e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com

# FRUIT IMAGE RECOGNITION AND CALORIE MEASUREMENT USING CONVOLUTIONAL NEURAL NETWORK (CNN)

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## ABSTRACT

In this paper, we propose an easy approach to the new deep convolutional neural network (CNN) configuration and built an application to recognize fruit images using a Tensor Flow Lite model trained on Teachable Machine. However, deep learning has been widely used as an efficient image recognition method, and CNN models are built to evaluate its performance on image recognition and detection dataset. A main element of the application is the fruit identification features it which is done using machine learning. A convolutional neural network (CNN) is specifically used to complete the task of recognition of fruit. We prefer a convolutional neural network because the architecture of a CNN is the more feasible for the image identification function. CNN framework is inspired by biological processes and includes alteration of multilayer preceptors that result in minimal amounts of preprocessing. In a CNN, there are multiple layers that each have distinct functions to help us identify an image. CNN achieved significantly higher accuracy than the conventional process.

**Keywords**: Convolutional Neural Networks, Fruit Image Recognition ,Tensor Flow, Deep Learning, Teachable Machine, Calorie Measurement.

## I. INTRODUCTION

The fruit with greater calorie density provides high fat .Each gram of fat provides 9 calories which is double than that of protein or carbohydrates. It is challenging for common people to determine the nutrition facts of fresh fruits. The primary goal is to follow best and healthy eating plan, also monitor intake of carbohydrates, protein and make a calorie chart. To maintain a healthy diet it is necessary to include fruits in your diet as fruits are low in calories but provides all vital nutrients. For example, a medium sized 100gm apple contains 53 calories, which is 17% of your daily requirement. A same size apple also provides other vital nutrients in good proportion as 0.32 grams protein and 13.9 grams carbohydrates, 85% water, 10.5 grams sugar, 2.5 grams fiber and 0.2 grams fat.

Many professional centers who promote weight loss campaign follow the same process of monitoring the calorie intake and minimizing it according to the body type as the everyone requires different calories intake level considering many factors like age, sex, BMI etc. Calories are essential for human health. The key is consuming the right amount. Weight loss process initiates when our body starts utilizing the calories stored in form of fat and this happens when we spend more calories than we take in. If people are able to figure out calories they require every day will lead to a healthy lifestyle. On the contrary too low or too high calorie intake would eventually lead to the severe health issues. For the awareness of people, food packaging industries provide all the nutritional information on the packaging. Calories are listed in the nutritional information on all fruit packaging but not fresh fruits. Through this study we are trying to make it easier for people to know the nutritional value of a particular fruit.

In this paper, we focus on a Convolution Neural Network to solve fruit recognition in an initial algorithm. The further algorithm focuses on calorie measurement and identifying the origin of the fruit. Deep learning is the shining element of machine learning that is based on learning levels of representations. It is easy to interpret the pattern and behavior of the data available in the form of image, test, audio etc. Convolution neural network framework & algorithm is a multilayer perceptron specially designed for the identification of two-dimensional image information.

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## II. METHODOLOGY

### 1. Data Collection

Acquisition involves accumulating or adding to the data assets. The methods we follow to accumulate data are as

i) Make your own dataset

ii) Reuse available dataset

### 2. Building a Dataset

In this study, we focus on building Tensor Flow based models is getting easier – that is, through Google's AI experiment Teachable Machine. It can be used for generating training dataset and training a Machine Learning model straight from a web browser. In fact, as we shall see, the trained model can be exported for usage in native Tensor Flow, TensorFlow.js and Tensor Flow Lite. MNIST, CIFAR-10, Fruit-101, Caltech-256, is relatively easy to start exploring datasets and make some first predictions using simple Machine Learning (ML) algorithms.

### 3. Export & integrate the trained model to Android Application

Although to make these trained models useful in the real world, it is needful to make that models available to make predictions on either the Web or Portable devices. TensorFlow Lite is a platform developed by Google to train Machine Learning models on mobile or any portable devices. Using TensorFlow Lite, all the workflow is executed within the device, which avoids having to upload or share data with the server and send back to the user.

We created an Application on Android Studio using the TensorFlow Lite Dataset model trained on the Teachable. Teachable was created for resolving some constraints brought from creating huge and deep neural networks for image sorting tasks. We used Android Studio as the IDE to integrate all the required Tensor Flow Lite dependencies.

We applied the transfer learning method to our data model by using the pre-trained model as a checkpoint and continue to train the neural network. The reason of doing so is that a Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone. Teachable is a unique way for creating and train your own Machine Learning models from the web browser. Teachable is the platform having huge number of trained datasets. Using this feature based platform and pre-trained machine learning model we can accelerate the process of data model training as shown in fig.1.

