High Speed Real Time Quality Inspection System

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Abstract- *In Cookie industry, real time inspection of Cookie is necessary to ensure its quality. The Cookie, say bisX, is a premium crispy Cookie with almond and cashew sprinkles on it. The objective of the work is to design, implement and verify a computer vision system for quality control of the Cookie. The quality parameters of the Cookie are colour pattern (which is an indication of cooking i.e over cooked or under cooked), shape, quantity of almond sprinkles, uniformity of almond sprinkles, surface finish (cracked Cookies) and perimeter of Cookie. Numpy operations are extensively used in each stage instead of pre-built algorithms. Cookie is segmented out from undefined background and an ellipse is fitted over that. Cookie, whose major and minor axis difference goes above threshold are rejected so that out of shape and cracked Cookies can be removed. Over baking and under baking of Cookies is determined by plotting a baking curve along which there is a colour variation. The scope of this research lies as the existing bakery inspection methods are not sufficient for providing overall checking of quality.*

I. INTRODUCTION

The bakery sector can be considered to be one of the most important sector in food industry. Real-time inspection is very desirable in this industrial sector because food products like biscuits are being produced by millions each day. Like other manufacturing processes, quality evaluation and sorting are two essential operations performed routinely in every biscuit factories. Since the particular biscuit(that is the biscuit we are inspecting in our project, as a part of NDA name of the biscuit is kept confidential) belongs to premium class, quality of the biscuit is very important. Cracks over the biscuit, improper baking, non-uniform distribution of nuts, improper shape etc will cause consumer complaints. In traditional quality inspection systems, quality evaluation is done by some trained inspectors and they take decisions accordingly. But these decisions are always variable, time consuming, labour intensive and prone to errors. Therefore robust Real time high speed biscuit quality inspection system is sufficient for detecting proper biscuits and rejecting false biscuits.

CURRENT FOCUS OF RESEARCH IN THE AREA OF BISCUIT INSPECTION

As the existing bakery inspection systems are inefficient to give the real time robust inspection of the quality of the biscuits. The focus of the Research in the area of biscuit inspection is to build a robust and high speed system which will process min 5 biscuits per second. Also the focus will be on exact crack detection, shape detection, proper bake detection, crispiness detection.

APPLICATION OF BISCUITS INSPECTION SYSTEM

It is an industrial application which will decide an appropriate the quality of the rich biscuits. It will be built in real time industry. As a part of NDA (Non Disclosure Agreement), the name of the company and biscuit model are kept confidential.

II. LITERATURE SURVEY

Computer vision techniques used for quality evaluation of bakery products are highly application dependent. The development of segmentation method, the choice of color space, the extraction of size, shape and texture features, and the selection of classification technique have to be tailored to the task to be performed. Techniques employed for different bakery products are summarized in separate sections of the papers. The color, size and shape inspection techniques for bread, muffins, biscuits and pizza bases, along with others, are described, respectively. In addition, the methods for texture inspection of crumb grain are searched and the segmentation and classification methods developed for different bakery products are also searched. Also one of the challenges associated with machine vision inspection of biscuits or baked products with non-uniform color distributions and textured background is the detection of a small and minute crack. In this study, a pyramid automatic crack detection scheme was proposed. This requires an enhancement method to properly distinguish the crack and intact samples. CannyâASDeriche filter was used to emphasis the crack and reduce the noise. In order to segment minute crack pattern with less noise, a unimodal thresholding technique was developed and tested. Also in the literature survey I took the survey of current biscuit inspection systems in which the an intelligent system for color inspection of biscuit products is proposed. In this system, the state-of-the-art classification techniques based on Support ector Machines (SVM) and Wilk's Îz analysis were used to classify biscuits into one robust and real time inspection of quality of the biscuits.

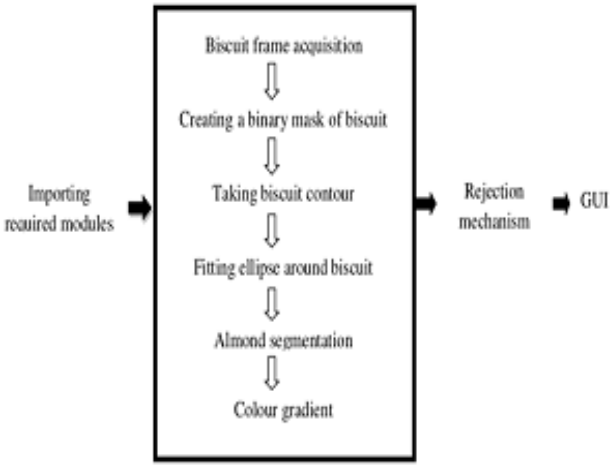
III. ROLE OF COMPUTER VISION IN AUTOMATIC INSPECTION SYSTEM

Image Quality control is the most important factor for any manufacturing industries.

