ARTIFICIAL INTELLIGENCE

(SMJE 3203)

PROPOSAL: FOOD RECOGNITION

NAME:

1. MUHAMMAD HAFIZUDDIN BIN REDZUAN
2. MUHAMMAD ARIS BIN ADNAN
3. HAREZ IRFAN BIN FADIL
4. SHAHIRUL FARIS BIN MOHD SUHAIDI
5. AINUL NAJIHA BINTI MOHD NOR SHAZALI
6. KHALILA AINA BINTI KAMARUL AZAM
7. NUR AIDA HAMIZAH BINTI KAMARUDIN
8. NUR AZREENA BINTI MD AZMAN

COURSE/SECTION: 3 SMJE/02

LECTURE'S NAME: DR MOHD IBRAHIM BIN SHAPIAI @ ABD. RAZAK

ABSTRACT

Artificial Intelligence (AI) is an application that is useful for various field, which was built to mimic some of the function perform by human brain. To live up to its expectation, AI should be able to learn something by its own which is a term that researchers named it as Machine Learning (ML). Most common approach done by ML is deep. And of course many methods developed to fully utilize deep learning but the most effective method is the Convolutional Neural Network (CNN). Given a task which is to do food recognition, it is expected for CNN to outperform any other existing method at its time. Currently, image become one of the most popular research area, computer learn to recognize many kinds of object based on image. Capturing image of meal allows to extract information which contain in food for health reference. Food recognition is an emerging topic in computer vision. The problem is being addressed especially in health-oriented systems where it is used as a support for food diary applications. The goal is to improve current food diaries, where the users have to manually insert their daily food intake, with an automatic recognition of the food type, quantity and consequent calories intake estimation.

In this paper we introduce 3 methodology in order to recognise a food which is convolution Neural Network (CNN) method, Building a data set for food images and food recognition. A multilayer neural network, whose neurons take small patches of the previous layer as input. A CNN system comprises a convolution layer. Where each input can convolves the filter. As the food recognition, the different features are extracted by these filter. We then define the food-domain representativeness of different food databases. Different features are then extracted from a CNN based on the Residual Network with layers architecture and trained on food databases with diverse food-domain representativeness. We evaluate these features for the tasks of food classification and retrieval. After we get the sufficient data, we can use CNN from the first method as food recognizer. So with all the data given, we categorise the type and name of the food based on the list given. The expected result is the CNN module should classify the type of food, content and nutrition information to its respective categories.

Keywords: Food Recognition System, Recognition System, Food

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In this new era of technology, individuals are more aware of living a healthy lifestyle. Since smart technologies play a big role for individuals, it helps the individuals to monitor their balanced diet using an application. Therefore, the number of individuals who cares about their food habits and diet increases.[1]–[5]. For the past two decades, recognizing the food and their nutritional information from images captured using computer vision and machine learning techniques has been common for researching. Accurate estimation of calorie value of food is the biggest concern in order for individuals to properly evaluate dietary consumption. There are many individuals who are overeating and being slightly passive. Keeping up with urbanization shown how stressed individuals are today, causing them to lose their track of the healthy diet consumption effortlessly. This only raises the importance of proper recognition of food. In this paper, an effort has been made to recognize the images of food for further diet monitoring applications using convolutional neural networks (CNNs).

1.2 Problem Statement

Nowadays more and more people care about the dietary intake since unhealthy diet leads to numerous diseases, like obesity and diabetes. It also helps them to be able to order food properly and know the information about the food, for example the amount of calories, possible allergies, and so on. For food recognition, previous work mostly used traditional image processing techniques with hand-engineered features. These methods include relative spatial relationships of local features, feature fusion, manifold ranking-based approach and co-occurrence statistics between food items. These methods either have poor adaptation to large scale, low recognition rate or are computational expensive.

Food recognition is a challenging task since there is less intra-class difference in food images. Besides, any image recognition also needs more computation power than most of the text base data classification. Because of the wide diversity of types of food, image recognition of food items is generally very difficult. But to benefit from food recognition model people should be able to use it in a less expensive device.

