FOOD ADULTERATION DETECTION

Design Project Report

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In

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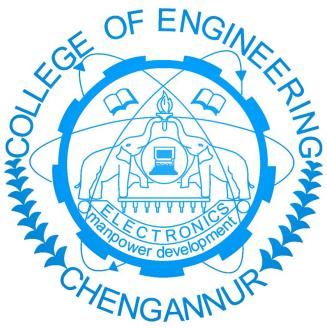

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ABSTRACT

This project was undertaken to develop a software for detecting food adulteration. This software is basically a software which compares two images and finds the difference between them. This software can be implemented in shopping malls, fruits and vegetable stalls and even for personal use on their independent devices.

Functions of the software:

*Can scan the sample
*Can select a material to be compared
*Displays the result along with a graphical chart
*Graphical chart shows the percentage of deviation of various attributes

ACKNOWLEDGEMENT

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Above all, we would like to thank our parents for their blessings, without which we would have been able to accomplish our goal.

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1.INTRODUCTION

The Objective of this project is to detect food adulterants present in different food stuffs.

Adulteration in food is normally present in its most crude form; prohibited substances are either added or partly or wholly substituted. Normally the contamination/adulteration in food is done either for financial gain or due to carelessness and lack in proper hygienic condition of processing, storing, transportation and marketing. This ultimately results that the consumer is either cheated or often become victim of diseases. Such types of adulteration are quite common in developing countries or backward countries. It is equally important for the consumer to know the common adulterants and their effect on health.

The increasing number of food producers and the outstanding amount of import foodstuffs enables the producers to mislead and cheat consumers. To differentiate those who take advantage of legal rules from the ones who commit food adulteration is very difficult. The consciousness of consumers would be crucial. Ignorance and unfair market behavior may endanger consumer health and misleading can lead to poisoning. So we need simple screening, tests for their detection. In the past few decades, adulteration of food has become one of the serious problems. Consumption of adulterated food causes serious diseases like cancer, diarrhea,asthma,ulcers, etc. Majority of fats, oils and butter are paraffin wax, castor oil and hydrocarbons. Red chilli powder is mixed with brick powder

and pepper is mixed with dried papaya seeds.

Several agencies have been set up by the Government of India to remove adulterants from food stuffs. Selection of wholesome and non-adulterated food is essential for daily life to make sure that such foods do not cause any health hazard. It is not possible to ensure wholesome food only on visual examination when the toxic contaminants are present in ppm level. However, visual examination of the food before purchase makes sure to ensure absence of insects, visual fungus, foreign matters, etc. Therefore, due care taken by the consumer at the time of purchase of food after thoroughly examining can be of great help. Secondly, label declaration on packed food is very important for knowing the ingredients and nutritional value. It also helps in checking the freshness of the food and the period of best before use. The consumer should avoid taking food from an unhygienic place and food being prepared under unhygienic conditions. Such types of food may cause various diseases. Consumption of cut fruits being sold in unhygienic conditions should be avoided. It is always better to buy certified food from reputed shop.

2.SYSTEM STUDY

2.1 EXISTING SYSTEM

The analysis part contains the study of existing systems. Some of the existing systems include :

A. Chemical Test

1.Metanil yellow in pulses

Shake 5 gms: of the suspected pulses with 5 ml of water. Add a few drops of

hydrochloric acid. A pink colour shows the presence of metanil yellow.

2. Water in milk:

Measure the specific gravity with a lactome-ter. The normal values will fall

between 1.030 and 1.034. Milkmen are wise to the test and may dilute the

milk only to the right density, so this is only a rough test.

B. Non-DNA based methods

Morphology and physico-chemical based methods

In the past, morphology based methods were the criterion for differentiating various rice groups (Thind and Sogi 2005; Vaingankar and Kulkarni 1989). Significant variation in price within similar kind of kernel morphology, made this criterion unsuccessful for differentiating the cultivars. For instance, premium Basmati rice has long grain and soft texture. There are many long grain rice varieties of low cost with kernel morphology of Basmati but with quality unmatched to it .

