Automated Nutrient Level Determination Using Machine Learning

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Abstract. In present scenario, people look health issues as non-trivial. The primary agenda of life is to have better nutrient food. The calories and nutrition intake as proved harmful worldwide, as it has led to many disease's however dieticians have mistaken that the standard intake of number of calories is essential to maintain the right balance of nutrition and calorie context in the human body. The common people (literate or illiterate) may not able to analyze and decide about nutrient levels in packed food items and even unable to identify the freshness of the food. This system is an aid in such scenarios where if the ingredient list is given, then the system gives a suggestion regarding the nutrition level based on the input. Since the system is to be used by the common (non-technical) people the input to the system is the image of the nutrient list (available at rear end of packaged food items).So our system involves both image processing and machine learning (for automated suggestions based on the input ingredient list).

Keywords: Nutrient Level Determination · Food Freshness · Python · Machine Learning

1 Introduction

Now a day's most of the people look health issues as non-trivial. The primary agenda of life is to have better nutrient food. Our system is an aid in such scenarios where if the ingredient list is given, then the system gives a suggestion regarding the nutrition level based on the input.

Since the systems is to be used by the common (non-technical) people the input to the system is the image of the nutrient list (available at rear end of packaged food items).So our system involves both image processing and machine learning (for automated suggestions based on the input ingredient list).The system has a privilege to detect the freshness of certain food items.

This system helps to dietitians for maintain their weight and also it helps to control the health condition of patients. The system designed here provides users with convenient and intelligent mechanisms that allow them to track their food intake and monitor their calorie count.

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Calculating food calorie and nutrition level in the intake on a daily basis is mere impossible as it involves dieticians, doctors etc. To treat the patients who suffer from obesity, overweightness, or other food-related health problems there should be correct diagnosis which is challenging issue.

Shervin shirmohammadi et al. [1] gives personal software instrument which can calculate intake calorie and nutrient in any camera equipped device. Image segmentation and preprocessing identifies ROI (region of interest) i.e. food portions from the overall. Amount of each food portion in image is calculated. Level of nutritional facts is calculated using the mass of each portion from its measured volume and matching it against existing nutritional fact tables. As a continuation of the work, in [2] cloud based food calorie measurement system is implemented which is suitable for android devices. Its implementation is analyzed in detail about its functionality on Android system utilizing cloud computing infrastructure. The algorithm is able to withstand huge test and training dataset.

In the paper [3], as against the conventional methods, a novel method is proposed. Vision Based Measurement (VBM) [1] has gained an appreciation as it is simple to use. The algorithm deployed are transferred to the smartphone for real-time implementation.

In the paper [4], the problem caused by the uncertainty of freshness of fruits and vegetables can be overcome by this new and, creative freshness sensor without any chemical treatment which could damage the nutritional value of samples. Additionally, this novel device could be considered as an innovative project which could be a solution for microorganism caused respiratory diseases and allergy like diseases by detecting contamination before microorganism colonies become visible with naked eye by measuring ion concentration changes occurred at samples.

As one more method paper [5] also proposes a method for measuring food nutritional value; this method can be used as a personal assistive application on smart phones. They system analyzes food and fruit images using a set of images processing and analysis procedures, and makes use of a database of images to extract the information needed like color, shape and size properties from the images. It then uses an SVM to the food portion types. Experimental results shows that our image processing technique works better than others in segmenting and extracting the food portions.

In another method [6] uses smart phone to analyse images has many potential applications for people, especially patients. But, the variability of the food objects makes it very difficult to adapt the algorithms with real data. Existing methods can process, analyse and texture features. We have improved the functionality and flexibility of the recognition system by adding shape and size features as well as color and texture. Furthermore, by increasing the number of images in the database the recognition rate can be increased.

2 Objectives

- A person is considered obese when the Body Mass Index is higher than or equal to 30kg. Recent studies have shown that obese people are more likely to have serious health conditions such as hypertension, heart attack, high cholesterol, breast and colon cancer etc.

- High calorie intake as proved harmful worldwide, as it has let too many diseases. However, dieticians have mistaken that a standard intake of number of calories is essential to maintain the right balance of calorie content in the human body
- As per the guidelines of FDA, it has 32 different names of salts,31 different names of sugar,17 different names of fats and 17 different names of allergens based on these, help to decode the ingredient list.
- How it means, with the help of differently mentioned names of sugar, salt, fats and allergens, it measures what type of ingredient is present in the given ingredient list.
- Scenarios which arrive even to common person during the purchase are

  - Even though ingredient list is displayed, the common people may not able to analyze and decide about nutrient levels in packaged food items.
  - May not be able to identify the freshness of the food.

- This system should be able

  - To identify the nutrition level from the input image ingredient list
  - Freshness of the unpacked food item
  - Best suitable suggestions based on identified nutrient level

- **Proposed Methodology & Implementation** (Fig. 1)**:**

The work handles two of food items.

