**1.Nutrition Analysis using Image Classification**

**1.1 Introduction**

**Python** is an [interpreted](https://en.wikipedia.org/wiki/Interpreted_language), [high-level](https://en.wikipedia.org/wiki/High-level_programming_language), [general-purpose](https://en.wikipedia.org/wiki/General-purpose_programming_language) [programming language](https://en.wikipedia.org/wiki/Programming_language). It was created by Guido van Rossum, and released in 1991.

It is used for:

* web development (server-side),
* software development,
* mathematics,
* system scripting.

Python has syntax that allows developers to write programs with fewer lines than some other programming languages.

Python runs on an interpreter system, meaning that code can be executed as soon as it is written. It is designed for readability

What can I do with Python?

* System Programming
* Graphical User Interface
* Internet Scripting
* Component Integration
* Database Programming
* Gaming, Images, XML, Robot

**Artificial intelligence (AI)** is an area of research that goes back to the very beginnings of computer science. The possibility of building a machine that can perform tasks that require human

             The term Artificial Intelligence has been applied to computer systems and programs capable of performing tasks more complex than basic programming.The most important fields of research in this area include information processing, pattern recognition, and practical fields such as medical diagnosis. Systems are being created that can understand speech and game playing computers are being created that can beat even the best human chess player.

Applications of artificial intelligence

* Knowledge reasoning
* Planning
* Machine Learning
* Natural language processing
* Computer vision
* Robotics

There are various programming languages like Lisp, Prolog, C++, Java and Python, which can be used for developing applications of AI. Among them, Python programming language gains a huge popularity and the reasons are as follows −

Simple syntax & less coding

Python involves very less coding and simple syntax among other programming languages which can be used for developing AI applications. Due to this feature, the testing can be easier and we can focus more on programming.

Inbuilt libraries for AI projects

A major advantage for using Python for AI is that it comes with inbuilt libraries. Python has libraries for almost all kinds of AI projects. For example, **NumPy, SciPy, matplotlib, nltk, SimpleAI** are some the important inbuilt libraries of Python.

* **Open source** − Python is an open source programming language. This makes it widely popular in the community.
* **Can be used for broad range of programming** − Python can be used for a broad range of programming tasks like small shell script to enterprise web applications. This is another reason Python is suitable for AI projects.

**1.2 Objectives of Research**

The main role of this research is to verify the hypothesis that nutrition data can be extricated utilizing integration of vision-based procedures and deep learning from pictures of fruits, which were taken with the help of a hand-held smart-phone camera in a supermarket.

This research exhibits an algorithm that introduces a framework that can be utilized to distinguish the skew angle of a NL with no imperatives on the rotation magnitude and in this manner extricate nutrition information from it by utilizing Deep Learning.

This research was done in 2 stages. The first stage was the advancement of CNN (Convolutional neural network) algorithm. The second and the final stage we use the GUI (Graphical User Interface) with Tk – Python 3.7.3 for displaying the classification of images into nutrition labels.

The first related research area is technology solutions for enhancing the accuracy of dietary measurement. The second related research area is visual-based dietary information analysis.

In this, we employ machine-learned features with deep learning based method, rather than the hand engineered features, to achieve a much higher accuracy.

Further research in information processing includes programs that enable a computer to understand written or spoken information to produce summaries, answer specific questions, and to redistribute information.

**1.3 Problem Statement**

By using this application, one can get a clear idea about the nutritional facts and contents of the selected fruit. It can thus help people in managing their intake of vitamins and nutrients based on their requirement.

**2. Review of Literature**

In recent years, deep convolutional neural networks (CNNs) have shown record-shattering performance in a variety of computer vision problems, such as visual object recognition, detection and segmentation.

These methods have also been utilized in nutrition analysis domain for nutritional facts and classification. We present an extensive literature review of CNN techniques applied in nutrition analysis, focusing on the architectures, pre-processing, data-preparation and post-processing strategies available in these works. The aim of this study is three-fold.

Fruit classification is quite difficult because of the various categories and similar shapes and features of fruit. In this work, we proposed two novel machine-learning based classification methods. We applied CNN to the tasks of food detection and recognition through parameter optimization. We constructed a dataset of the most frequent food items in a publicly available food-logging system, and used it to evaluate recognition performance.