Currently, image recognition application in a smartphone mainly requires a computer since the recognition process requires a considerably amount of resources to serve the used database. If the size of the database is large, the limited resource in a smartphone cannot keep up processing the data. The effectiveness of the recognition in this case then depends on the performance of the computer and the speed of the internet connection. Research on food image recognition, however, has been mainly focused on the correctness of the food name for the given food image. Many techniques are applied, for example using image segmentation to separate the food from the background image. However, it is not appropriate to be used in a smartphone application since more image processing is needed.

To overcome such problem, one possible approach called Convolutional Neural Network (CNN) can be adopted. At present, CNN has been used widely with image recognition. In fact, research found that CNN performed much better than did traditional methods using handcrafted features. CNN has been continuously studied and developed so that the recognition of the effectiveness of CNN is higher than that from the conventional techniques used in computer vision. CNN can help extracting the features including colors, textures, and shapes. Moreover, image

classification can also be done by CNN. The goal of machine learning is to develop algorithms that can learn and recognize patterns or objects from complex data and make accurate predictions for previously unseen data. Therefore, we have decided to apply the use of Convolutional Neural Network for the purpose of our project that is Food Recognition.

1.3 Objective of Study

There are some main objectives of us performing this project. First and foremost, the main objective of this project is to build a framework that recognizes food item by just scanning images. At the same time, the system is also equipped with displaying and monitoring the calories consumption through a user-friendly food monitoring application. To achieve this, we are using Convolutional Neural Network (CNN) based algorithms with a few major optimizations, such as an optimized model and an optimized convolution technique where we will be able to apply the artificial intelligence knowledge towards completing this project. This will allow us to learn more deeply regarding the content of artificial intelligence.

Next, the objective of this project is to also train the multi-layer deep convolution neural network (CNN) by using hierarchical features learning from the labeled inputs. Other than that, the purpose of the project is to classify an object with higher degree of accuracy by fine tuning the hyper-parameters of the network. Based on image analysis, a conventional automatic vision-based dietary assessment system involves several fundamental steps starting with food detection, classification of food type and the nutritional information assessment.

One of the objective is also to apply computer language to solve problem such as by using Phython software. Overall, we propose to build an efficient food recognition based algorithm through CNN.

CHAPTER 2

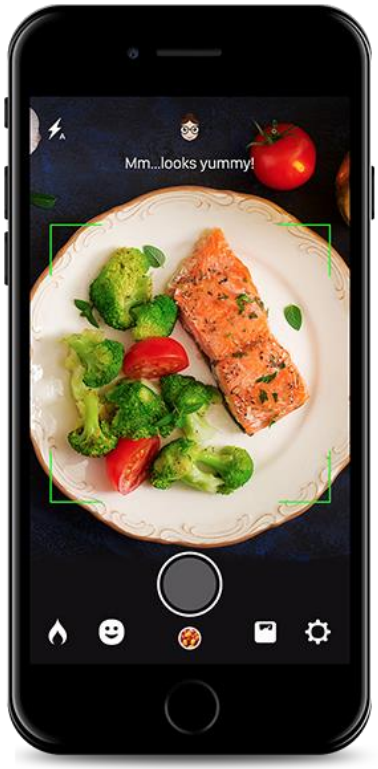
LITERATURE REVIEW

2.1 Available or Commercialized Product

2.1.1 Calorie Mama API

Calorie Mama App is powered by 2017 Azumio Inc. Food AI API. Food AI API is based on the latest innovations in deep learning and image classification technology to quickly and accurately identify food items. This food AI API has been trained on cuisine from all over the world and is the most culturally diverse food identification system on the market. Food AI API accuracy constantly improves as new food images are added to the database so it can identify thousands of food categories.

This food AI API is connected to Azumio Inc vast food database and every food item recognized by the Food AI is paired with detailed nutrition information. Developers using Food AI API can build detailed nutritional user profiles and recommend customized diets.



Calorie Mama: Instant Food Recognition

2.2 Previous Worked or Published Paper

Previous research as a study for the author is very important to determine relationship between previous researches with the new research that the author do at this time and to avoid duplication. The research that has been done is useful to show that it can be known the contribution of research to science.

Research on a supervised extreme learning committee for food recognition by Niki Martinel et al (2016). This study is to provide a system capable of automatically choosing the optimal features for food recognition out of the existing plethora of available ones (e.g., color,

texture, etc.). An Extreme Learning Machine (ELM) is trained to specialize on a single feature type. Then, a Structural Support Vector Machine (SVM) is exploited to produce the final ranking of possible matches by filtering out the irrelevant features and thus merging only the relevant ones.

