Improved Porous Identification using Segmentation

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Abstract:- **Porous measurement is one of the important criteria in maintaining the quality of the sponge. Detection of porous in sponge is one of the more intriguing problems in computer vision. Porous identification plays an important role in determining porous and to detect their defects. By means of simple segmentation technique the edges of the porous in sponge are identified. Porous per inch (PPI) is used as a standard and it is compared with the dataset. In this paper we have developed two segmentation methods for porous counting. First one is porous counting based on simple segmentation (PCSS) and the second one is porous counting based on watershed segmentation (PCWS). The experimental result shows that the PCWS provides better porous count compared to the manual and PCSS.**

Keywords- Edge based segmentation, Thresholding, watershed segmentation, Morphological operation, Morphological Reconstruction.

I. INTRODUCTION

In the modern foam industry, the quality control section employs human experts, who count the porous physically through visual inspection. And the global economic pressures have gradually led to business more competitive. Therefore, automatic visual inspection systems are increasing in demand for insuring high quality of products in production lines. Porous identification has been an active and popular research topic in computer vision.

The segmentation is desired in the field of texture industry to aid the analysis of
texture images by delineating round objects and obtaining information about objects, size, area, or shape to locate their positions or measures useful properties. Several
an algorithm for segmentation has been published. Watershed segmentation is a powerful tool for image segmentation. There exist two basic ways of approaching image
segmentation. The first one is boundary based and detects local changes. The second
is region based and searches for pixel and region similarities.

Unfortunately this segmentation leads to an over-segmentation of the image. To overcome this problem, a strategy has been proposed called marker-controlled
segmentation. It is based on the idea that machine vision systems often roughly know from other sources the location of the object to be segmented. This approach first defines the properties which will be used to mark the objects. These markers are called object markers. The same

is done for the background, i.e. for portions of the image in which we are sure there is no pixel belonging to any objects. These markers constitute the background markers.

The rest of the paper is straightforward and is used for all similar applications. The gradient image is modified in order to keep only the most significant contours in the areas of interest between markers.

The gradient image is often used in the watershed transform, because the main criterion of segmentation is the homogeneity of the gray values of the objects present in the image. But, when other criteria are relevant, other functions can be used. In particular when segmentation is based on the shape of the objects, the distance function is very helpful.

We focus on the design and development of the algorithm that automatically identifies, segments counts the porous from the sponge image, Firstly the morphological opening and closing reconstruction filter is used to remove the image noise, then we segment the reference image by using watershed algorithm. This will eventually improve the performance and ensure the quality of visualization of the sponge. Section 2 deals with the related work and section 3 deals with the proposed method used in the project,Section4 deals with the experimental results, Section 5 summary and conclusion.

II. RELATED WORK

Important issue concerning fundamental aspects of image segmentation methods initialization, convergence, ability to handle topological changes, avoiding over-segmentation. Watershed segmentation can classify the intensities with very small differences. Basic watershed algorithm is an efficient morphological segmentation tool. Major problem with watershed transformation is that it produces a large number of segmented regions in the image around each local minima embedded in the image[7].Gray scale reconstruction in various image processing applications and aims at demonstrating the usefulness of this transformation for image filtering and segmentation tasks[2]. A new approach for the segmentation problem taking advantage of the topological gradient approach and the watershed transformation[6].Tree counting by morphological opening and closing by reconstruction and watershed transform to delineate overlapping tree crowns[5].An efficient method for image segmentation based on multi resolution application of a wavelet transform and marker based watershed segmentation algorithm, also address the issue of excessive

fragmentation into regions of watershed segmentation, which is avoided by the multiresolution analysis fact [3]. Wavelet transform and gradient methods in the preprocessing stage and the application of the watershed transform for enhanced images [1]. Multiscale analysis of intensity minima in the gradient magnitude images provides a mechanism for imposing a scale based hierarchy on the watersheds associated with these minima [4].