1. Packed Food.

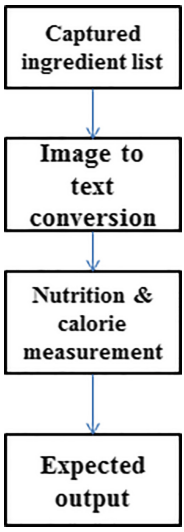

Fig. 1. Proposed Methodology for packed food items

2. Unpacked Fresh vegetable/Fruits.

Capture the food of the image using smart phone. Captured image is preprocessed and is converted into text using character recognition. The text converted image will measures the nutrition and calories by using mathematical calculations which acts like a dataset for machine learning. Using machine learning algorithm a suggestion is given to specific people according to their diet concern. The final outcome of the food measures the nutrition and calories. Same methodology is applied to check the freshness of food.

Let us consider snicker as an example, by capturing ingredient list (like sugar, chocolate, milk fat & so on) by the camera. Such list will convert image to text with the help of image processing (Figs. 2, 3, 4 and 5).

Then the system will measure the nutrition and calorie from the image captured. Then the people will come to know about the nutrition and calorie of the snickers.

Those people who dieting they receive guidance from the dietician. What and how much to be consumes for their health. If the snickers calories and nutrients are matched with dietician guidance, then it is preferable to consume snickers, If it is not matched with dietician guidance, then it is not preferable to consume.

The technical details block will explain how technically it works for both nutrition and calorie measurement as well as for freshness identification of food (vegetables, fruits, meat, etc.).

First we capture the image using smart phone it automatically select ingredient list from the packed food for measurements and capture the food image for freshness identification.

The image to text conversion uses the OCR (optical character recognition) tool to extract the text from image (ingredient list). It helps to analyze the text in the image that what image we upload and converts into text. For freshness identification no need

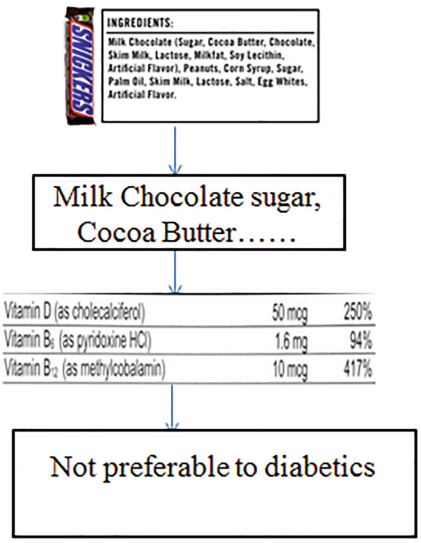

Fig. 2. Example w.r.t packed food

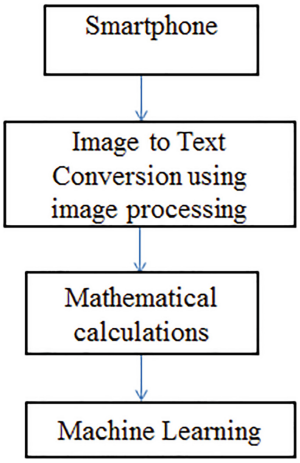

Fig. 3. Technical procedure w.r.t. packed food

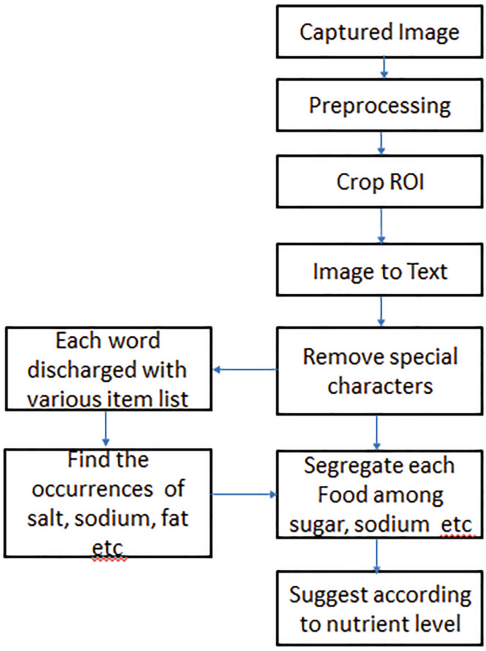

Fig. 4. Flowchart of handling packed food

to convert from image to text but for measuring nutrition and calorie needs to convert from image to text.

The mathematical calculation block will measure the nutrition and calorie in the packed food and freshness identification of the food. Finally it goes to the machine learning block it gives final result to the users.

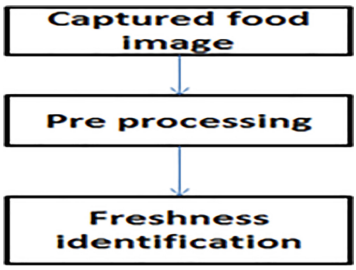

Fig. 5. Block diagram w.r.t. unpacked food

This block will identify the freshness of the food items. The purpose of this,people don't might be know if an food gone bad before buying it and don't know how much foods contaminated by microorganisms this leads to health issue.To overcome this problem freshness identification technology is developed.

