Bachelor's Thesis

for the study program B.Sc. Computer Engineering

Iranian nutritional fact scanner and analyzer

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Abstract

In today's world, where making quick and informed decisions is crucial, access to accurate and reliable information about food products is vital for healthier choices. However, consumers often face challenges due to the complexity and inaccessibility of nutritional details on food labels. These labels are typically difficult to read or understand, leading to misinformation and potential health risks.

To address this issue, this project is developed to create an application that uses advanced image processing and machine vision techniques to scan and extract nutritional information from product labels. The application displays details such as energy content, sugar, salt, fat, and trans fats, helping users better analyze the nutritional value of products.

Additionally, the application compares the time of different activities needed to burn the intake calories of the product, offering tailored insights into energy consumption. It also provides access to extra information, including the health license number, brand name, manufacturer details, and expiration date, by verifying the product's license.

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Introduction

1.1. Motivation and objective

With the increasing pace of life and concerns about food safety, access to accurate and comprehensive information about the nutritional value and technical specifications of products has become very important for consumers. The complexity of some labels' information and people's misunderstanding can lead to incorrect choices, so the need for more efficient systems to provide this information is essential.

The project aims to provide an innovative solution to these challenges. An application has been developed that allows users to scan the nutritional value labels of store products and automatically read the information on them using image processing and machine vision technology. This application can extract energy, sugar, salt, fats, trans fatty acids, and other important nutritional information and provide it to users understandably.

In addition, the possibility of inquiring about the health license number of the product has also been provided, allowing users to check the product's technical information and ensure its accuracy and safety.

This project aims to facilitate consumers' access to nutritional and technical information on food products, increase public awareness, and promote community health, playing an important role in making more informed and healthier choices.

1.2. Research Goal

The project is designed to raise awareness and empower consumers to choose appropriate and healthier food products. To achieve this overall goal, more specific goals have been defined, which are discussed in detail below:

1.2.1 Increasing consumer awareness of food products' nutritional content

The main goal of this project is to provide consumers with easy and quick access to nutritional information on food products. Using this application, users can easily view and analyze the amount of energy, sugar, salt, fats, trans fatty acids, and other nutrients. This information helps consumers make better decisions for their health by better understanding the content of products.

1.2.2. Facilitating the process of choosing healthy and appropriate food products

Another important goal of this project is to simplify the process of choosing healthier food products. Using image processing and machine vision technology, the program can quickly and easily present complex and sometimes illegible information on food labels to users. This allows users to choose products that align with their needs and health goals quickly.

1.2.3. Providing technical and health information about products

In addition to nutritional information, the project allows users to access important technical details such as the product's brand name, the name of the manufacturing plant, the date the health permit was obtained and expired, and the plant's address by checking the product's health permit number. This information helps users ensure the quality and safety of the products and make more informed choices.

1.2.4. Increasing transparency in the food industry

Another goal of this project is to increase transparency in the food market. By providing accurate and reliable information about the content and technical specifications of products, this project helps to strengthen consumer trust in the information provided by manufacturers, leading to a more transparent and trustworthy market.

1.2.5. Supporting manufacturers committed to quality

This project can help food producers who value the quality and transparency of their product information to gain a better position in the competitive market. By providing tools that allow consumers to access accurate and reliable information, this project helps promote quality products and increase consumer trust in reputable brands.

1.2.6. Improving the general health of society

This project's ultimate goal is to improve society's general health. By increasing consumers' access to accurate nutritional and technical information, this project will help reduce the consumption of harmful substances such as sugar, salt, and unhealthy fats. This can lead to a reduction in the incidence of diseases related to poor nutrition, such as obesity, diabetes, and cardiovascular diseases, and ultimately improve the community's overall health.

These goals collectively help to achieve a healthier and more transparent food environment, enabling consumers to make more informed and confident food choices.

1.3. Challenges

• OCR systems are usually trained on regular text, which comprises sentences and paragraphs, but nutritional labels are tabular and strongly emphasize numbers. Secondly, these charts are highly variable in terms of colors, brightness, font and text size, patterns, textures, etc., making it very challenging to develop a general system that can generalize to all of these conditions.

• Images captured from labels may contain background noise such as light reflections, shadows, or other nearby products that can reduce text recognition accuracy. Filtering out this noise without losing important information is a major challenge.

• Some labels contain very dense information packed into a small space. Accurate recognition of these dense texts, which may use tiny fonts, is challenging for OCR.

• If the application must operate in real-time, meaning that the user can view the information as soon as they take a photo of the tag, challenges arise such as optimizing processing speed and reducing latency. This is especially challenging on mobile devices with limited resources such as memory and processors.

These challenges not only demonstrate the importance and complexity of the project but also emphasize the need to use innovative approaches and continuous optimizations to achieve desired results.

1. Concept

This part reviews previous research and projects in image processing and optical character recognition. Optical character recognition is one of the key technologies in image processing used to extract text from images. OCR technology has been developed since the 1950s and has seen continuous improvements in accuracy and efficiency over time. Recent advances include the use of deep learning algorithms and artificial neural networks, which have significantly increased the accuracy of character recognition. For example, algorithms such as Tesseract, developed as open source, can accurately recognize texts in multiple languages .

