International Journal of Engineering Applied Sciences and Technology, 2020
Vol. 5, Issue 3, ISSN No. 2455-2143, Pages 189-195
Published Online July 2020 in IJEAST (http://www.ijeast.com)

PREDICTION OF USER'S CALORIE ROUTINE USING CONVOLUTIONAL NEURAL NETWORK

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Abstract— Now a days, people are having very busy schedules due to changes in their lifestyle and work commitments. People are not concentrating in their food habits, hence it leads to obesity. Obesity is becoming a common problem in today's modern life. So that we need a system which can make changes to the food choices of people and provides them with instruction that leads to effective results of maintaining their body. If a system informs the nutritional information of a food item and classify it as healthy or non-healthy to the user, then people are able to identify their daily intake of calorie value of their food items. This proposed system helps the user to control their food habit system and also gives information on how to burn calories in daily routines that makes user's healthy. Convolutional Neural Network model is applied to classify food item from the input image and the proposed system provides the accuracy of 91.65%.

Keywords— **Android Application, Convolutional Neural Network, Deep learning, Food nutritional information.**

I. INTRODUCTION

Food has always been essential in human life and attracted people's attention more than before. Each food items have each nutritious value which may be high or low. Therefore, a food detection system is essential that can automatically show their nutritious value of food items and calculate the calories based on the amount of food that the user intakes by capturing the image of the food.

Nowadays everyone are using smart phones, so we have developed smart application to monitor the food habits of the user and prompt the user which food suits based on their health condition. Due to the advancement in technologies used in smart phones, their computational power has also increased. Nowadays smart phones can handle high quality of images, research on food classification is focused on developing real time application which capture image and get result from the model instantly. Most of the people are overeating and not being active enough. Because of their busy schedules and people are stressed today, they forget to keep track of the food they eat. So by using this application we can able to get knowledge of the nutritional value of the food items. It helps to avoid severe condition of diseases such as diabetes, blood pressure and so on. Some of the methods currently in use for dietary assessment involve self-reporting and manually recorded instruments. The issue with such methods of assessment is that the evaluation of calorie consumption by a participant is prone to bias, in order to increase the accuracy and reduce the bias; enhancements to the current methods are required. Automatically analyze the dietary and calorie information employing the computing capacity of the cloud for an objective assessment. Over the last few years, many research and development efforts have been made in the field of visual-based dietary and calorie information analysis. However, the efficient extraction of information from food images remains a challenging issue.

In this paper, one of the main challenging part is that it requires a large image data to train a deep learning model and also an effort has been made to classify the images and nutrition of food for further diet monitoring applications using Convolutional Neural Networks (CNNs) which serves as a backbone of the application and handles the training and testing requests at the top layers. Since the CNNs are capable of handling a large amount of data and can estimate the features automatically, they have been utilized for the task of food classification.

II. LITERATURE SURVEY

The task of the food detection system images were segmented initially to form the feature vector with size, shape, texture, color (normalized RGB), and other context-based features. With this motivation, a minimized feature vector with the Gabor filter responses (texture), pixel intensity, and color components however, the performance is good for food replicas, and a less efficient performance is observed with real images. The size of images and their variations in capturing could be the reason for the performance degradation with this, the better performance is found with less number of classes, although the images of each class are

more. Images contain some common visual patterns that are useful in recognizing the category of food. This process reduces the complexity raised by the direct image matching techniques. Experiments have been conducted on real time database with fast-food images has been created.

Later the research has focused on collecting the varieties of dataset proposed a new dataset to evaluate algorithms to recognize food which helps to monitor diets. The database has been created for more number of instances of food images. A medium sized dataset has been created to develop a mobile based log system.

Deep Convolutional Neural Networks have been used for food recognition recently which uses a combination of baseline feature extraction and neural network fine-tuning. Convolutional Neural Networks along with a Maximum Pooling layer generates Activation Maps (heat maps of food probability). Fine tuning is done for Activation Map generation, which includes adding a convolutional layer with stride, and setting a softmax layer. Additionally, via threshold, bounding boxes are generated. The present work is to combine above methodologies together, that creates a food classification system that predicts the class of food the image is in, and also gives the calorie value based on the food weight or count given by the user. This concept has a high scope in the health sector, as people want to keep track of what and how much they eat and simplifying the process into this form of implementation increases usage and awareness of health-related factors.

