Smart Refrigerator for Fruit Classification

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Abstract- *The task to get helpful systems (electronic home appliances) to alter our lives, is one in every of the most functions of intelligent systems. Intelligent appliances with transmission capability are rising into our lifestyle. because of the quick advance of computing technology. sensible house is one in every of the foremost outstanding areas of intelligent appliances. room is one in every of the places wherever such intelligent appliances are used. At an equivalent time, it's been a apply for all people to use the junk foods, or too previous vegetables and fruits in our lifestyle thanks to the busy regular life that we tend to lead. Or some prospects wherever we tend to don't bear in mind the vegetables/fruits we've not been feeding for a protracted time. This successively results in lack of nutrition or, some unsafe infections or may disturb the immunity power in every people. Why do not we tend to encounter a shot to own a tool to point what we've (food/vegetables/fruits) and the way previous is it.*

Index Terms*- Image acquisition, Morphological process, Edge detection, OpenCV.*

I. Introduction

Kitchen is one in every of the foremost vital places for a sensible home because it consists of the many Appliances that provides higher services to the menage. the main target of our project is on the sensible icebox. several efforts within the development of the sensible icebox are created, none of that has been energy economical or price effective. the trendy living and also the fast setting don't permit the user to stay a track of the food things within the icebox. though efforts are place by the trade to develop the sensible icebox, this or the present technology remains not price effective or energy economical. The technology is just too difficult or complicated for a straightforward menage user WHO have very little data of however all the mechanism behind the sensible icebox works. The sensible icebox or the net icebox because it is named, is employed to observe the things within it and give notice regarding scarce merchandise. sensible refrigeration module is meant to convert any existing traditional icebox into a sensible and low price machine victimization sensors and computer science. sensible icebox compares the standing of the food for e.g. weight, amount etc. Significance of this work are going to be removable of food spoilage, cut back health problem and create healthier mode of recent age individual. The sensible icebox is capable of sensing and observance its contents and additionally provides advantageous options. Here we tend to study regarding sensible icebox, as a result of folks area unit terribly busy in day to day life vogue. sometimes {they do|they area unit doing} not very have time to appear when their healthy habits and diet; since we tend to are capable to wear down the technology we will style a sensible icebox system that helps USA to keep up a healthier mode while not putt any additional effort and time. during this project we tend to had propose sensible icebox that results in healthier mode. the concept of connecting home appliances to cyberspace or the wise home setting has been seen as a result of the long run and is extremely thought to be resulting huge issue.

II. Existing System

Existing systems used barcode or RFID scanning to remain track of the stock. The merchandise presently offered unit costly as a result of the user should purchase the whole refrigerator. The Intelligent refrigerator module is supposed to convert ANy existing refrigerator into AN intelligent cost-effective appliance victimization applied science. The intelligent refrigerator is capable of sensing and observance its contents and counts the age of the contents. further utility includes indication of things we've not been feeding for terribly very long time. The core utility of the intelligent refrigerator is to stay up, with minimum effort, a list list of food things that might would like to be purchased as quickly as they flip too previous. As a result, the user is notified each day relating to the count and age of vegetables, and additionally the dud vegetables. A camera is connected to the device running the program. The camera faces a white background and a fruit. The program is

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dead and additionally the maturity is obtained. The maturity is calculated supported straightforward threshold limits set by the pc engineer for the particular fruit.

III. Objectives

Using portable computer Vision Library, we have a tendency to tend to capture footage of food things.
Processing the captured image and analyzing it.
Calculating maturity by a color image of the fruit.

IV. Technology

- **Image method AI tool.**

Manipulating an image to amplify identical to return up with knowledge out of it's spoken as image method. In Image method Phases there unit eight phases for image method that works step-wise:

Image acquisition: Captures the image with a tool and converts it into a manageable entity Image enhancement: The input image quality is improved and in addition extracts details hidden in it

Image restoration: Any achievable corruption like blur, noise, or camera misfocus is removed to induce a cleaner vision on probabilistic and mathematical model basis

Color image process: the colored footage and varied color areas unit processed with pseudo color or RGB process means that.