Previous research on Machine Learning and Scale-invariant feature transform (SIFT) Approach for Indonesia Food Image Recognition by Stanley Giovany et al (2017). This research proposes a technique in food recognition, especially Indonesian food, using SIFT and machine learning techniques. K-Dimensional Tree (K-D Tree) and Backpropagation Neural network (BPNN) are chosen as machine learning techniques to recognize types of Indonesian food.

Research on Whale-based neural network to food recognition has been done by Emmanuel and Minija (2018). The main purpose of this research is to introduce a dietary assessment system based on the proposed Cauchy, Generalized T-Student, and Wavelet kernel based Wu-and-Li Index Fuzzy clustering (CSW-WLIFC) based segmentation and the proposed Whale Levenberg Marquardt Neural Network (WLM-NN) classifier and has been analyzed for the efficient classification of the food images from the database. Various segmentation and the classification processes used in the related works have been discussed. Dietary assessment system which automatically identified the food items from the input image. The food items are segmented using the multiple hypothesis methods. Combining with the previous research that provided a system capable of automatically choosing the optimal features for food recognition using Extreme Learning Machine (ELM). Then, the structural Support Vector Machine (SVM) was used to filter out the irrelevant features for the final ranking of possible matches of food types.

Previous research on CNN-based features for retrieval and classification of food images that has been done by Gianluigi Ciocca et al (2018). The purpose of this research is to investigate the use of CNN-based features for the purpose of food recognition and retrieval. Introducing the Food-475 database, that is the largest publicly available food database with 475 food classes and 247,636 images obtained by merging four publicly available food databases. Then, define the food-

domain representativeness of different food databases in terms of the total number of images, number of classes of the domain and number of examples for class.

The reference to develop this research are some of the literature review above. The research on the application of image processing for image classification using Deep Learning method which is Convolution Neural Network will be done from the results of analysis of various studies that have been done earlier. This research can produce accurate image classification using Deep learning method that is used to solve the problem of image classification because of its use that has a relatively fast computation process.

CHAPTER 3

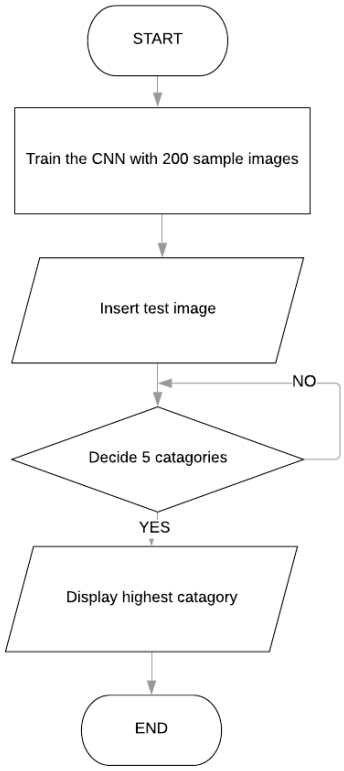
METHODOLOGY

3.1 Data & Analysis Method

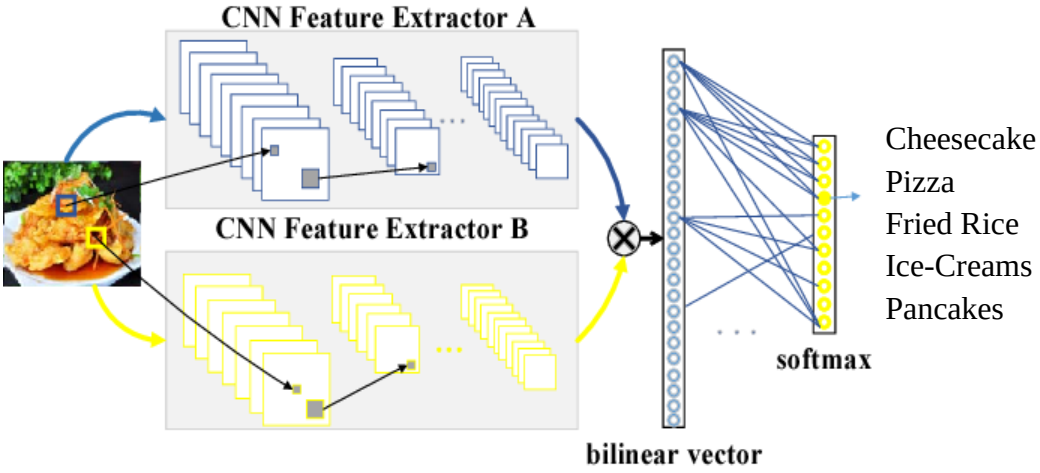
Data analysis method that will be used in this food recognition is Convolution Neural Network (CNNs) where it is used to recognize the image of food for further diet monitoring applications.