The freshness identification technology is done by freshness sensor which identifies the food freshness as helps to know the hidden details present in foods like fruits, vegetables, meat, etc.

Figure 6 shows flowchart of handling the unpacked food.

- First it will choose the colors of the food.
- On the basis of green, red and yellow we are going to implement the freshness identification of the food.
- Based on the green color we decide that the fruit is not ripe, based on the red or yellow color we decide that fruit is ripe.

3 Machine learning

Machine learning deals with the automation of programming where the computer program modifies itself based on the new dataset. At first it should be basically trained using test dataset. It is classified into Supervised learning and unsupervised learning. Data samples are categorized into four types for classification: false negatives (FN), true negatives (TN), true positives (TP), and false positives (FP).

Here lasso regression method is used to check the freshness based on features like color texture, shape etc. The algorithm uses both variable selection and regularization along with soft thresholding. It selects only a subset of the provided covariates for use in the final model. It is mathematical defined by,

$N^{-1} \sum_{i=1}^{N} f(xi, yi, a, b)$.

To check the efficiency of classification, RMSE is evaluated.

- $\text{RMSE} = \sqrt{\frac{1}{N} \sum_{i=1}^{n} x_i^2}$
- $\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n} x_i^2}{\sum_{i=1}^{n} n_i^2}} \text{ x100\%}$

Here xi and ni are the error and reference, N is length of the analyzed data which is 125 in this work.

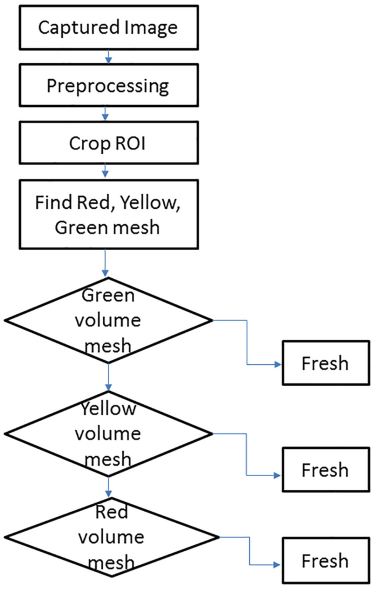

Fig. 6. Flowchart of handling unpacked food

4 Result

To check the freshness the dataset from Kaggle is used. The recognition rate is summarized in the Table.1. About 125 experiments were conducted with the variation types, colours and other parameters. The recognition rate is about 70% which can further be increased.

Since the system is to be used by the common (non-technical) people the input to the system is the image of the nutrient list (available at rear end of packaged food items).The system has a privilege to detect the freshness of certain food items. Figure 7.and Fig. 8 shows the one of the example results of how the system works by handling both packed and unpacked food.

The RMSE for the designed classification is 0.307 which is within the thumb rule of 0.2 to 0.4.

Fig.7. Results of handling packed food

Table 1. Summary of Food Freshness

FOOD ITEMS		RECOGNITION RATE (%)					
		USING COLOUR FEATURES	USING TEXTURE FEATURES	USING SIZE FEATURES	USING SHAPE FEATURES	USING ALL FEATURES	USING ALL FEATURES (10FOLD CROSS-VALIDATION)
1	apple	60	85	31	23	98	59
2	orange	65	79	41	71	96	70
3	tomato	71	70	48	45	90	65
4	carrot	75	80	69	65	100	78
5	onion	46	80	32	23	90	54
6	bean	77	80	77	65	99	80
Total average		**66**	**79**	**50**	**49**	**96**	**68**

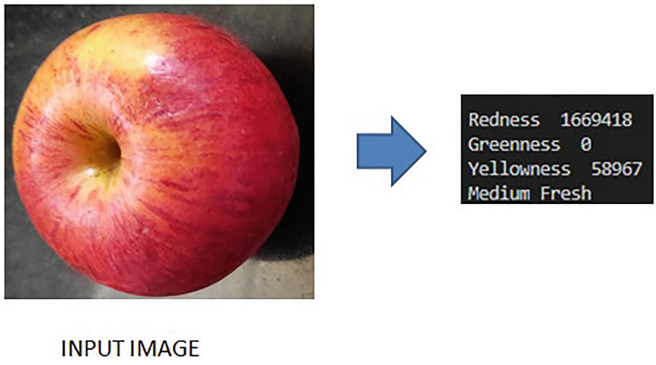

Fig. 8. Results of handling unpacked food

5 Conclusion

- The proposed system can identify the nutrition level from the input image ingredient list
- Based on nutrient level in the ingredient list the system is able to give appropriate suggestions based on identified nutrient level.
- Freshness of the unpacked food item can also be checked
- Regression models were implemented to classify. Lasso regression showed better results in terms of lesser MSE.
- In future the work can be extended to clustering so that system is more robust even for the non-identified objects which make the system more suitable for real time applications.

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