A Method to Read Numbers in Thai Nutrition Facts Label by using SVM

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***Abstract*— Due to a problem of current research occurring when reading the nutrition facts label with Thai font. In this paper, we proposed a method to read the amount of the nutrition numbers on nutrition facts label with Thai font by using integrated image processing technique. This method consists of three steps: label extraction, number segmentation, and number classification. Nutrition facts label image is used as input of algorithm. First, the label is extracted by using a local adaptive threshold. Four sides of a label box are detected from histogram in horizontal and vertical axis. Second, numbers are segmented based on blob region analysis. Blob of number can be defined according to blob sequence in a line. A number in blob of number is then separated. Third, a number is divided into 5x7 regions. A number vector defined from 35 regions is used to classify the number by the support vector machine. To test the performance of the proposed method, number of the amount of the nutrition is extracted from twenty Thai labels. In such labels, there are 180 numbers. A number is classified into number 0-9. By using support vector machine for classification, the accuracy is 81.11%. The experimental result shows the satisfactory results. This is the first method for reading number in Thai nutrition facts label.**

Keywords-component; Nutrition facts label, number calssification, the amount of nutrition.

I. INTRODUCTION

Malnutrition leads to overweight or obese and develops to noncommunicable diseases (NCDs), including diabetes, heart disease, stroke and cancer. Consuming a healthy diet with proper and enough nutrition helps to prevent malnutrition [1]. To balance daily nutrition, nutrition intake should be measured and recorded. Nutrition of a food is also provide in form of the guideline daily amounts label (GDAs) and the nutrition facts label. These label is on the food package. The nutrition facts label reports more nutrition type than GDAs. Recording such nutrition information in daily life is not convenient. Therefore, it is important to develop a new innovation technology to make the consumer more convenient.

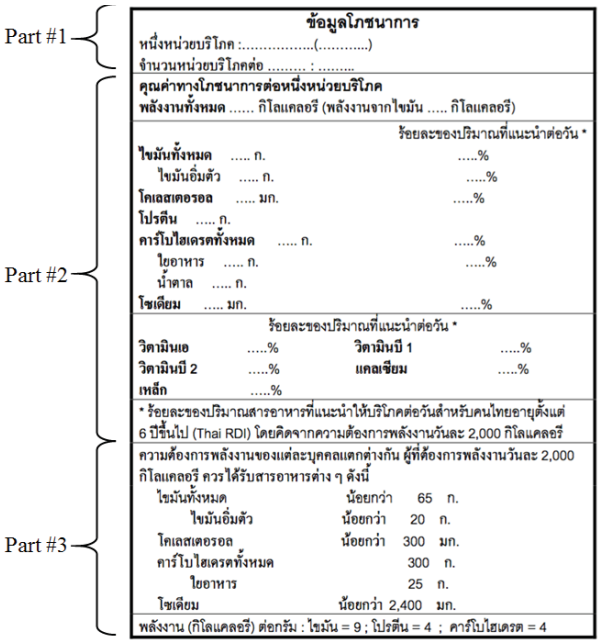

Figure 1 Nutrition facts label format with Thai font [8]

Nutrition facts label is also inform nutrition information on a package as shown in Fig. 1. A label format consists of three parts. Part 1 and 2 are the nutrition information of the food in a package. The amount of nutrition is varied according to type and amount of food in a package. Part 3 is proper nutrition for 2500 calories.

There are many research in proposed to measure the amount of nutrition from images captured in different environment [2, 3, 4]. Capturing a food on a disk into an image is a popular method to measure the nutrition. R. Almaghrabi and et al. [3, 4] proposed a method for a food nutrition and energy intake recognition. Food on disk is captured into an image. Amount of food intake

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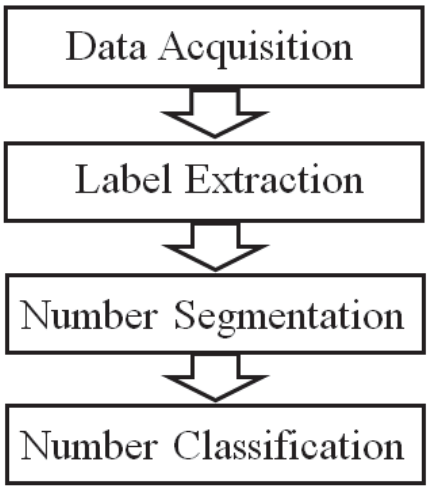


Figure 2 Flowchart of the proposed method

is measured from the difference of food image before and after eating. The nutrition components is estimated from the different food area in the image. M. Sun and et al. also proposed a method for estimating food portion size from food photographic. As these methods uses food image, it is not appropriate for reading number on the nutrition facts label.