3.1.1 Convolution Neural Network (CNN)

Convolution Neural Network (CNN) method is a multilayer neural network, where neurons take small patches of previous layer as input. CNN usually applies for image visual analyzing. Multi-layer perceptrons that commonly refers to fully connected networks where each neuron in one layer is connected to all neurons in the next layer. Each input can convolve with filters, thus each layer will produce different output by the filter that we set. As food recognition, these filters will extract different features that can make the machine recognize the foods. As to produce final results, CNN that is common to use multiple convolution and pooling layer with a fully connected layer are used in this situations.



Flowchart of food recognition



CNN of Food Recognition

3.1.2 Population & Sample

The population that will be used in this research is the image of cheesecake, pizza, fried rice, ice-creams and pancakes. Each of the category will use 300 images from the Google Image website while the sample that will be used in this study is a picture of cheesecake, pizza, fried rice, ice-creams and pancakes.

3.1.3 Expected Output

This study is to recognize the image of cheesecake, pizza, fried rice, ice-creams and pancakes using the convolutional neural network (CNN). By making a food recognition design, the basic principle conduct training on CNN is needed to produce the best accurate model. In CNN training, there is data train and data test or validation, data train is applied to do training on model and test data for validation of training data. Accuracy model can be determined by validating by using test data. Training models use library keras on Anaconda by back-end Tensorflow. Google develops Keras as a Tensorflow wrapper to apply and give parts of the folder contrib in the Tensorflow code. Keras designed to remove boilerplate code. Several lines of keras codes generate more than original Tensorflow code, so it can be easy to design CNN and RNN and can run it on GPU or CPU.

3.2 Creating Data Set

The researcher collects and creates a dataset of images from the Google image website. In the evaluation of food recognition each category need image from Google Image websites to train them. Researchers use JavaScript and python programs to collect images from Google image. In JavaScript program is intended to take the image URL that is in Google image then Python program that execute to download the image.

3.3 Dataset for CNN Training

In the expected output, we will do the selection of images that will be used. The characteristics of a good image that is there is only the object in the image and the background of the object is white. Select 300 images to be used as data train and test each category.

CHAPTER 4

RESULT AND DISCUSSION

In this experiment we will be solving how to classify food images recognition. Our main objective to divide the class of the input image belongs to subject.We are going to use the artificial neural network (ann) on thousands images of five type food classification and make NN(neural network) learn to predict which class the image belongs to.

Keras deep learning library in python required to build Convolutional Neural Network (CNN). First, we download all the images that related to images object from the google platform that required for training and test data set. All the images of the objects saved in both folders named “trainingset” and “testset”. First the folder “trainingset” contains 5 different sub folders which are “cheesecake”, “pizza”, “fried rice” , “ice cream”, “pancakes”, each holding 300 images of the respectively . Then , the folder “testset” contains 5 subs folders which are “cheesecake”, “pizza”, “fried rice” , “ice cream”, “pancakes”, each holding 100 images of respective category.

The process of building a Convolutional Neural Network (CNN) always involves 4 major steps:

Step 1 : Convolution

Step 2 : Pooling

Step 3 : Flattening

Step 4 : Full connection

- **Importing the keras libraries and packages**
  Import all the required keras packages using to build our CNN in anaconda and used Theano backend.