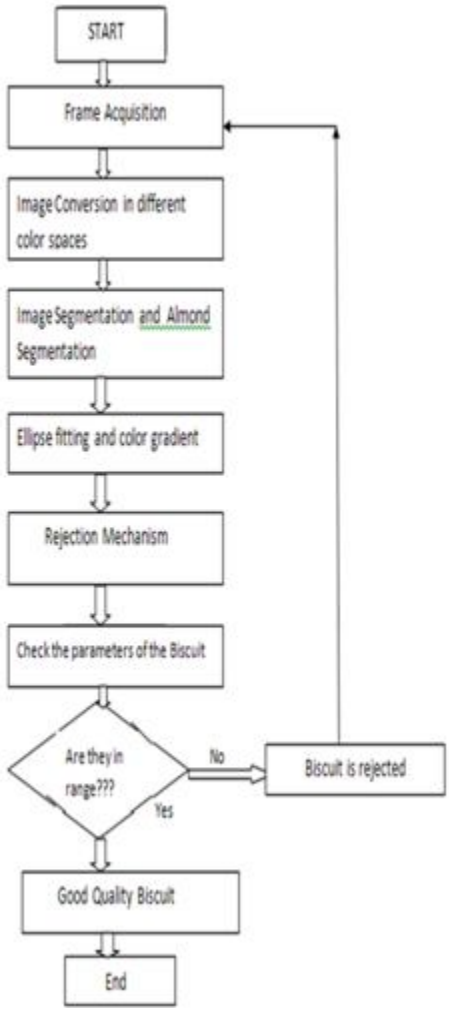
Since the conventional defect detection methods are slow, subjected to errors and time consuming, most of the industries now opt for automatic inspection systems. Also, the increasing production speed and high labour charges also paved way for the fast existence of this new trend. Increased expectation of high quality products from customers made the industries more responsible. As a solution to these problems, artificial vision based automatic inspection systems arrived. The field of machine vision, or computer vision, has been growing at a fast pace. As in most fast-developing fields, not all aspects of machine vision that are of interest to active researchers are useful to the designers and users of a vision system for a specific application. Decreasing size and cost of computer vision systems with increasing functionality, power efficiency and ease of use is making such systems an inevitable device of industries and factories. Camera, lighting system and an image processing unit is the main components of every computer vision based automatic inspection systems. Computer Vision (CV) is the process of applying a range of technologies and methods to provide imaging-based automatic inspection, process control and robot guidance in industrial applications. While the scope of CV is broad and a comprehensive definition is difficult to distil, a generally accepted definition of computer vision is âAŸthe analysis of images to extract data for controlling a process or activity. Computer vision is a novel technology for acquiring and analyzing an image of a real scene by computers to control machines or to process it. It includes capturing, processing and analyzing images to facilitate the objective and non-destructive assessment of visual quality characteristics in agricultural and food products . The techniques used in image analysis include image acquisition, image pre-processing and image interpretation, leading to quantification and classification of images and objects of interest within images. Images are acquired with a physical image sensor and dedicated computing hardware and software are used to analyze the images with the objective of performing a predefined visual task. Computer vision âAZs advantages over many other detection sensors or location technologies are generally twofold. First, computer vision systems are relatively inexpensive and can be easily installed on a vehicle or road infrastructure element, and they can detect and identify objects without the need for complementary companion equipment such as transponders. Second, computer vision systems can capture a tremendous wealth of visual information over wide areas, often beyond the longitudinal and peripheral range of other sensors such as active radar. Through continual innovations in computer vision processing algorithms, this wealth of visual data can be exploited to identify more subtle changes and distinctions between objects, enabling a wide array of evermore sophisticated applications. Here are a just few examples for (machine) vision technology applications: Inspecting of the surfaces of bathtubs for scratches. Checking whether airbags have been properly installed into cars. Applying adhesives evenly and correctly. Verifying that welds are strong enough. Checking paper in the production process for flaws. Making sure that syringes are manufactured properly. Finding irregularities on flat glass. Guiding robots so that they can adapt to changes in their environment. Reading license plates of cars. Recognising and identifying persons. Reading addresses on parcels and checking their dimensions.