Not much research has been done in the field of extracting information from food labels, one of the reasons for this is the difference between printing nutritional value labels on different products and using different colors. A few examples of research in this field have been conducted on American product labels, and there is no similar system for Iranian products.

2. A review of related work

Few studies and works in image processing and machine vision have been conducted on food product value labels, all of which have been on labels other than Persian. Some of these products are in the form of Android software that tries to provide services with quick and easy access[1], and others are scientific articles that have a similar process to this project, which is explained in more detail below[2-4].

These applications have different ways to obtain user input of nutritional information. One solution for these applications is to use information that a set of users has already collected. Consumers can search for their product by name to find relevant statistics, but the collected data may be lacking.

The information may be repetitive for each product and may not match each other, which confuses the user. The information may also be completely inaccurate because users enter it manually without any restriction. Other solutions that have been implemented revolve around building a database of known products.

Database-based nutritional data requires all the data to be collected in one place. The changing data must be constantly updated. This approach involves a lot of infrastructure, collaboration, and maintenance. If the data is not

maintained or new products are not added, the data the user wants may not exist or be outdated.

Those papers that focused on developing a program based on extracting information from nutritional labels followed a process similar to the one described below.

1. The algorithm takes an image as input.

2. The nutritional label is found in the image and cropped.

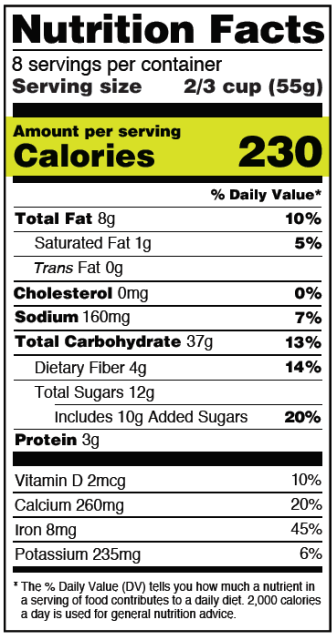
3. The image is divided into sections, each representing a word.

4. The different parts into which the image was broken are read to extract the number or word.

5. The output is obtained and displayed as a list of information.

The data used in these articles is much more limited than the data available in the algorithm introduced in this thesis. One of the articles[2] used classifiers instead of OCR to read words because the words are limited and do not need to be read. This means that if a classification is done incorrectly, that nutrient will be mismeasured. However, using OCR, if there is a problem with reading, one or two letters are changed but the word can be understood from other letters. Of course, if the number of images in the dataset is large, this problem will be somewhat solved.

The Previous research was mainly conducted on American product labels, as shown in the figure below.



Nutrition Facts

8 servings per container

Serving size **2/3 cup (55g)**

Amount per serving

Calories **230**

	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

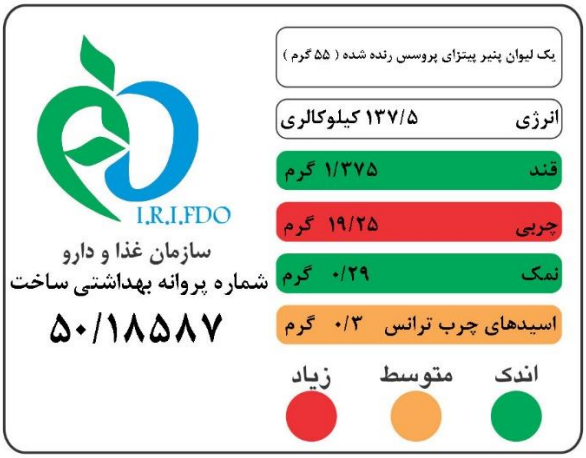
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

American nutritional fact label

This label has more information than the information on Iranian food products. This information includes calories per serving, number of servings per product, types of fat, cholesterol, sodium, total carbohydrates, protein, vitamin D, calcium, iron, and potassium. The amounts of these nutrients are also written in both weight and percentage.

Another main difference between American and Iranian labels is the color of the nutrients' background. This color makes it a little more difficult to read than American labels because the background color code may be difficult to distinguish from the color code of the written text, and the model must be trained on a lot of data to extract information correctly.

Below is a sample of the Iranian nutritional fact label.



Iranian nutritional fact label

Some studies[4] focus on reading labels with a skew of up to 30-45 degrees. However, in this project, the focus is only on the label itself without excessive skew.

3. Summary

This chapter has reviewed previous research in image processing and optical character recognition and discussed the challenges associated with product nutrition labels. Given the lack of research in this field, especially for products with Persian labels, the efforts made in this project can help advance the existing knowledge and expand the applications of OCR in Persian. Also, a review of related research has shown that current systems have limitations, including data inconsistencies and the need to maintain databases.

This project seeks to provide innovative solutions to improve the accuracy and efficiency of OCR systems in recognizing nutrition labels by using new algorithms and diverse datasets.

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Link to the research's repository

https://github.com/Ali-Pourgheisari/Iranian-nutrition-fact-scanner-and-analyzer