C. DNA-based methods

Of all the methods of adulteration detection, DNA-based techniques have wider acceptability due to their simplicity, accessibility, repeatability and rapidness. Advances in the development of DNA markers and cost effective sequencing techniques, renders DNA based methods more popular.

Eg: Molecular markers systems

2.2 PROPOSED SYSTEM

Food adulteration has now become a burning problem. The adulterants used are so similar to natural foodstuffs that it becomes very difficult for a common man to detect them. Hence the software helps us detect the adulterants.

A. Raspberry Pi

The Raspberry Pi is a series of small single-board computer developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that imply, at a low-power consumption level.

B. Microscopy Digital Camera

The microscopy digital cameras are like cell-phone cameras, though much more high-end. A lens focuses an image onto an array of sensors, which records the image. But those sensor arrays are not all alike, and microscope cameras have features that can make them more or less compatible with particular applications.

Conceptual framework:

Features Provided:

1. Mobile app sends the capture request
2. Capture microscopic images
3. Raspberry Pi examines the input images
4. Raspberry Pi processes the image
5. Raspberry Pi outputs the result
6. Mobile app receives the result

Algorithms

- App builder algorithm
- Open CV and Matplotlib algorithm in Raspberry Pi

Tools Used:

- Used Microscopic camera to capture images
- Camera module to connect camera with Raspberry pi
- Used Raspberry pi to process images
- Python Ide
- Wifi module to connect app and Raspberry pi
- MIT AI2 to build app

3.REQUIREMENTS SPECIFICATION

3.1 HARDWARE REQUIREMENTS

The selection of hardware configuration is a very important task related to software development. This system uses 3 different types of hardware parts:

3.1.1 RASPBERRY PI 3

Figure 3.1 Raspberry Pi 3

CPU: 1.2GHz quad-core 64-bit ARM cortex A53

• USB: Four USB 2.0 with 480Mbps data

• Wireless: 802.11n Wireless LAN (Peak transmit/receive throughput of 150Mbps), Bluetooth 4.1

• Memory: 1GB LPDDR2-900 SDRAM

• Camera Interface

• Display Interface

3.1.2. MICROSCOPIC DIGITAL CAMERA

Fig 3.2 Microscopic digital Camera

Specifications:

- Image Sensor: 0.3M CMOS Sensor
- Controller: High Speed DSP
- Magnification: 0 - 1000X (Manually)
- Focus Range: 15mm - 40mm
- LED Quantity: 8pcs LED
- Illumination Scope: 0 - 30000LUX
- Brightness Control: Manual Adjustment
- Power Supply: USB DC 5V
- PC Interface: USB 2.0

3.1.3 SERVER

• Personal Laptop of any Specification to Run as a server
• Uses Apache Web Server
• Wi-Fi Module enabled Laptop
• High Storage capacity

3.1.4 SOFTWARE REQUIREMENTS

Operating System: Ubuntu, Android

Packages: OpenCV , NumPy , Matplotlib

Languages : Python , MYSQL, MIT AI2

4. SYSTEM DESIGN

System design is a multi-step process that focuses on the data structures, software architecture, product details and interface between modules. The design process translates the requirements into a representation of software that can be assigned for quality before coding begins. System design the following steps

1.Input-output design

2.Database design

4.1 INPUT-OUTPUT DESIGN

The goal of designing input data is to make data entry as easy, logical and free from errors as possible. Input design is a part of the overall system design, which requires careful attention.

The proposed system satisfies the following input data objectives:

1.The highest possible level of accuracy

2. The input is acceptable and understood by the user

3. They must specify the steps to follow when an error occurs

4. Identify the data items that needed validation to detect errors

Input Objectives:

1.Avoiding errors in data

2.Checks validation of data

3.Secure

4.Standard software

5.Standard code

Functional Requirement:

1.Image capture

2.Adulterant recognition

3.Comparing with training data set

4.Display result

Non-Functional Requirement:

Performance: The system is to be designed for optimum performance, speedy retrieval and update of the data is to be ensured.