III.POROUS COUNTING USING SIMPLE SEGMENTATION (PCSS)

The overall architecture is shown in Figure 1. Initially the sponge image is loaded and the image is converted into gray image. The edges of the porous are identified by means of edge based segmentation. The image is then converted into binary for clear representation of porous. Porous ambiguity is checked, it is counted and it is compared with the manual count. If the count is equal then the quality is verified.
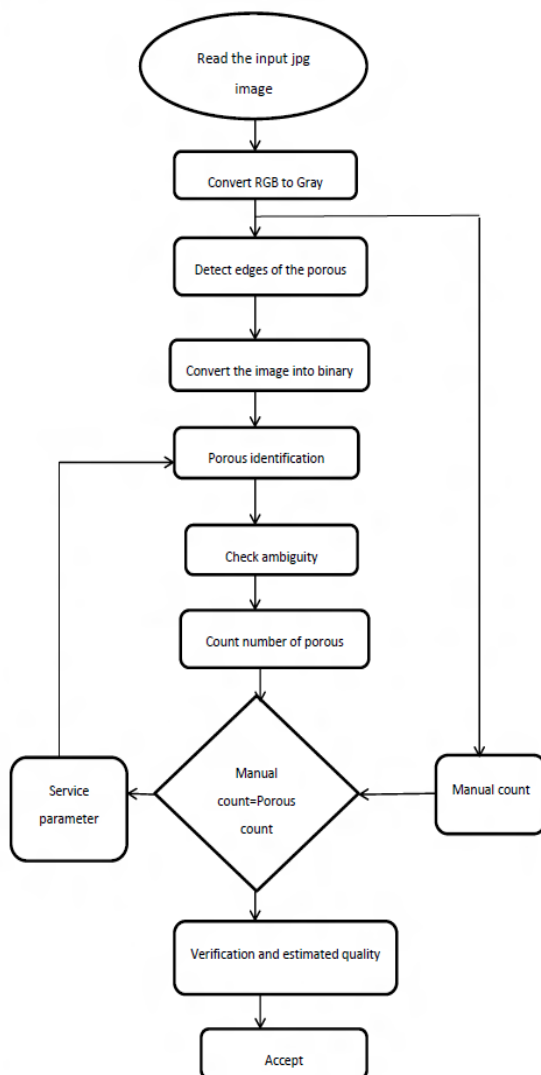

Fig 1:Block diagram for PCSS

A. Sponge Image

Sponge image is loaded as input image. Loaded image is converted into gray image. Then the image is resized into a fixed size. The image we processed are free from noise and the preprocessing stage makes the image ready for further processing.

B. Edge based segmentation

Edge based segmentation represents a large group of methods based on information about edges in the image. In edge based segmentation, an edge filter is applied to the image, pixels are classified as edge and non-edge depending on the filter output, and pixels which are not separated by an edge are located to the same category.
To identify the edges in the sponge image Sobel edge detector is used. Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. The Sobel operator is based on convolving the image with the small, separable and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations.

C. Thresholding

Thresholding is the most frequently used technique to segment an image. Thresholding technique identifies regions based on the pixels with similar intensity values. Thresholds map a gray valued image to a binary image. After thresholding operation, the image has been segmented into two segments, identified by the pixel values 0 and 1 respectively.

The binary information should contain all of the essential information about the position and shape of the objects of interest. The advantages of obtaining first the binary image is that it reduces the complexity of the data and simplifies the process of recognition and classification.

Distinct porous boundary in the sponge is determined and each segmented porous is identified and it is labelled. Number of porous in the image is identified by fixing the threshold value. Number of porous counted is tested with the manual count and the sponge is graded as good/better/poor quality.

IV.POROUS COUNT USING WATERSHED SEGMENTATION (PCWS)

The overall architecture is shown in Figure.2. Initially the sponge image is loaded and it is converted to gray image. Segmentation using watershed methodology is performed and the porous in the images are identified. In order to avoid overlapping of porous filtering technique is used to eliminate the background and the ambiguity of the porous is checked, it is counted and it is compared with the manual count. If the count is equal then the quality is verified and the sponge is accepted. If it is not correct then it is recomputed to find the number of porous.
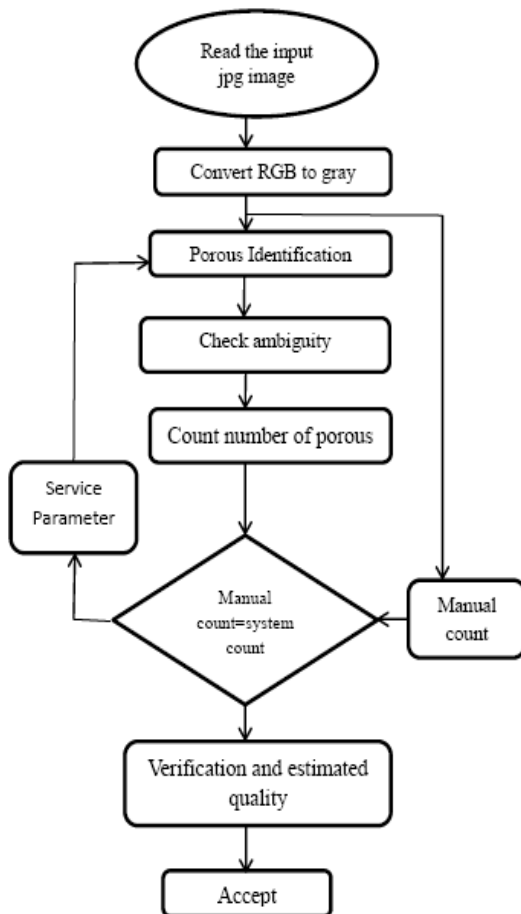
Fig 2: Block Diagram for PCWS