Image compression and decompression: this permits for changes in image resolution and size, be it for reduction or restoring footage reckoning on the necessity.

Morphological processing: Defines the item structure and kind at intervals the image.
Image recognition: For a selected object, the precise choices unit illustrious at intervals the image and techniques like object detection unit used for identical.

Representation and description: is all relating to visualizing the processed data.
The images captured with regular sensors would love pre-processing as some could contain AN excessive quantity of noise or unit misfocused. There unit two detection techniques to be used for method digital footage additionally as for pre-processing.

Filtering: accustomed modify and enhance the input image. With varied filters on the market, sure options within the image is emphasized or removed, may scale back the image noise then on.
Edge detection: Used for knowledge extraction and image segmentation, to search out substantive object edges within the pictures that are pre-processed.
We are exploitation Edge detection in our project. to form things easier, there are specific libraries and frameworks that may be wont to implement image process functionalities.

OpenCV:
The ASCII text file laptop Vision Library (OpenCV) could be a in style laptop vision library that gives ample algorithms and functions that support the algorithms. It includes numerous modules like, image process module, object detection module, and machine learning module to call some. This library will be wont to perform image process tasks like image acquisition, compression, improvement, restoration, and knowledge extraction.
I. style and Implementation
Image process involves playacting some operations on a picture, so as to urge AN increased image or to extract some helpful data from it. once it involves Python, OpenCV is that the library that provides the most effective image process tools. OpenCV could be a library of programming functions in the main aimed toward period laptop vision. with the exception of mercantilism and saving pictures, OpenCV conjointly provides image process operations like edge detection, segmentation, Morphological operations and plenty additional.
The system consists of three main stages:

Stage1: effort the image of the Fruit:
It involves the capturing of the photographs of the fruit exploitation camera. To capture image exploitation OpenCV initial, we have a tendency to import the OpenCV library. Next, we've got a way referred to as Video Capture that is employed to form the VideoCapture object. This methodology is employed to trigger the camera on the user's machine. The parameter to the current performs denotes if the program ought to create use of the constitutional camera or AN add-on camera. '0' denotes the constitutional camera during this case. And lastly, unharness the discharge} methodology is employed to release the camera in an exceedingly few millisecond. once capturing image, we have a tendency to write image exploitation imwrite() methodology.

Stage 2: Detection process:

The process of image detection involves detection sharp edges within the image. This edge detection is important in context of image recognition or object localization/detection. There ar many algorithms for detection edges because of its wide relevancy. We'll be exploitation one such rule called cagey Edge Detection. cagey Edge Detection is AN rule wont to extract edges from pictures, and since it's quite easy, I think we will begin with it.

The rule has four stages:

1. Performs noise reduction with a mathematician Blur;

2. Gets the gradient direction and magnitude with a Sobel kernel;

3. Applies non-maximum suppression, that removes unwanted pixels that don't seem to be a part of a contour;

4. Applies the physical phenomenon Thresholding that uses min and goop values to filter the contours by the intensity gradient.

after edge detection we discover contours in edge map. Contours are the outer form of AN object that is employed for form analysis. realize the contours and edges of objects exploitation cagey edge detector that produces edge map,

Canny(img_gray, img_canny, 80, 120);

findContours(img_canny,contours,hierarchy,CV_RETR_EXTERNAL,CV_CHAIN_APPROX_SIMPLE);

To show the image with contour use:

imshow ("Contours Demo", drawing);

Next step in image process is color segmentation i.e., Colour filtering. Color filtering is wide employed in OpenCV for distinctive specific objects/regions having a particular color. the foremost wide used color area is RGB color area, it's referred to as AN additive color space as the three-color shades add up to give the colour to the image. to spot an area of a selected color, place the brink and build a mask to separate the various colours. HSV color area is way additional helpful for this purpose because the colours in HSV area is way additional localized therefore is simply separated.