III. EXISTING SYSTEM

There are some applications are present in this user's food calorie management. But each one has its own drawbacks. The following are the available applications in the existing system.

3.1 Fatsecret

Fatsecret application is Australia based application. In this application user need to add a capture of their food items and add tag name to that then it will give calorie information of the food item. User can share what they eat to others and connect with their friends. This application mainly gives the diet plans to the user to reduce their weight. But to use the diet plans, they need to buy a premium membership for some cost. They give barcode scanner for packed food items to detect and give nutritional information of food items. The bar code scanner does not work with Indian packed foods. In this they provide connect with our dietitian by invite them but it also require premium membership. It gives the report of what they ate and calorie information of their intake. Overall this application is good but works well only for foreign people. It doesn't provide diet plans and correct nutrition values of all Indian foods. In this application, the developer did not use deep learning or any other technologies to classify food items.

3.2 Nutrition plus

Nutrition Plus is an application where the user can search for the food items based on the nutrition values such as carbohydrates, protein, fat, iron, calcium and vitamin. The user can also search by food items and find the particular food's nutrient composition. It gives the healthcare information about the diseases and provides the diet plans. They didn't use any technologies for the classification of food images.

3.3 Calorie Mama

Calorie mama is another application in this domain. It provides calorie and other nutritional information of food items by capturing the food items. It uses image classification technology to classify food items. It works well with foreign foods and some of Indian foods. It gives foreign meal plans to gain, reduce; maintain body weights for their premium membership holders. This is a paid application after free trails, the user need to upgrade the account. This application will not suggest Indian foods to user based on their health conditions.

IV. PROPOSED SYSTEM

In this paper we introduce an application that is capable of classifying foods by capturing the images, provide correct nutritional information of Indian foods and classify the foods based on user's health condition. For the purpose of analysis, the user's food intake, calorie values, blood pressure and diabetes data are given. Also helps them to burn the calories by doing exercises or some changes in their daily routines. The proposed system consists of two modules; one is image classification module using convolutional neural network and the second module is the development of android application.

4.1 Convolutional Neural Network

The overall flow of the proposed system is shown in Fig.4.1. Each block of the proposed system is explained in the following sections. From this, model can be obtained which will classify any supplied image based on the trained dataset.

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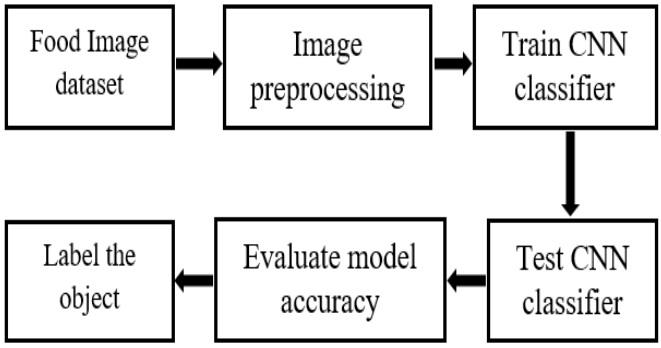

Figure.4.1. Overall flow of the proposed system

4.1.1 Food Image dataset

We have used web scraping to make our dataset. Indian food images are not available as dataset in dataset repository websites. So we need to make our dataset on our own. Initially we use five food classes as dataset. We use web scraping application to download Google search images and make a dataset for our model.

4.1.2 Neural Network configuration

1. Convolution: A Convolution2D function is used (input size (64, 64, and 3). This layer creates feature maps by convolving input data to create pooling feature maps.
2. Max-Pool: A MaxPooling2D function is used. The pooling function reduces variance in the data and reduces computational complexity. Max pooling extracts the maximum value of features from feature map, average pooling extracts average value of features smoothly.
3. Flattening: Converting the data into a 1-dimensional array for inputting it to the next layer. We flatten the output of the convolutional layers to create a single feature vector.
4. Fully connected: Fully connected layers connect every neuron in one layer to every neuron in another layer. The principle is same as the traditional multi-layer perceptron Neural-network (MLP).
5. Soft-max: Using Soft-max function as an output function almost works like Max layer as well as it is differentiable to train by gradient descent. Exponential function will increase the probability of maximum value of the previous layer compare to other value. Also, summation of all output will be equal to 1.0.