4.2.1 ADULTERANT DATABASE

Adulterant database is a record of identified microscopic images of all the adulterant materials, listed under FCI, taken by the recognition device. When an adulterant recognition device scans a food material, it then matches the identified image against the enrolled image that is stored in adulterant database.

4..2.1.1 DATABASE DESIGN

FIELD	TYPE	NULL	KEY	DEFAULT
ID	INT(11)	NO	PRI	NULL
NAME	VARCHAR(20)	YES		NULL
COLOR	VARCHAR(20)	YES		NULL
DIAMETER	INT(11)	YES		NULL
CELL SPACING	INT(11)	YES		NULL

4.2.2 FOOD DATABASE

Food database is a record of identified microscopic images of all the food materials taken by the recognition device. When an adulterant recognition device scans a food material, it then matches the identified image against the enrolled image that is stored in food database.

4.2.1 DATABASE DESIGN

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COLOR	VARCHAR(20)	YES		NULL
DIAMETER	INT(11)	YES		NULL
CELL SPACING	INT(11)	YES		NULL
AREA	INT(11)	YES		NULL

4.3 Database Design

4.3.1 ENTITY RELATIONSHIP DIAGRAM

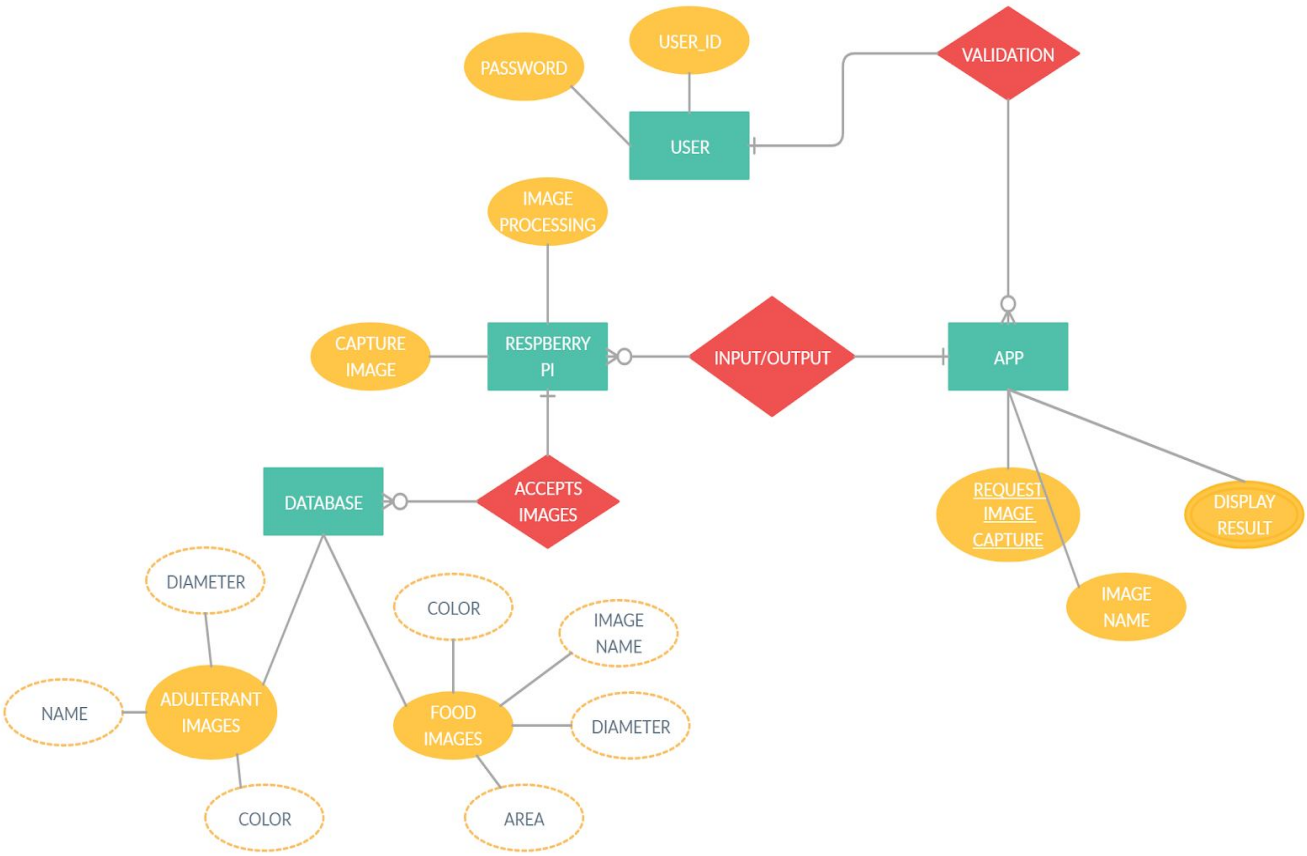
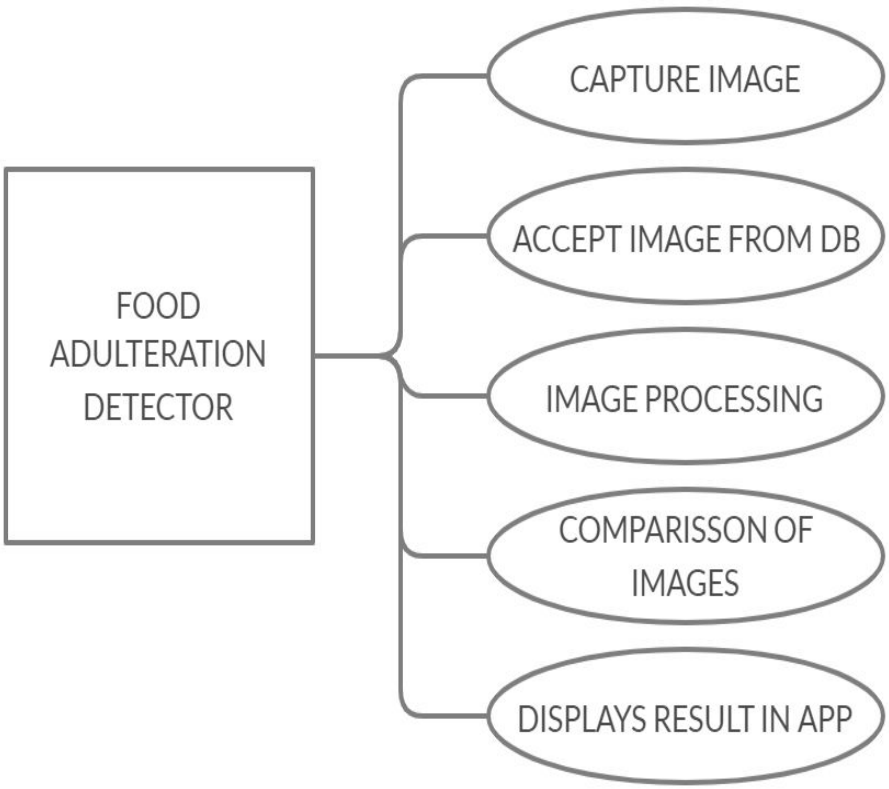


Fig.4.1 ER-Diagram

4.3.2 USE CASE DIAGRAM



5. IMPLEMENTATION

5.1 WORKING

A crucial phase in the system life cycle is the successful implementation of the new product design. Implementation is the stage of the project when the theoretical design is turned into a working model. If the implementation stage is not properly planned and controlled, it can cause chaos. Thus, it can be considered to be the most crucial stage in achieving a successful new product. Normally, this stage involves setting up a coordinating committee, which will act as a sounding board for ideas, complaints and problems. The first task is the implementation planning. The next task in preparing for the implementation stage is training set. Evaluation and maintenance is done to bring the new system to required standards. The implementation phase comprises of implementation planning, education and training system training.

The implementation phase of the software development is concerned with translating design specifications into source code. The user tests the developed system and changes are made according to their needs.

