displayed in the classified image. To show the given below image of the classified image.

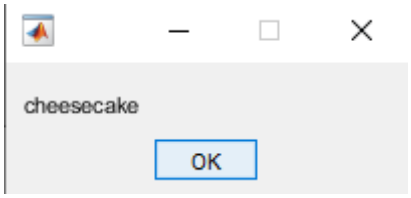

Fig: Classified output

We assigned the prices for each (food). And finally, total cost is calculated for the detected objects of the given below input image.

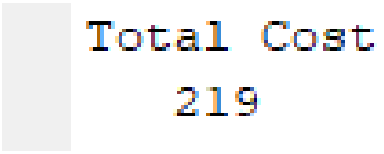

Fig: Total cost

CONCLUSION

The researchers discovered that we can recognise food using image processing and deep learning methods. The network is trained using a dataset from kaggle. Existing methods can process, assess, and recognise fruits and meals based on their colour and texture features. We were able to improve the usability and versatility of the recognition system by integrating AlexNet. Much data augmentation, as well as the learning of the generic pattern required to recognise and identify food items, is required. The network separates the information into train and test data. Its precision is considerably superior to that of all other classic models.

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