4.1.3 Image preprocessing

There are a few image preprocessing techniques used to ensure maximum efficiency from the CNN model. These preprocessing techniques ensure that any image taken from any angle will be able to get classified by the model accurately.
Image preprocessing parameters: The following are the parameters that are considered for image preprocessing.
rescale:1./255 is an operation that moves your data from one numerical range to another by simple division using a constant value.
shear_range: 0.2. Shear transformation slants the shape of the image. We fix one axis and stretch the image at a certain angle known as the shear angle. This creates a sort of 'stretch' in the image. It specifies the angle of the slant in degrees.
zoom_range:0.2 this parameter controls the zooming factor. This is equal to 0.2 means that the zooming factor will be chosen from the range [0.2, 1.2].
Horizontal flip = True: Images are flipped horizontally. Random flipping of images helps in identifying different patterns and for "upside down" images to be predicted by model accurately as well.
Train_datagen.config['random crop size']: Assigns the crop size for the images that are fed to the network, in this case 64x64x3. All images are forced to be cropped to this resolution which ensures the compatibility and linearity of input to the neural network.

4.1.4 Neural network model

The CNN model is trained using preprocessed dataset. The above image preprocessing techniques are applied to images in dataset. The model is developed with parameters that are defined in previous section. The trained model file is then loaded into the application and test it against the images captured and submitted by the user. The system then performs the image recognition.

Process and generates probabilities against the label name list. The label with the highest probability send to the android system for further steps. The standard way to model a neuron's output as an activation function of its input x is Relu function. This algorithm will help us to tweak the weights (w) and bias (b) during the learning phase, in a way we can finally determine the output as one of the two (Apple

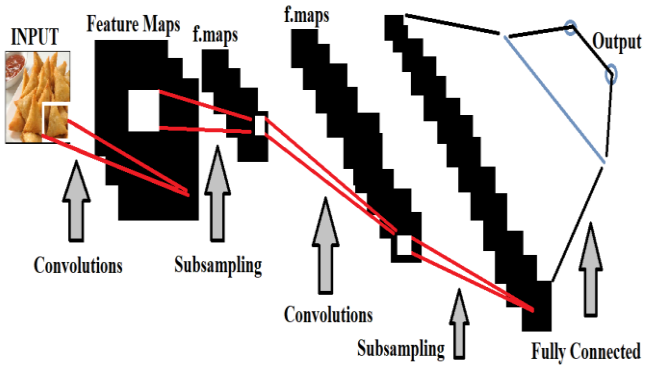

Figure.4.2. CNN model to recognize the food items from images

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or Orange), without affecting the rest of the food classes.
Delta changes in either the weights or the bias will change accuracy of model. Fig.4.2 shows the CNN model for recognizing the food items from the input images. As shown in the above diagram, we have taken the color feature into account any change in weight w or bias b would alter final results. If the probability of the image p>0.5 towards apple, object will be classified as apple and it is same case with other food type

4.2. Android system

An android application that is used to capture a food item then the image is preprocessed and predict with the model. The unit calorie of each food is obtained from the database and used to calculate the actual calorie of food. These calories are summed up at the end of the day and used for analysis.

Every day calories of the user are stored in the database for further analysis. An optional option is also given to user to input their blood pressure and blood sugar values for providing food suggestion. Calculate the burned calorie by increasing their steps, physical exercises and by doing changes in their daily routines for analysis. The android application gives the complete history of user's food taken; calorie gained, calorie burnt information, history of blood pressure and blood sugar values.