Before implementation, several tests have been concluded to ensure that no errors are encountered during implementation, implementation phase ends with an evaluation of the system after placing it into operation for a period of time.

5.1.1 FOOD DETECTION:

The problem of adulteration recognition is all about adulterant detection. This is a fact that seems quite bizarre to new researchers in this area. However, before adulteration recognition is possible, one must be able to reliably find a food and its features. This is essentially a segmentation problem and in practical systems, most

of the effort goes into solving this task. In fact, the actual recognition based on features extracted from these food materials is only a minor last step.

There are two types of adulterant detection problems:

1) Adulterant detection in images and
2) Real-time adulterant detection

5.1.2 ADULTERANT DETECTION STEPS:

1. Pre-Processing:

To reduce the variability in the foods, the images are processed before they are fed into the network.

All positive examples that are the food images are obtained by cropping images and aligning them. All the cropped images are then corrected for lighting through standard algorithms.

2. Classification:

The model is first trained using the microscopic image of the consumable apple, open CV and matplotlib generates and extracts the features from the image. Now, when it gets the microscopic image of the test apple that has to be checked for adulteration it extracts the features of the test apple and then compares it with the source. Depending upon the percentage of feature matching it displays the labels of whether the apple is consumable or not.

5.1.3 FOOD ADULTERATION DETECTION WORKING

The implementation of this model can be achieved in these Steps:

1. Training of the model using the digital image of the source(consumable apple)

2. Feature extraction of the source is done using matplotlib and open cv for image processing

3. The model is tested using a target (apple used for checking the adulteration)

4. The model extracts the features of the target using open cv and matplotlib

5. Features of the target and source are matched

6. Calculation of the percentage of feature matching

7. If more than 75% of the features are matching then display the label of "consumable" or display the label of "inconsumable" this can be well defined in a diagrammatic representation