Our primary goal is to report how different CNN architectures have evolved, discuss state-of-the-art strategies, condense their results obtained using public datasets and examine their pros and cons. Second, this paper is intended to be a detailed reference of the research activity in deep CNN for nutrition analysis.

Finally, we present a perspective on the future of CNNs in which we hint some of the research directions in subsequent years.

**3. Data Collection**

Nutrition Analysis uses machine learning algorithms to identify over a hundred thousand fruits. It covers many local and global fruits.

Find out more here at <https://github.com/Horea94/Fruit-Images-Dataset>

It contains a high-quality, dataset of images containing fruits.

The following fruits are included: Banana, Cactus fruit, Chestnut, Dates, Kohlrabi.

Different varieties of the same fruit (apple for instance) are stored as belonging to different classes.

## **Dataset properties**

Total number of images: 3199.

Training set size: 2391 images (one fruit per image).

Test set size: 808 images (one fruit per image).

Image size: 100x100 pixels.

## **Repository structure**

Folders [Training](https://github.com/Horea94/Fruit-Images-Dataset/blob/master/Training) and [Test](https://github.com/Horea94/Fruit-Images-Dataset/blob/master/Test) contain images for training and testing purposes.

Folder test contains images with multiple fruits. Some of them are partially covered by other fruits. This is an excellent test for real-world detection.

Folder [src/image\_classification](https://github.com/Horea94/Fruit-Images-Dataset/blob/master/src/image_classification) contains the python code for training the neural network. It uses the TensorFlow library.

Folder [src/utils](https://github.com/Horea94/Fruit-Images-Dataset/blob/master/src/utils) contains the C++ code used for extracting the fruits from background.

## **Alternate download**

Dataset can also be downloaded from: [Kaggle](https://www.kaggle.com/moltean/fruits) (<https://www.kaggle.com/moltean/fruits>)

**4.Methodology**

**4.1 Data Modelling**

The algorithm applied in the modelling of Nutrition Analysis is CNN ( Convolutional Neural Networks )

Convolutional Neural Networks – which are designed to**address image recognition** systems and**classification** problems, have **wide applications** in image and video recognition, recommendation systems and **natural language processing.**

It is a **popular** deep learning technique for current **visual recognition tasks.** Like all deep learning techniques, Convolutional Neural Networks are very dependent on the **size** and **quality** of the training data.

Convolutional networks were [inspired](https://en.wikipedia.org/wiki/Mathematical_biology) by [biological](https://en.wikipedia.org/wiki/Biological) processes in that the connectivity pattern between [neurons](https://en.wikipedia.org/wiki/Artificial_neuron) resembles the organization of the animal [visual cortex](https://en.wikipedia.org/wiki/Visual_cortex).

They neurons are associated with learnable weights and biases.

Each**neuron** receives several **inputs**, takes a weighted **sum** over them, **pass** it through an **activation function** and responds with an **output.**

**As** its name suggests, it is a **machine learning technique** which is modelled after the **brain** structure. It comprises of a network of **learning units** called neurons.

These **neurons** learn how to convert input signals into corresponding output signals, forming the basis of automated recognition.

The whole network has a **loss function** and all the tips and tricks that we developed for neural networks still apply on **Convolutional Neural Networks.**

There arefour layered concepts we should understand in Convolutional Neural Networks:

1. Convolution,
2. ReLu ( Rectified Linear Unit )
3. Pooling
4. Fully Connected Layer

**5.Conclusion**

In this paper, we have addressed the eﬀectiveness of CNNs for nutrition recognition and intake of nutrients for each fruit.

Convolutional Neural Networks (CNNs) have also shown great generalization capabilities in food detection and recognition

We assembled and trained the CNN model to classify photographs various fruits. We have tested that this model works really well with a small number of photos. We measured how the accuracy depends on the number of epochs in order to detect problem.

We were able to build an convolutional neural network (CNN) that can recognize images with a very high accuracy using TensorFlow than any other conventional method.

We did so by pre-processing the images to make the model more generic, split the dataset into a number of batches and finally build and train the model.