HSV, unlike RGB, separates the image intensity, from the colour data. this could be terribly helpful if we wish to centered on the intensity element, and leave the colour parts alone. Actually, in laptop vision, we tend to typically need to separate color parts from intensity for varied reasons, like hardiness to lighting changes, or removing shadows. as a result of worth is separated, you'll construct a bar graph or thresholding rules victimization solely saturation and hue.

In OpenCV, there are a unit many colorspace conversions (more than 150): RGB ↔ grey, RGB ↔ CIE, RGB ↔ YCrCb, RGB ↔ HSV, RGB ↔ HSL etc. But here, we'll be centered on the foremost wide used ones: BGR ↔ grey and BGR ↔ HSV.

To convert colorspace, we'll use cv2.cvtColor(input_image, flag) wherever flag determines the sort of conversion:

1. BGR → Gray: cv2.COLOR_BGR2GRAY

2. BGR → HSV: cv2.COLOR_BGR2HSV

We grab the higher and lower bounds of the colour we'd wish to discover. during this case, we decide the values from yellow/red-ish to fully red. we tend to produce a NumPy array containing these values:

#Color strength parameters in HSV

weaker = np. array ([0,0,100])

stronger = np. array ([10,255,255])

One more step, Threshold the image to solely show modify the vary we tend to simply outlined. we tend to use the perform cv2.inRange with the parameters being our hsv image and outlined range:

#Threshold HSV image to get input color

mask = cv2.inRange(hsv, weaker, stronger)

Next step is Morphological image process. it's technique for modifying the pixels in a picture. OpenCV incorporates a perform that helps you to do composite morphological operations yet. These operations include: Opening, 2. Closing, 3. Morphological Gradient, 4. Top Hat, 5. Black Hat

The purpose of morphological image process is to get rid of unwanted artifacts from a picture or improve its clarity. associate degree object in a picture is diagrammatic by a selected set of pixels, known as object pixels. Background pixels area unit diagrammatic on an individual basis and area unit white. The operation of abrasion converts pixels related to the object's boundary to pixels within the background, whereas with dilation, the bordering background pixels area unit modified to ones related to the item. Objects become smaller throughout the erosion method, and enlarge or maybe merge throughout dilation.

The two operations is combined in morphological image process, therefore a picture is altered by acting erosion then dilation, which ends in gap. Filaments and isolated pixels is aloof from the item during this thanks to

smooth the image. Background pixels is filtered victimisation the closing operation, which may take away holes and pixels that area unit already best-known to not be within the right place. Another morphological image process technique is termed skeletonization, throughout that additional pixels is removed to create single lines.

