

HappyFit: A dietary Calories Counter Application Using Image Recognition

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Abstract: Over the last three decades, obesity has increased worldwide. Statistics have shown that the rate of obese population all over the world is keep increasing and the reasons are varied. This has led the attention of the World Health Organization (WHO) [1]. Studies have shown that peoples' awareness of the risks being an obese are also improving. Today, people are becoming more concerned about their weight, and eat more healthy food and practicing a healthy lifestyle. Obesity treatment requires constant monitoring on daily calorie intake. With the evolution of information technology, the smart phone has become a vital gadget for everyday life. An Android-based apps with calorie intake counter features can be very helpful to control obese. There are many mobile applications popping up like mushrooms that can assist people to count their calorie intake, however, most of them were specifically developed for western people and not suitable for Malaysian user. In addition, the applications do not provide any automated advisory for appropriate exercise based on the calorie intake of a user. This paper presents the development process of HappyFit, a mobile application that used the Convolutional Neural Network (CNN) for the food image recognition. This application is specifically developed for Malaysian users to monitor their calorie intakes based on the food images. This application is also able to provide the suitable exercise types based on the amount of the calorie intake by the user.

Key words: *Calorie Counter Application, Food Image Recognition, Convolutional Neural Network (CNN)*

INTRODUCTION

Malaysia has been listed as one of the countries with a highest obesity population in southeast Asia. This was based on the finding of the survey done by Economist Intelligence Unit's in its report entitled "Tackling Obesity in Asean: Prevalence, impact, and guidance on interventions", which covered Malaysia, Singapore, Indonesia, Thailand, Philippines, and Vietnam [2]. The prevalence of obesity in Malaysia is reported at 13.3%, while overweight is at 38.5%. Today, many Malaysian become more aware about the risks of obesity. However, there are still some people do not know how to practice a good life style by having a balanced intake of food nutrition. A professional adviser such as dietitians is needed to advise them for the proper diet plan. There is always a cost when engaging with professional dietitian. In the era of technology, the smart phone has become so vital

as it has the ability to support many mobile apps that very useful in our daily life. The Android-based calorie counter app can be very helpful for helping people in monitoring their food intake. A calorie is a measuring unit that is used to calculate the overall amount of energy in any food intake (carbohydrate, protein, and fat). A calorie is needed in our body system to generate energy. However, the excessive of calorie intake can cause the development of fats. Too much fat in our body can lead to the obesity and overweight. Obesity and overweight can lead to serious life-threatening conditions such as type two diabetes mellitus, obstructive sleep apnea, some types of cancer, such as breast cancer and bowel cancer, and stroke. Obesity may also cause cardiovascular diseases such as coronary heart disease and blood vessel diseases. Obesity can also affect the quality life of a person and lead to psychological problems, such as depression. Studies also revealed that obese

people have considerably low self-esteem [3]. Many studies show that junk foods and processed foods are the main caused for the increasing of childhood obesity [4]. Obesity can be controlled through consistently monitor the dietary plan. The daily calorie requirement is depending on the Body Mass Index (BMI) of an individual. If the BMI of a person is more than or equal to 30 kg/m² he/she can be categorized as obese [3]. Therefore, an accurate estimation of dietary calorie intake is important for assessing the effectiveness of weight loss interventions. Obesity treatment requires constant and consistent monitoring of daily calorie intake. It can't be denied that today's technological developments, especially in smart phone can extremely helpful in many areas. There are many new technologies adopted by health industry such as computers and smart phones to support treatment. Medical is one of the important areas that utilizing these technologies. These advanced tools make the life of doctors or nutritionists become easier in monitoring patients. In the last few years, the numbers of applications developed for the calorie intake monitoring are also popping up like mushrooms. However, most of the applications have limitation; some are only developed for the use of dietitian, and the food database mostly stored the info about western food. Most of these applications are mainly developed for western people and not suitable for Malaysian users. This paper presents the development of 'HappyFit' a mobile calorie counter. In our propose application, the Convolutional Neural Network (CNN) is the technique used for the food image recognition.