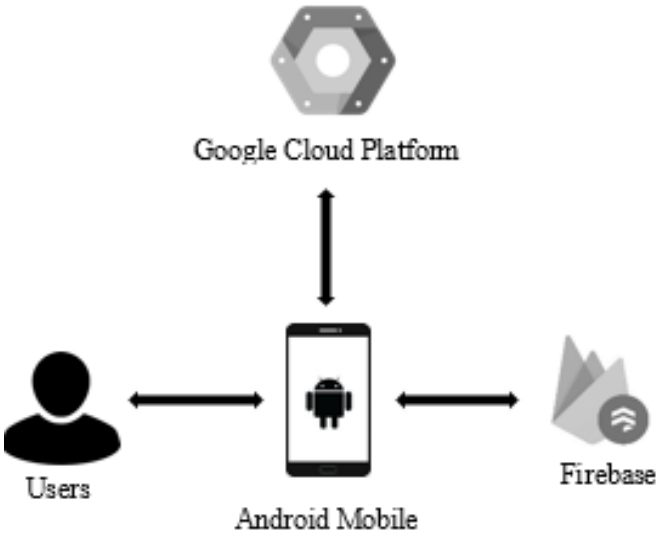

Figure.4.3. Component diagram of proposed system

4.2.1 Calorie measurement

The calorie values of each food item are already stored in our image database. These stored calorie values are mapped with each food respectively. So that if the user uploads the captures of the food item it automatically recognizes the food and the corresponding nutritious value for the food is generated and stored accordingly. The average calorie values are considered for the different class food, per 100g of serving.

4.2.2 Nutrition value

The nutrition values for all the food items are taken from "Nutritive value of Indian foods " by C. Gopalan, "Indian food composition tables" by T. Longvah books and data from "National Institute of Agricultural Extension Management". The nutrition values consists of carbohydrates, fats, proteins, vitamins, sugar, saturated fat, sodium, calcium, potassium. These nutritive values are taken and are matched with each of the food images respectively. So that the nutrition values are shown if the user takes the photo of the food item that the user is going to eat.

4.2.3 Blood Pressure and Sugar value based food suggestion

Since we are highly concerned about the user's health, we are suggesting the user about the details of the food they have taken. We get the user's health issues first whether he/she is having BP or sugar, based on their inputs. We suggest the food based on high BP as well as low BP and also for diabetes patients the food is suggested accordingly. The user has to enter their updated sugar and BP values so that we measure if the values are normal, high or low. Based on their entered values we suggest the user about the food items that are to be in taken.
It shows the food items which are not suitable for them to eat. This may helps the user to know about their food habits and change their food habits if their health is bad or suggest them the foods that are good based on the user's health condition.

The major tools used in our system to develop the application are, android SDK for android application, Firebase Firestore database, MLKit database for storing and distributing deep learning model.

V. SYSTEM TOOLS

5.1 Android

Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, which is designed primarily for the mobile devices such as smartphones and tablets which was developed by Google. Android mobiles are capable of run lite version of keras and tensor flow algorithms. The advancement in mobile makes them to have much more computing power. The users are

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provided with a mobile application which has user registration and user sign in options. Once the user logs in, after that every time user enter into application it start camera to take picture. After that take a photo it send to model for classification. At completion of classification the highest probability of labeled food item shown to the user. User need to give the amount of food in weight and count for some foods. A request to database which have calorie value for unit weight of each food to calculate the calorie of user's food intake is given. The calorie values are saved to firestore database. Later it will used for analysis by user as well as doctors. The android application give another option of classify food by healthy or non-healthy based on user's blood pressure and diabetes values.

5.2 Firebase

Firebase is a mobile and web app development platform that provides tools and services to help them develop high-quality apps, grow their user base. It provides authentication, Database, Cloud Functions and MLKit. The Firebase Realtime Database is a cloud-hosted NoSQL database that store and sync between your users in realtime. Realtime syncing makes it easy for your users to access their data from across any device. Another benefit of Realtime Database is that it ships with mobile and web SDKs, allowing you to build your apps without the need for servers. When your users go offline, the Realtime Database SDKs use local cache on the device to store data. When the device connects with internet, the local data is automatically synchronized with realtime database. We use this realtime database as our database and MlKit as our model provider dataset.