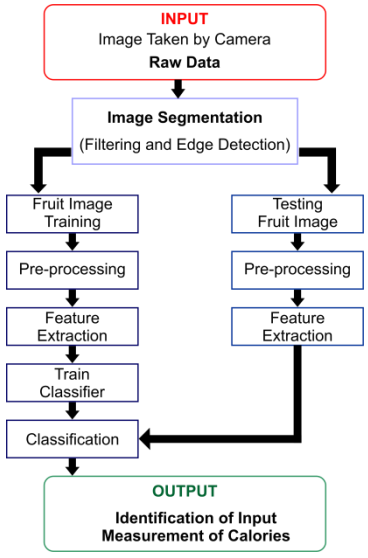


**Fig.1 Flowchart of Algorithm**

## III. MODELING AND ANALYSIS

### 1. Convolutional Neural Network

Convolutional Neural Network (CNN) provides an exceptional model architecture for image classification and recognition as shown in fig 2. CNN is a multilayer neural network, whose neurons take small shifts and rotations. CNN's are generally a configuration of three layer types. Convolutional layer, fully connected neural

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network, apply a specific number of convolution filter which is referred as kernel with specific weight (n x n) to the input data image. A single output value is generated by applying a set of mathematical equations & operations to each an every section of an image. Each input convolves these filters. Each layer has many filters i.e. kernels that generate several outputs. The second type of layer is the pooling layer, which produces down sample of the resulting image produce by the convolution layer to reduce the size of the feature map for faster processing time. There are several algorithms such as maximum polling and average pooling. A widely used algorithm is maximum pooling. This makes the CNN output more invariant with respect to position Fully connected layer, perform classification on the extracted feature after down sampling by a pooling layer. Each unit of the final layer represents the class probability.

### 2. Dataset Model Training Analysis

Machine Learning algorithms learn from data that we feed. Neural networks and other artificial intelligence programs require an initial set of data, called a training dataset, to act as a foundational measure for further processing and utilization. This dataset is the baseline and foundation for the program's store room of information. The training dataset must be accurately labeled before the model can process and learn from it. The dataset you want to use for training usually require upgrading, enriching, or labeling. We should consider multiple factors in play for concluding how much machine learning training data you require. First and foremost is how important accuracy is. We are creating a sentiment analysis algorithm by training a dataset which achieves about 85% accuracy. To a system or machine, an image is just a series of pixels. Some might be green, some might be brown, but a system doesn't know the scanned input picture is of fruit until we label it accurately. Referring to the label system predicts correctly and displays the result as this collection of pixels right here is a specific fruit. If a machine detects enough labeled images of fruit, it can starts interpreting similar groupings of pixels in an unlabeled image also constitute a fruit. The best way to prepare featured training data with the accurate labels, your model needs to succeed is with a human-in-the-loop who can label and upgrade your data accurately and efficiently. The more accurate you label and enrich your training data, the performance of the model increases and more accurate results you achieve.

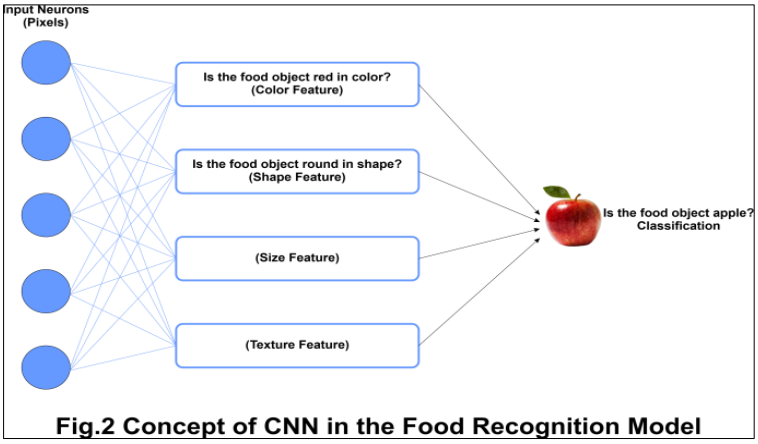


**Fig.2 Concept of CNN in the Food Recognition Model**

## IV. RESULTS AND DISCUSSION

We received the output on the built application as referred in the Fig 3.

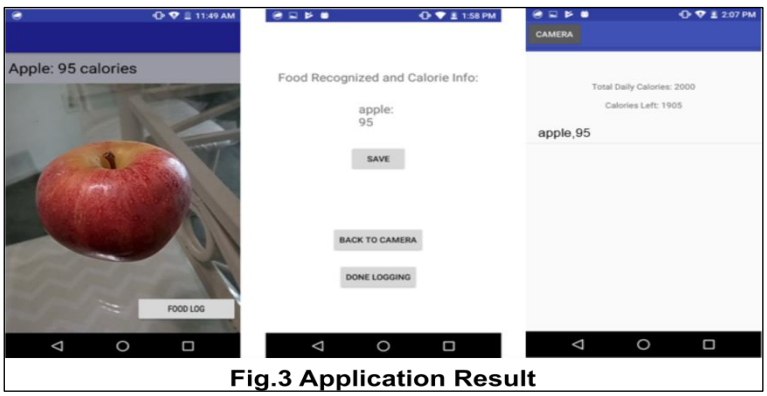


**Fig.3 Application Result**

Referring to the fig.3, the output reflected by the system is "Food Recognized and Calorie Info: Apple 95". The user interface is created by using an application "Android Studio" and can be improvised.

## V. CONCLUSION

After this study, we can conclude that we have built an easy and effective approach to build CNN based application to recognize the fruit and measuring calories. The dataset were collected from web and trained on web browser application Teachable.

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