LITERATURE REVIEWS

Research in image recognition has grown rapidly especially in food image recognition. This research area is very useful especially in diet planning and calorie intake monitoring for healthy living. Food image recognition is one of the most powerful object recognition applications that can be used to process the food-intake estimation and dietary assessment. With the evolve of the technology in smart phone, food recognition with the calorie estimation counter has become a popular tool. Many approaches have been introduced by researchers to estimate the calorie of the food based on images through machine learning. In 2009, a comprehensive food image dataset is developed and named as Pittsburgh Fast Food Image Dataset (PFID). This dataset consists of 4,545 still images from 101 different types of food

items. The Support Vector Machine (SVM) classifier is applied on the dataset the classification accuracy benchmark[4]. Chen et al [5] in their research work, proposed a method of Chinese food identification and quantity estimation for dietary assessment. They used Gabor and color features to represent the food items. The SVM classifier label combined with Adaboost algorithm to produce a new technique. With the 50 categories of food known worldwide and each consists of 100 sample images they had successfully improve the accuracy and the performance of Scale invariant feature transformation (SIFT) and local binary patterns (LBP) feature descriptions. Podutwar. Et al. [6] in their research work, used the color, texture features, shape and size for food image recognition. The segmentation and classification techniques were combined to produce high accuracy of food images using Fuzzy c-means clustering technique. Today, deep learning has become a very powerful image recognition technique and convolutional neural network (CNN) is the most popular one. Kagaya et al. [7] applied the CNN on their own dataset for the identification food item. In their research work, CNN provides higher accuracy than traditional SVM methods where the accuracy rate was at 73.70% and the detection rate was at 93.80%. Liu et al. [8], propose a new Convolutional Neural Network (CNN) based food image recognition algorithm and applied it to UEC-256 and Food-101 data sets and achieved 87.2% and 94.8% accuracy respectively. Figure 1 is the typical architecture of convolutional neural network technique.

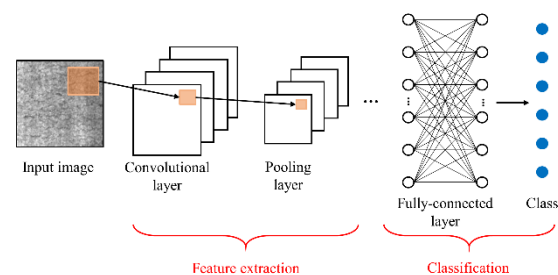


Figure 1. Convolutional Neural Network (CNN) technique

In 2015, Yanai et al. [8] have introduced the deep convolutional neural network (DCNN) technique for the food photo recognition task. In their experiments with 2000 categories of food images, they had achieved 78.77% accuracy in the recognition task and identified that DCNN is

a suitable method for the large-scale of image data. Christodoulidis et al. [9] applied the 6-layer DCNN on their own dataset containing 573 food items to classify food and the accuracy rate yielded at 84.9% in which the overlapping patches for each food item extracted and classified. Due to the complexity of food images, many of the previously proposed methods for food recognition achieved the accuracy in small-scale images. Moreover, the existing systems were developed not for Malaysian user. Villalobos et al. [10] conducted a project for image processing approach for calorie intake measurement. In their research work, they proposed an application named “Lose It!”. There are several functions applied in that project, one of it, is a type of food database that used are just for western food only. Other than that, the user needs to take a picture 2 times for each food intake, which require the top and the side view of the food. However, this application does provide any suggestion or recommendation for the appropriate exercise to burn calorie. This application can only be used by the dietitian to monitor patients. Moreover, this application requires licenses. Rana [11] in his thesis, described about the measuring techniques for food and nutritional based on food images. The ‘Food Dietary Recall’ is the name of application developed by Rana [11], focuses on the western food database. The application required the user’s thumb to calibrate and analyses the captured images. The size of thumb is used to measure the number of calories by comparing it with the size of food images. Podutwar [12] proposed a system named ‘FatSecret’ is also based on the western food database. The calculation of calories based on the food portion recognition images is done by using the support vector machine. The “Calorie Mama Instant Food Image Recognition” [13] is another popular application. Calorie Mama application is powered by their Food AI API. Food AI API is based on the latest innovations in deep learning and image classification technology that quickly and accurately identify food items. This application is available in App Store and Google Play. Most of the existing calorie counter systems are based on western food database and may not suitable for Malaysian users. This paper presents the development of HappyFit, a mobile application that is used to calculate the calorie intake based on food images. The technique use

for food image recognition is CNN. The targeted users of this application are Malaysian.