VI. RESULTS AND DISCUSSION

We have developed the CNN model with above specified configurations it gives an accuracy of 91.65%. After developing the model it has been tested with real time food image data. So as the result of successful testing this model is hosted in Google cloud to make sure it is available to the production. A Mobile application is developed and connected with Google cloud to classify food images. After the classification, the food image specified with its calorie is updated on the database. Here are the result screens of the mobile application system.

6.1 Screen shots

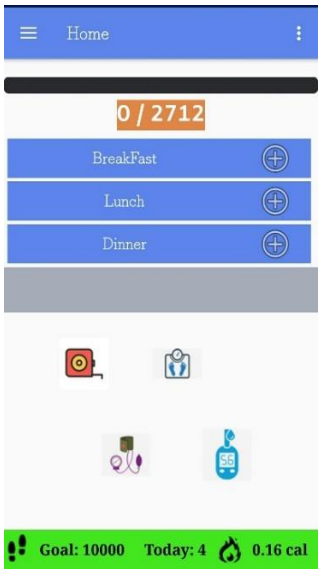

Fig.6.1 Home Screen

Fig.6.2 Food Prediction Screen1

Fig.6.3 Food Prediction Screen2

Fig.6.4. Exercise Screen

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Fig. 6.5 Exercise Screen

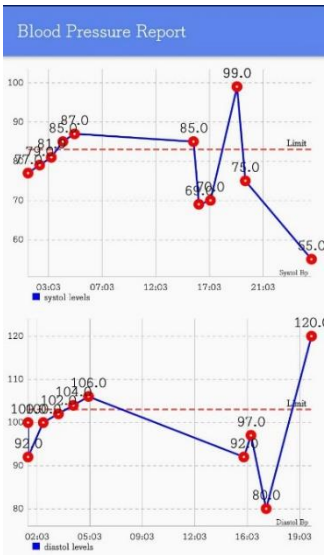

Fig. 6.6 Reports Screen

Figure.6.1 Home screen of application. This screen shows user's foods and its calories per daily basics. Additionally it shows daily steps count and its burned calorie of steps users walk. An option of editing user details with blood pressure, blood sugar and user profile details. Figure.6.2 Food prediction screen. Food image is captured and send to CNN model for classifying food name. Food name mapped with database food values and show nutritional information. The weight of food is get from user and calculate total calorie amount and saved to database. Figure.6.3 Food prediction screen2. Every use has their own daily calorie limit bases on their height, weight and age parameters. If user exceed daily limit, button will show in red color for intimate user to avoid that food. Figure.6.4 Exercise instruction screen. If calorie limit is exceeded but user can't avoid that food, this screen will give basic daily routine way to burn that exceed amount of calorie to ensure user has to be in their limit. Figure.6.5 Exercise screen. This give easy and home workouts for fitness of user. These exercise are easy to do and doesn't require any weight and costless. Figure.6.6 Report screen. Graphical representation of Report will give better understanding of their health. So that we develop a reports of blood pressure, blood sugar, daily calories and daily steps. These reports will helpful to doctors and give more insights of user's health.

VII. CONCLUSION

This paper is to empower the user by a convenient, intelligent system that helps them become sensible about their calorie intake. We employed rather unique deep learning neural networks as a means of accurately classifying and recognizing food items. We get the classification model accuracy of 91.65%. However, the CNNs need high-performance computing machines in order to experiment on the huge multi-media datasets. The CNN is capable of training highly non-linear data, and for that in contrast, it takes more computational time to train network. However, the performance is matters and once the system is properly trained, the system can produce the results in less time. The images are properly preprocessed and all kinds of images are tested with CNN. From this, it is concluded that CNNs are more suitable for classifying the images when the number of classes are more. However CNNs are consuming high computational time, But the feature-based approach is highly appreciable. Moreover, a dataset containing all Indian food categories is also not available in the literature yet. As a future enhancement, the Android application will connect with doctors and nutritionist to make the historical data to be a useful thing. And this application is connect with other health tracking application like Google fit. Now we have only few classes of food items. In future we will add many food items and hence we make a food suggestion to other diseases also.