  Importing the Keras libraries and packages
  from keras.models import Sequential
  from keras.layers import Conv2D
  from keras.layers import MaxPooling2D
  from keras.layers import Flatten
  from keras.layers import Dense

- **Initialising the CNN**
  Create an object of the sequential class.
  Initialising the CNN

- **Insert 4 major steps for building CNN**
  The process of CNN : convolution, pooling, flattening, full connection.
  Step 1 - Convolution

  Step 2 - Pooling

  Adding a second convolutional layer

  Step 3 - Flattening

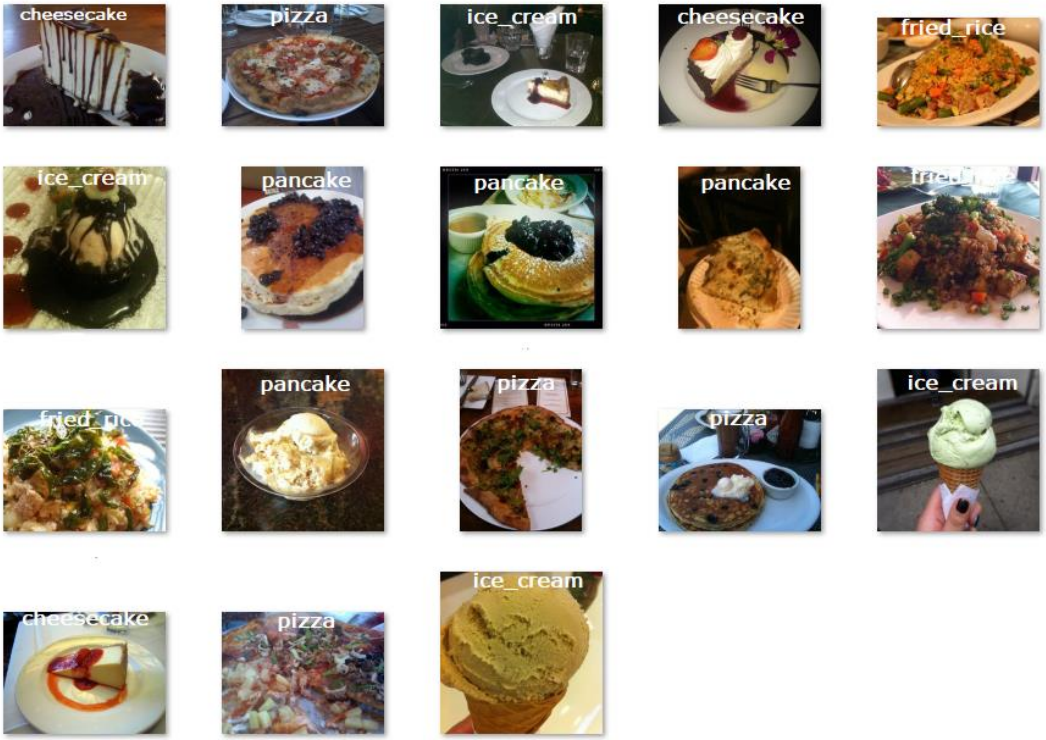
Step 4 - Full connection

- **Compiling the CNN**
- **Fitting the CNN to the images**
- **Making new predictions**

  The test_object holds the image that needs to be tested on the CNN. The test_object will prepare to be sent into the model by converting its resolution to 64x64 as the model only except that resolution. Then we used predict () method on our classifier object to get the prediction.

- **Result**

  Result of the test on the objects (cheesecake , pizza , fried rice , ice cream , pancakes)


cheesecake
pizza
ice_cream
cheesecake
fried_rice
ice_cream
pancake
pancake
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pizza
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cheesecake
pizza
ice_cream

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Today, there are many use cases for AI and machine learning in the food industry. Some of the world's leading startups and enterprises are already using machine learning and deep learning in their operations. Artificial intelligence and the technology are one side of the life that always interest and surprise us with the new idea, topics and innovations.

Based on our written paper, we have done a project on how to make food recognition by using computer language. Based on the knowledge and literature review that has been done, we obtained some conclusions such as we learn to implement the Convolutional Neural Network (CNN) method for food recognition using *keras* package in software Anaconda version 4.4.10, TensorFlow and Project Jupyter. Next, we have expected that the images used are limited object under study to make the accuracy higher. Besides, computer specifications are also expected to be higher in order to be able to train models with more images. Graphics processing unit (GPU) and Random-access memory (RAM) are among the specifications required to detect many images. Lastly, the comparison between the value of the number of filters, learning rate, epoch, layer dropout, and activation functions used can be further research to see how the effect on the level of accuracy obtained.

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