METODOLOGIES

This section describes the methodologies used to construct the HappyFit. The prototype system is developed using the technologies such as Android Studio, Firebase database and Tensorflow Mobile. Android Studio is used as a platform to develop android mobile application. Firebase database is used to store all the information about food as well as the images. Tensorflow is the main technology behind the HappyFit that perform the image recognition task. Tensorflow Mobile is an open source framework for machine learning in mobile platform that can easily connected with the Android Studio via the library. The Malaysian Food Composition Database (MyFCD) is the reference database used in Happy Fit. This database provides the information about the exact nutrient of Malaysian food. The Convolutional Neural Network (CNN) is the technique used for the food image recognition. This technique is preferred method as it offers the 85% accuracy for image recognition. Figure 2 is the overall architecture of the food recognition system procedure.

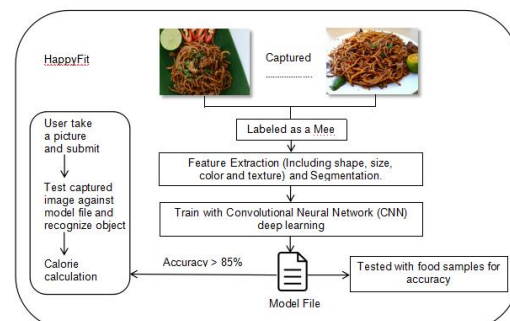


Figure 2. Overall architecture of food recognition system

Figure 2 presents the overall architecture of food recognition system. The first step is the image capturing, follow by the submission of the captured image to the system for processing. The model is trained with convolutional neural network (CNN) deep learning in which the shape, size, color and texture of the image will be extracted. The CNN has four layers (see Figure 1); convolutional layer is the first later and is designed to identify features such as shape, color, size and texture, the second layer is a Rectified Linear Unit (ReLU) is an extension of the convolution layer to increase the non-linearity of the images, the third layer is the pooling layer and the last layer is the connected layer.

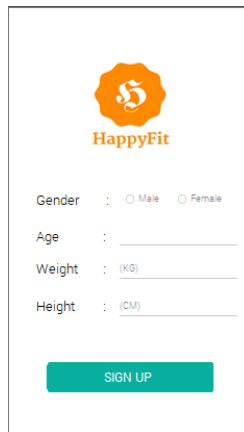


Figure 3. User info screen

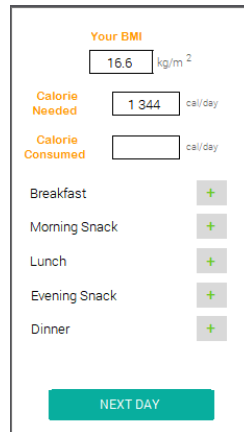


Figure 4. Calorie Estimation Screen



Figure 5. Capturing Screen

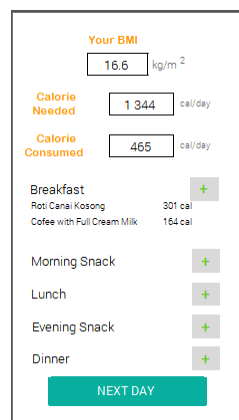


Figure 6. Calorie Counter Planner

Figure 3. is the user info screen that required the information from the users such as gender, age, weight and height. Once the required information fills up by the user, the Body Mass Index (BMI) and calorie needed will automatically calculated for that person. The calculated BMI and calorie needed is displayed in Figure 4. The image capturing screen is shown in Figure 5. This screen is embedded with the camera to allow users to take the picture of the food. Once the photo successfully captured and recorded, calorie counter planner screen will display as shown in Figure 6. Users can actively used HappyFit to consistently monitor their diet plan and calorie intake every day. This can nurture the healthy eating habit.

CONCLUSION

A calorie is needed in the body, however an excessive of calorie can lead to the development of fats. Fat lead to obesity and obesity can lead to many potential illnesses such as heart attack, high cholesterol and many other serious illnesses.

Therefore, the calorie intake needs to be monitored and controlled for healthy living. In this paper, HappyFit is an android-based mobile application developed for calorie intake counter based on food image recognition. This application is specifically designed for Malaysian users. HappyFit is not only suitable for overweight people, but it can also be used by normal weight people. HappyFit can help people live in healthy life style by nurturing the healthy eating habit through the consistent monitoring of the calorie intake. However, due to the complexity of the food images identification, this system can only recognize two types of Malaysia food images, that are “mee” (noodle) and also “nasi lemak” (coconut rice). For the improvement and suggestion for the future work, more features need to be added in HappyFit such as the feature to recognize more types of Malaysia food such as ‘roti canai’, ‘satay’ and etc and the feature to provide the diet recipe for healthy practice.

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