Stage 3: Detection of defective fruit:
Find out defective fruit is one in all the foremost vital preprocessing steps. The defective skin is calculated. A color image of the fruit was used for the analysis. If the picture element worth is a smaller amount than the chosen threshold worth then it's thought-about as a district of defective skin i.e., unhealthy quality fruit. Any picture element worth bigger than the chosen threshold worth may be a a part of pure skin i.e., sensible quality fruit. we tend to produce a red HSV color boundary and threshold HSV image and use morphology technique for extracting image parts that area unit helpful within the illustration & description of form. Then we tend to calculate the matureness of fruit by adjusting limits for our fruit and examination with the brink worth obtained earlier to understand the matureness of fruit.
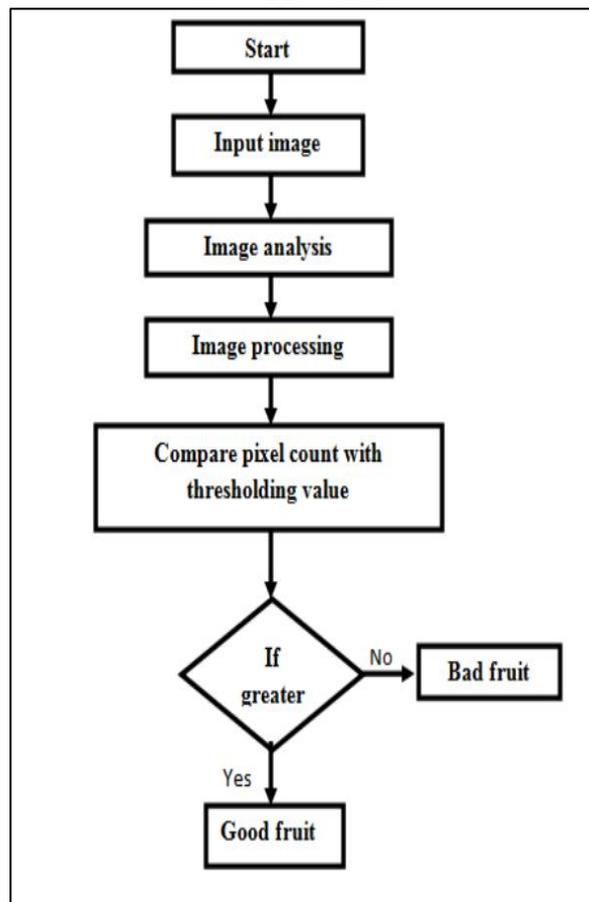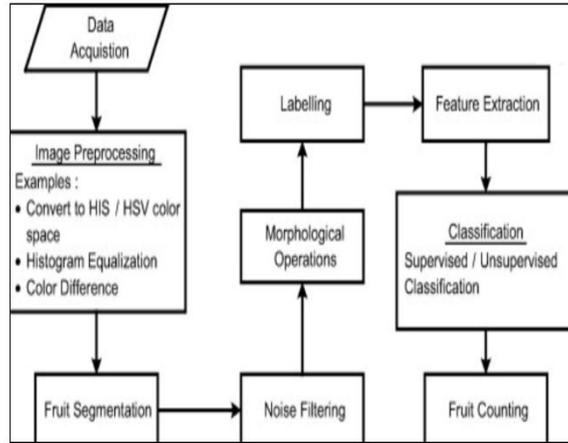
V. Flowchart