VIII. ACKNOWLEDGEMENT

We would like to express special thanks of gratitude to our project guide Dr.T.Sathiya, our project coordinator, for her patient guidance, her advice and assistance in keeping our progress on schedule. My grateful thanks are also extended to Dr.B.Sathiyabhama, HOD of our department for her professional guidance and valuable support and finally we thank our institution Sona College of Technology for supporting us.

IX. REFERENCE

[1] Lili Pan, Samira Pouyanfar, Hao Chen, Jiaohua Qin, Shu-Ching Chen (2017). DeepFood: Automatic Multi-Class Classification of Food Ingredients Using Deep Learning - IEEE 3rd International Conference on Collaboration and Internet Computing, 2017, DOI 10.1109/CIC.2017.00033

[2] Wu W. and Yang J. (2009), "Fast food recognition from videos
of eating for calorie estimation," in Multimedia and Expo, ICME 2009. IEEE International Conference on. IEEE, (pp.1210–1213)

[3] Pouladzadeh P., Shirmohammadi S., Bakirov A., Bulut A., & Yassine A. (2014).Cloud-based SVM for food categorization,
Multimedia Tools and Applications, 74(14), 5243–5260,
DOI 10.1007/s11042-014-2116-x

[4] Ankita Podutwar A., Pragati Pawar2 D., Abhijeet Shinde V.,(2017),A Food Recognition System for Calorie Measurement,
International Journal of Advanced Research in Computer and Communication EngineeringVol. 6, Issue 1, January 2017
DOI 10.17148/IJARCCE.2017.6146

[5] Zhang W., Zhao D., Gong W., Li Z., Lu Q., & Yang S. (2015),
Food Image Recognition with Convolutional Neural Networks. 2015 IEEE 12th Intl Conf on Ubiquitous Intelligence and Computing and 2015 IEEE 12th Intl Conf on Autonomic and Trusted Computing and 2015 IEEE 15th Intl Conf on Scalable Computing and Communications and Its Associated Workshops (UIC-ATC-ScalCom),DOI 10.1109/UIC-ATC-ScalCom-CBDCom-IoP.2015.139

[6]Muthukrishnan Ramprasath, Vijay Anand M., Shanmugasundaram Hariharan (2018), Image Classification using Convolutional Neural Networks, International Journal of Pure and Applied Mathematics Volume 119 No. 17 2018, (Pg 1307-1319)

[7] Deepika Jaswal, Sowmya .V, Soman K.P. (2014),
Image Classification Using Convolutional Neural Networks, International Journal of Advancements in Research & Technology, Volume 3, Issue 6, June-2014 (Pg 1661 - 1668)

[8] Yim J., Ju J., Jung H., & Kim J. (2015), Image Classification Using Convolutional Neural Networks With Multi-stage Feature. Robot Intelligence Technology and Applications 3, DOI 10.1007/978-3-319-16841-8_52 (Pg.587–594).

[9] Shweta Suryawanshi, Vaishali Jogdande, Ankita Mane (2020),
animal classification using deep learning, International Journal of Engineering Applied Sciences and Technology,Vol. 4, Issue 11, ISSN No. 2455-2143, (Pg 305-307).

[10] C. Gopalan, B.V. Rama Sastri & S.C. Balasubramaniyam
"Nutritive value of Indian foods"

[11] T. Longvah R. Ananthan K. Bhaskarachary K. Venkaiah "Indian Food Composition Tables"

[12] "Dietary Guidelines for Indians" – A Manual, National Institute of Nutrition, Hyderabad, 2010

[13] National Food Security Mission, Operational Guidelines,
Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, 2007

[14] Pradeep Kothari, Android Application Development, Dream Tech Press.

[15] Wallace McClure, Jonathan Dick and Chris Hardy, Professional Android Programming with Mono for Android, Wrox Publication

[16] Android Application Development, Android studio https://developer.android.com/studio

[17] Firebase firestore (Collection and Document based NoSQL) database reference
https://firebase.google.com/docs/firestore?authuser=0

[18]Google Cloud Platforreference - https://cloud.google.com/docs