Guideline daily amounts label also shows the amount of nutrition of food on a package. It is an alternative solution to understand nutrition components. A. Poonsri and et al. [6] proposed a method to read the amount of food from guideline daily amounts (GDAs) label image. GDAs is captured by a camera. The otsu's threshold is used to define the label area. Four nutrition number is extracted by using histogram technique. Extracted numbers is classified by the Neural Network technique. However, GDAs template is absolutely different from the nutrition facts label.

A method is proposed to read nutrition in the nutrition facts label [2]. This system is developed to recognize nutrition facts from the fact label. A combination of Otsu's method for label segmentation and optical character recognition are used. From 50 images, the accuracy is 64%. However, this method is appropriate for the font in the label is English.

For nutrition facts label, the limitations of existing research reading nutrition facts label is that the method in Ref. 2 performs effectively for the label with English font. Additional, nutrition information and space between words in the facts label of each language is different. Number recognition is a preliminary and significant step before reading the amount of each nutrition in a facts label. Therefore, we proposed a new method for reading number in Thai nutrition facts label.

In the following sections, the algorithms for reading the number in nutrition facts label are described in section II. In section III, the experimental results are shown and discussed. The conclusion is in last section.

II. The Proposed Method

In this section, the proposed method is described. It consists of three processes: label extraction, number

Figure 3 input image

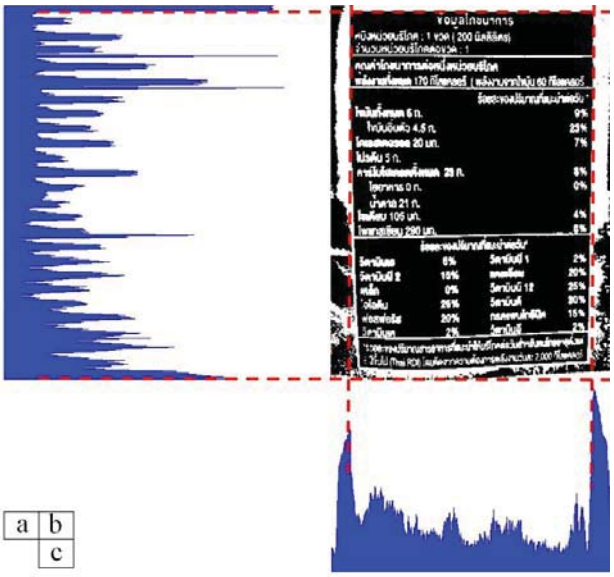
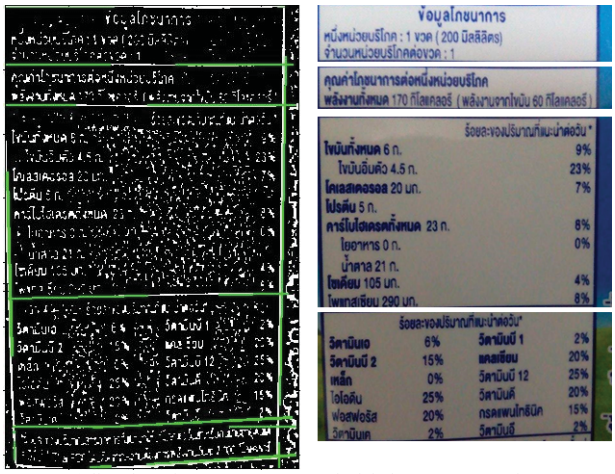


Figure 4 histogram in horizontal and vertical axis of a black and white label image



a) line detection b) label part segmentation

Figure 5 four regions in label extraction

segmentation, and number classification. A flowchart of the proposed method is shown in Fig. 2.

A. Data Acquisition

In this paper, we aim to develop the method for reading the nutrition facts label. A mobile camera is used to take a photo. Distance from a camera to a label is about 5-10 centimeter. An image must cover four sides of label box as shown in Fig. 3. Numbers in part #2 are processed in this method.