Fig. 1 Flow Chart

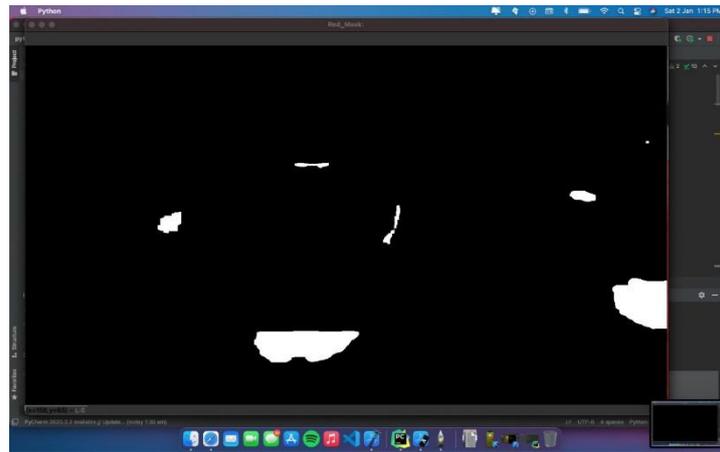**Fig. 2** Component flow diagram

VI.   Results

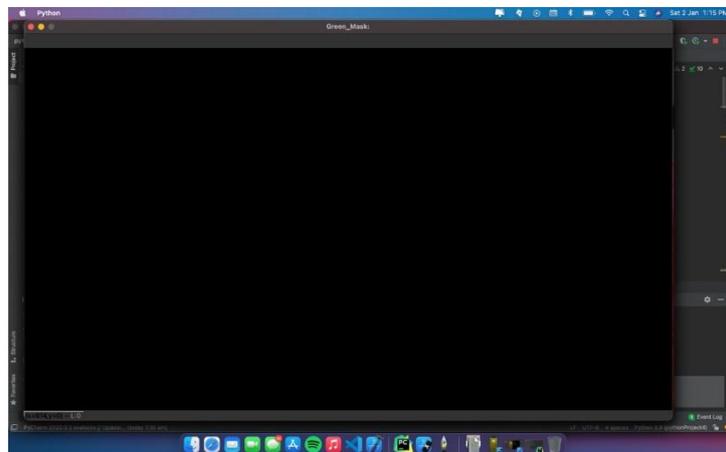**Fig. 3** Screenshot of Red Mask

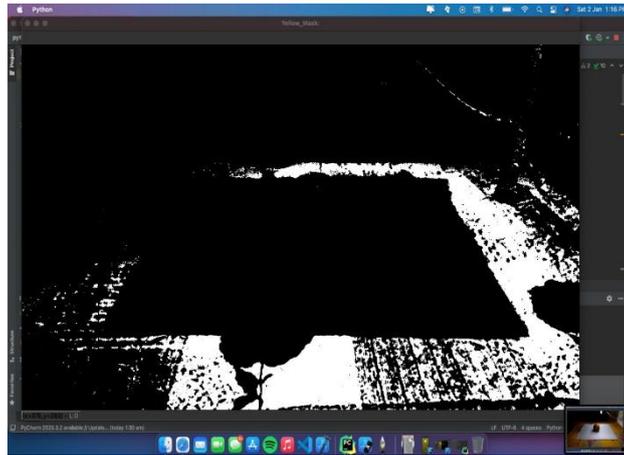

Fig. 4 Screenshot of Green Mask

Fig. 5 Screenshot of Yellow Mask
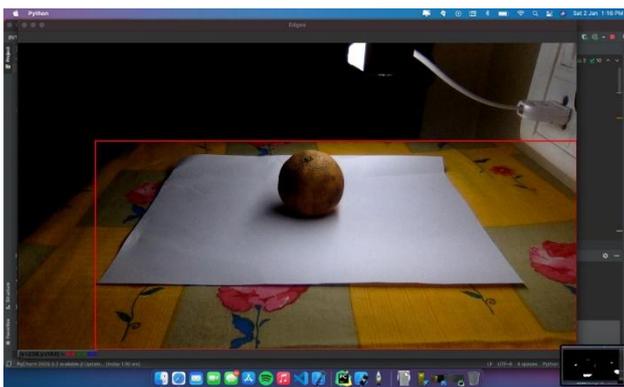

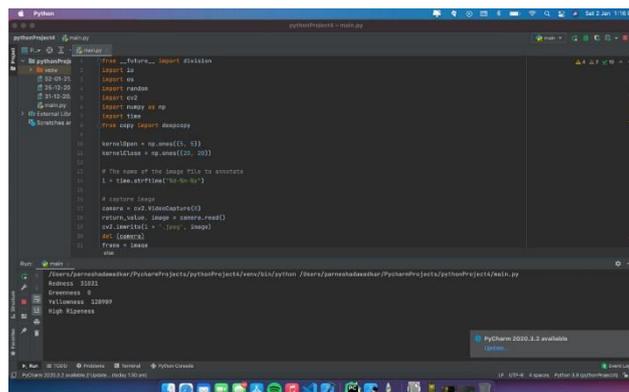**Fig. 6** Screenshot of Camera Capturing image

Fig. 7 Screenshot of Output

VII.   Future Scope

The feature in Smart Refrigerator can be upgraded with a Recipe Creator which can suggest various recipes based on the food available inside the fridge to promote timely use of food before it gets wasted. More area can be converted using more sensors. Device size can be reduced effectively. It can also facilitate purchase of the scarce food items from an online vendor. The notifications and information inside the application that is sent to the user via android application. This module allows the user to indicate a placed order and the other users to acknowledge the placed order.

VIII.   Conclusion

We have introduced smart refrigerator application with intelligent capability. In this project the identification of normal and defective fruits based on quality using OPENCV/PYTHON is successfully done with accuracy. The use of image processing for identifying the quality can be applied to any particular fruit. We can also apply this method to identify quality of vegetables with more accuracy. Thus, this will enable the

technology to be applied in many products. To replace manual inspection of food, computer vision system is used which provide authentic, equitable and non-destructive rating.

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