Figure 3.1: Computer vision system

IV. FLOW CHART



Method flow chart



Program flow chart

V. METHODOLOGY

5.1 BISCUIT FRAME ACQUISITION

After production and baking, biscuits comes through a conveyor belt and a camera mounted above the belt. Camera will capture each biscuit frame as they comes. Cv2 module is used for capturing frame from video.

5.2 CHANGING COLOUR SPACE

Each RGB biscuit frame is then converted into gray and HSV colour space.

5.3 COLOUR PICKER

A color picker code is written for getting hue and saturation values of each biscuit. It is picked up using mouse clicks on the biscuit. The âAŸg input âAZ fuction in matplotlib is used for color picking.

5.4 THRESHOLDING

Using minimum and maximum value of hue and saturation, which is obtained from colour picker, a threshold is set. Using the threshold, a biscuit mask is created.

5.5 BLOB REMOVING

A biscuit frame will contain not only the proper biscuit but also broken pieces of biscuits.

Therefore broken pieces are considered as blobs and they have to be removed for proper segmentation. For blob removal and binary mask creation, we use the concept of contours and hierarchy.

5.6 CONTOURS AND HIERARCHY

Contours are simply a curve joining the adjacent points have same colour and intensity values. Contour concept is useful for shape analysis, object detection and object recognition. Using the function cv2.find contours, contours and hierarchy of all objects in the frame are calculated. Then 4th column of hierarchy is extracted which contains parent of contours. From this parent of contours, contours having no parents is shortlisted. Contours having no parents are indicated as -1. Biscuit will be a contour without parent. Then index of all those contours are calculated. With the help of these index, using a for loop, area of contours are find out. With the assumption that largest contour area in the frame will be biscuit contour, all other contours are set to 0 and biscuit contour is set to 1.

5.7 SEGMENTATION

Biscuit mask is then multiplied with original RGB color image to get the segmented biscuit image.

5.8 ELLIPSE FITTING

An ellipse is fitted over the biscuit and its major axis and minor axis is calculated. If the difference between major and minor axis is large, then it shows the indication of cracks and those biscuits are rejected out. Ellipse is flexible and it gets automatically adjusted for biscuits

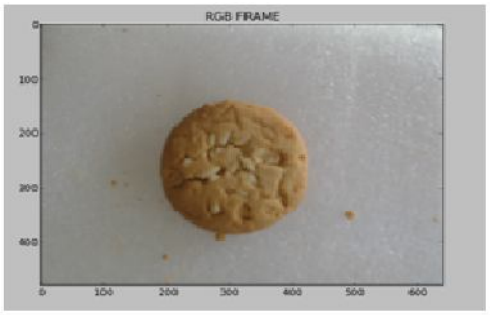
5.9 ALMOND MASK CREATION

Almond colour picker is created and threshold is determined. Then no: of almonds is counted and area is calculated.

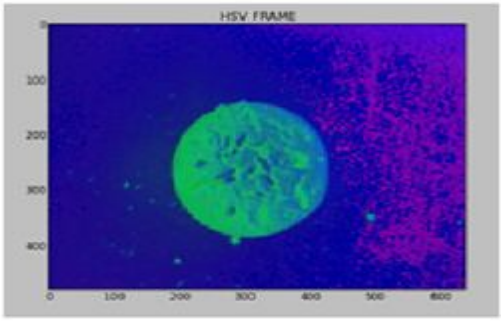
5.10 BAKING CURVE

Variation in colour from center of biscuit towards edge is plotted. Using graph values, it is possible to find out whether biscuit is overcooked or under cooked. Only normal ones are kept and others are rejected.: RGB Frame