B. Label Extraction

Label is extracted by using local adaptive threshold and hough transform. In some cases, shadow lies across the label. A local adaptive threshold method is effective for converting a color image to a black and white image [7]. Lines that are boundary of each part will appear as shown in Fig. 4. To detect the lines on boundary of a label, histogram in vertical and horizontal axis are used. White points are represented in term of horizontal and vertical histogram as shown in Fig. 4a and c, respectively. Highest and lowest position of horizontal lines including linear hough transform technique are used to define the lines on 2 sides of a label box. Lines can be detected by means of the horizontal histogram in Fig. 4a. In the same algorithm, left and right sides of vertical histogram including linear hough transform technique are also used to define the two line on a label box. Two lines on two sides of label box can be also detected as shown in Fig. 4b.

For label parts divider, linear hough transform is used to detect lines in the label region as shown in Fig. 5. These lines are edges to divide each label into three parts. A label is divided into four regions. Numbers will be detect from regions in part 2.

C. Number Segmentation

Numbers in part 2 is the amount of nutrition and calorie. Therefore, numbers in part 2 are segmented. Morphology filters such as dilation and erosion are used to merge characters in a word. Sequence of blobs in a line is referred with the label format for segmenting numbers of the

Figure 6 Sample of segmented numbers from label

nutrition. Segmented numbers are shown in Fig. 6. These numbers are used for classification.

D. Number Classification

Numbers are segmented from a nutrition facts label as explained in previous subsection. In this subsection, numbers classification algorithm is explained.

For numbers classification, data preparation has two steps: size normalization, region divider.

1) Size normalization: as size of number segmented is varied based on area around the numbers, size of sample should be adjusted equally. Height of sample is used as reference.

2) Region divider: a identity vector computed from a number image. A number image is divided into 5x7 regions or 35 element as shown in (1).

$$V = [e_1 \quad e_2 \quad e_3 \ldots \quad e_n] \tag{1}$$

where V is the identity vector, e_i is number of pixel number in a i region.

For classification, the support vector machine is used.

III. Experimental Results and Discussion

In this section, an experiment to test performance of the proposed method is descripted. Cause of error is also described in the discussion.

A. Experimental Results

To test performance of the proposed method, an accuracy of numbers classification is measured. Twenty-one label is captured. Number 0 to 9 are tested. An image is captured from several devices such mobiles or cameras. Numbers in part 2 is segmented and then classified. Support vector machine (SVM) technique with leave one out cross validation is used as classifier. 180 numbers are extracted from the labels. 146 numbers are classified correctly. 34 numbers are incorrect. Accuracy is 81.11%. The experimental result is shown in Table I.

TABLE I. ACCURACY OF NUMBER CLASSIFICATION

Number	Number of test data	Number of correct result
0	38	32
1	28	27
2	31	23
3	15	14
4	15	10
5	25	21
6	12	10
7	2	2
8	6	1
9	8	8
Total	**180**	**146**
Accuracy (%)		**81.11**

Figure 7. a wide range of intensity label.

B. Discussion

As classification of 34 numbers is incorrect, cause of error are light reflection on the label and label distortion. In case of light reflection on the label, intensity on local area in label is vary in widely range or too bright as shown in Fig. 7. Features on a number is segmented incompletely. It cause number classification incorrect. For the distorted label image, this is a cause that light reflects on a label as shown in Fig. 8.

IV. CONCLUSSION

In this paper, we proposed a method to read the amount of the nutrition numbers on Thai front nutrition facts by using integrated image processing technique. This method consists of three steps: label extraction, number segmentation, and number classification. To test the performance of the proposed method, number of the amount of the nutrition is extracted from twenty Thai labels. In such labels, there are 180 numbers tested. A number is classified into class number 0-9. By using support vector machine for classification, the accuracy is 81.11%. Error is occurred from light reflection on a label and distorted label image.

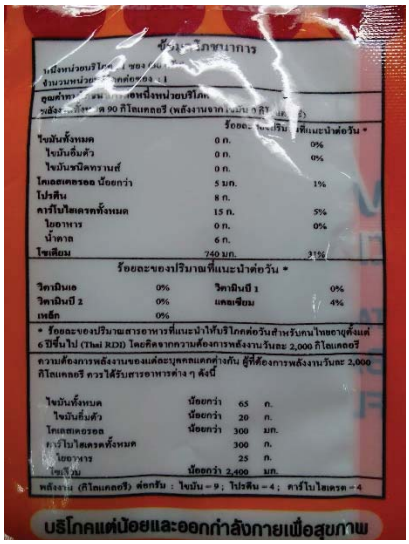


Figure 8. a distorted label

For real world application implementation, current problem of incorrect number classification mush be solved. Limitations of the proposed method that should be improved are light reflection on a label, label distortion, and label inclination.

ACKNOWLEDGMENT

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