5.2 BASIC FLOWCHART :

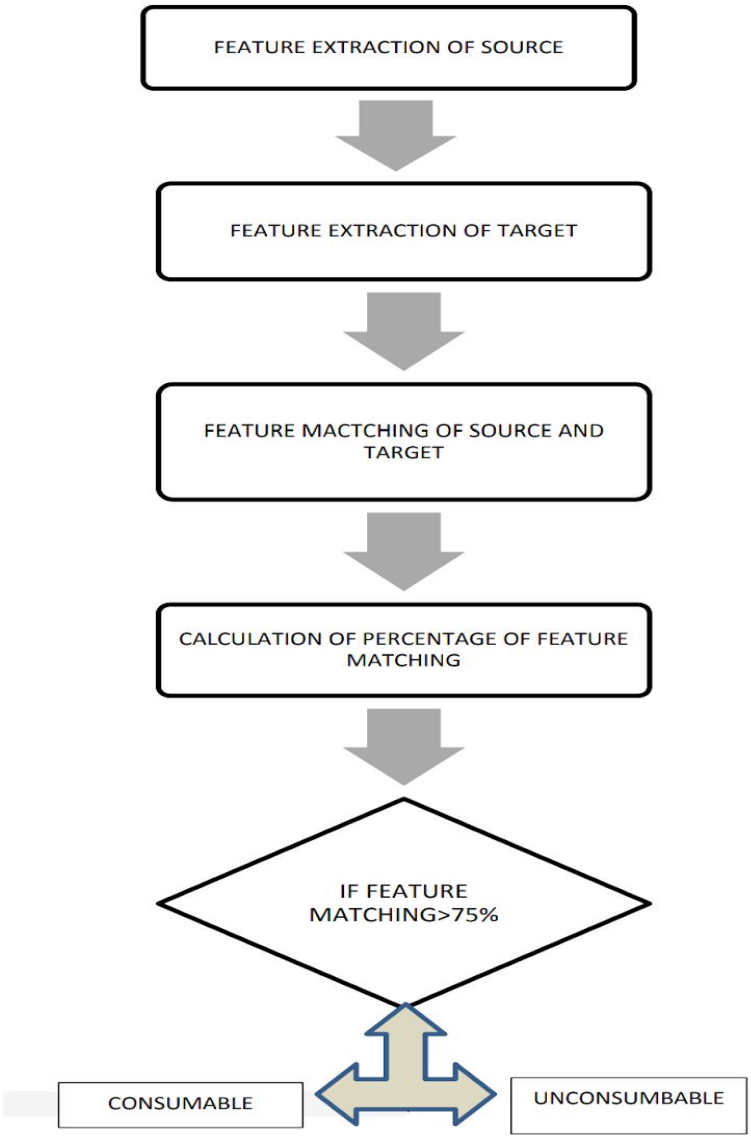


Fig 1. Flow of working of this model

5.2.1 IMPLEMENTATION STEPS

STEP 1: Food capture using Microscopic Camera along with name

Fig.5.3. Capturing of Image

STEP 2: Food item matching the name is sent to the Raspberry pi from Database

Fig.5.4. Images from database to pi

STEP 3: Captured image is detected

Fig 3 - Applet – image to which is to be queried

Fig.5.5 Image Detection

STEP 4: Matching image is imported from database

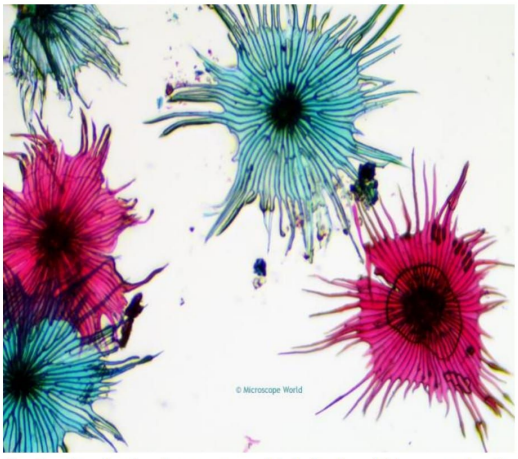


fig 2 - Applet1 – image to which it should be matched

Fig.5.6 Image imported

STEP 5: The image is recognized by comparing with the training set

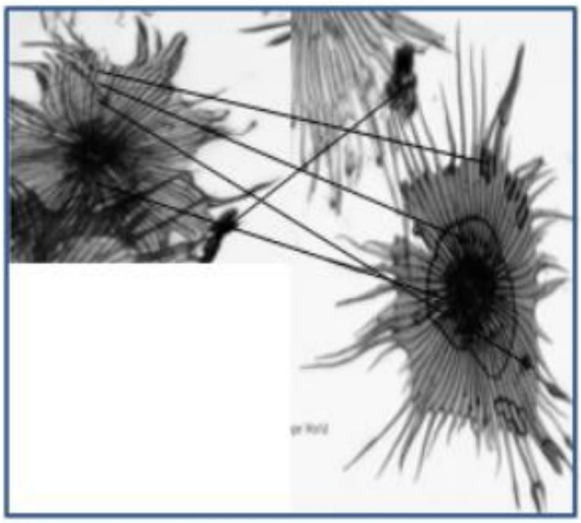


Fig 4 – features matches apples

Fig.5.7 Image Recognition matching

STEP 6: If the images are less matched

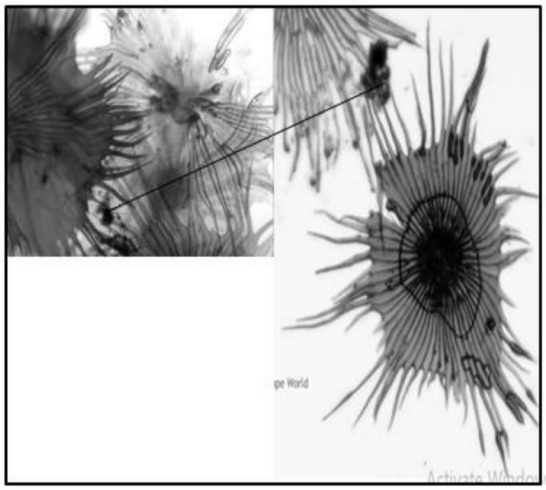


Fig 6 – less features matched apples

Fig.5.8 Image Recognition less matching

5.3 Python

Python is a popular programming language. It was created in 1991 by Guido van Rossum. It is used for : web development (server-side), software development, mathematics, system scripting. Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Python interpreters are available for many operating systems. CPython, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of Python's other implementations. Python and CPython are managed by the non-profit Python Software Foundation. Python 2.0 was released on 16 October 2000 with many major new features, including a cycle- detecting garbage collector and support for Unicode. Python 3.0 was released on 3 December 2008. It was a major revision of the language that is not completely backward-compatible. Many of its major features were backported to Python 2.6.x and 2.7.x version series. Releases of Python 3 include the 2to3 utility, which automates (at least partially) the translation of Python 2 code to Python 3.

Python's large standard library, commonly cited as one of its greatest strengths, provides tools suited to many tasks. As of March 2018, the python package index, the official repository for third-party Python software, contains over 130,000packages with a wide range of functionality, including:

· Graphical user interfaces

· Web frameworks

· Multimedia
· Databases
· System administration

· Image processing. Etc..

5.4 OpenCV

OpenCV is the most popular library for computer vision. Originally written in C/C++, it now provides bindings for Python.

OpenCV uses machine learning algorithms to search for features within a picture. Because features are so complicated, there isn't one simple test that will tell you if it found a feature or not. Instead, there are thousands of small patterns and features that must be matched. The algorithms break the task of identifying the face into thousands of smaller, bite-sized tasks, each of which is easy to solve. These tasks are also called classifiers.

5.5 MySQL