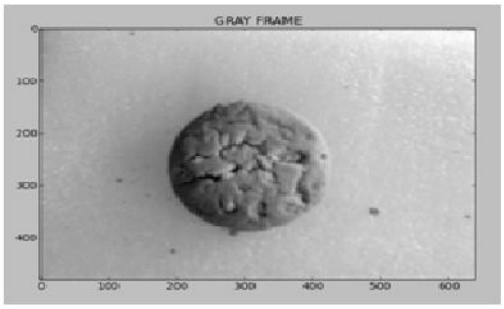
VI. RESULT & TESTING



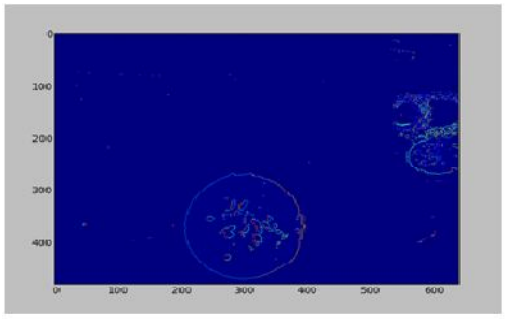
RGB Frame



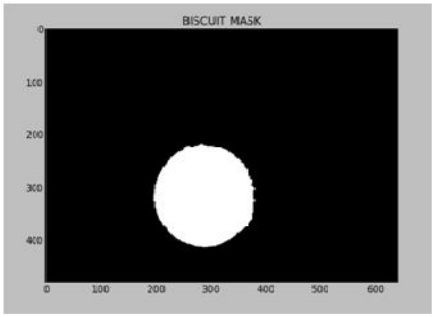
HSV Frame



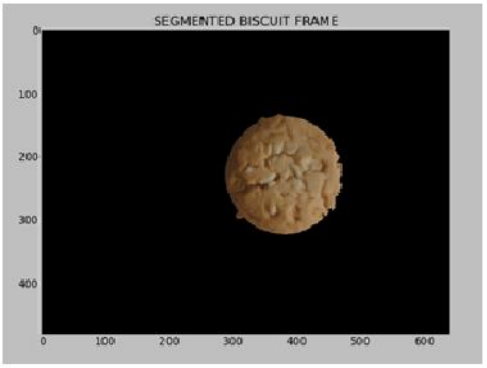
GRAY Frame



Contours of Biscuit Frame

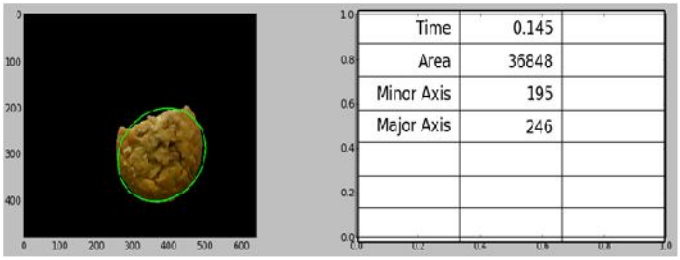


Biscuit Mask

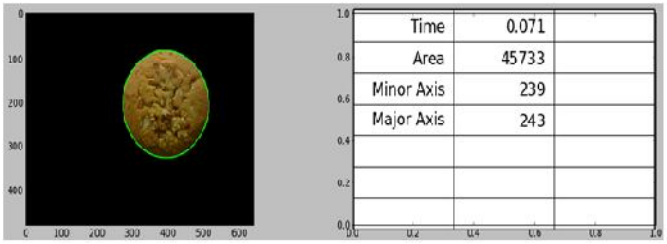


Segmented Biscuit

Ellipse Fitted Around Biscuits



Broken Biscuits



Good Biscuit

VII. ACKNOWLEDGMENT

We have great pleasure in presenting a project report on "HIGH SPEED REAL TIME QUALITY INSPECTION SYSTEM"

We would also like to take this opportunity to express our honor and respect to Dr. S. V. Admane, Principal,Imperial College Of Engineering and Research, Wagholi, Pune 412207. Our sincere thanks to our guide Prof. S. K .Bhatia , for their suggestions in presentation of this report. We would also like to thank our teaching and non-teaching staff member for the guidance for our project.

Finally, we would like to thank all those who directly or indirectly made a contribution to complete this report

VIII. CONCLUSION

Biscuit inspection system using computer vision and python is found to be more efficient in detecting small as well as large cracks. It can also be used for almond detection and various other parameters. Quality control can be achieved with minimum cost .Moreover it increase inspection speeds beyond human operators It is suitable for use in high-volume production of biscuits.

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