It is an open source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB,now owned by Oracle Corporation. For proprietary use, several paid editions are available, and offer additional functionality.

MySQL is a central component of the LAMP open-source web application software stack (and other "AMP" stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python". Applications that use the MySQL database include: TYPO3, MODx, Joomla, WordPress, Simple Machines Forum, phpBB, MyBB, and Drupal. MySQL is also used in many high-profile, large-scale websites, including Google (though not for searches), Facebook, Twitter ,Flickr and YouTube.

5.6 NumPy

NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays. In 2005, Travis Oliphant created NumPy by incorporating features of the competing Numarray into Numeric, with extensive modifications. NumPy is open-source software and has many contributors.

NumPy targets the CPython reference implementation of Python, which is a non-optimizing bytecode interpreter. Mathematical algorithms written for this version of Python often run much slower than compiled equivalents. NumPy addresses the slowness problem partly by providing multidimensional arrays and functions and operators that operate efficiently on arrays, requiring rewriting some code, mostly inner loops using NumPy.

Python bindings of the widely used computer vision library OpenCV utilize NumPy arrays to store and operate on data. Since images with multiple channels are simply represented as three-dimensional arrays, indexing, slicing or masking with other arrays are very efficient ways to access specific pixels of an image. The NumPy array as universal data structure in OpenCV for images, extracted feature points, filter kernels and many more vastly simplifies the programming workflow and debugging.

6. CONCLUSION

This paper presents a new concept of Adulteration detection in food materials designed for common people using low cost single board computer Raspberry Pi 2 and microscopic camera. For the demonstration purpose, the software is designed to test the purity of an apple. The system capability however can be easily extended to multiple tasks by adding more models to the core program, albeit restricted by the size of the raspberry pi SD card.

This project on "Food Adulteration Detection" which is based on the technology of digital image processing and open source computer vision, can definitely provide a permanent solution for the burning question of adulteration in fruits and vegetables with the help of enhanced research, required data sets and experiments and relieve consumers from the unnecessary intake of poisonous adulterants which will lead to many diseases and premature deaths. The precision of the results rendered by this model would be more accurate as it is developed with the latest technology 'opencv2' and modern tools and libraries like 'numpy, pyplot' As mentioned above this model when built into an application would serve every consumer and the dealers in their day to day routine checking of the goods they buy.

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