Watershed extraction generally means the thinning of the gradient image with the homotopic transformation. It also involves the detection of basins as regions and crest lines as boundaries for these regions. For these reasons, a watershed approach generally leads to finding the structures in an image based on an edge detection strategy.

C. Morphological processing

Morphological opening is used to smooth the contour of the image. Opening is the sequential combination of erosion and dilation. Though the structuring element takes care of the shape of the feature while processing the image, however, treat objects of same shape but of different size equally. The opening operation helps in smoothing the sponge image and helps in segmentation.

The basic effect of an opening is somewhat like erosion in that it tends to remove some of the foreground pixels from the edges of regions of foreground pixels. However it is less destructive than erosion in general. As with morphological operators, the exact operation is determined by the structuring element. The effect of the operator is to preserve foreground regions that have similar shape to the structuring element, or that completely contain in structuring element, while eliminating all other regions of foreground pixels.

D. Morphological opening by reconstruction

Reconstruction is a morphological transformation involving two images and a structuring element. One image, the marker, is the starting point of the transformation. The other image, the mask, constraints the transformation. In morphological opening, erosion typically removes small objects and subsequent dilation tends to restore the shape of the objects that remain. However the accuracy of this restoration depends on the similarity between the shapes and the structuring element. The size of the structuring element in the erosion step determines what structures are removed by the opening by reconstruction. The opening by reconstruction restores the original shapes of the object that remain after erosion. Regional maxima used in watershed filters are based on labeling approach. The concave and convex filters are therefore capable of providing more information than just a location and the value of the regional minima provide some clues about the local topology. Our next step is to compute the watersheds for an image to identify the local intensity minima and maxima.

With the help of regional minima and maxima the foreground and the background pixels are identified it is superimpose with the original image and it is checked for originality. By identifying the internal and external markers the porous is determined and it is counted.

E. Porous Count

The porous count of the sponge image is done by using the Euler count.
Euler count is computed as the difference of the number of connected components and that of holes. Holes as one important property of a binary image are locally countable.

A. Sobel mask and Gradient magnitude.

The gradient magnitude is used often to process a gray scale image prior to using the watershed transform for segmentation which is computed using linear filtering method. A gradient is a two dimensional vector that points to the direction in which the image intensity grows fastest. The gradient magnitude gives the amount of difference between pixels in the neighborhood which gives the strength of the edge. For any gray scale image (m,n), at co-ordinates(m,n), the gradient vector magnitude and angle at which maximum rate of change of intensity occurs at the specified co-ordinates(m, n).

B. Watershed Segmentation

The watershed is the key building block for morphological segmentation. In particular the gray scale segmentation methodology results from applying the watershed to morphological gradient of an image to be segmented. The watershed methodology has become highly developed to deal with numerous real world contingencies, and a number of implementation algorithms have been developed.

Generally, the method is applied to images that have been transformed by gradient like operator based on the measure of the local slope of the gray level function.

This can be defined using 4 or 8 connectivity. The Euler number is a topological invariant and it is thus a useful feature for shape analysis.

$$Euler = X - V$$

Where X is the number of objects in the image and V is the number of holes in the sponge image. Here in the sponge porous analysis the foreground and the background porous count are estimated and the average of both the result is compared with the manual count and the quality is estimated.

V.EXPERIMENTAL RESULTS

The test images are created by taking the photograph of physical sponge samples obtained from the U-FOAM pvt Limited, Hyderabad, Quality Control Division, where the actual manual quality check is carried out. The test samples are of specifications 6-7 PPI, 15-17 PPI, 30 PPI, 38-40 PPI   The images of these samples are taken by a camera model canon 600D 32 megapixel digital single lens reflex camera. The images are captured at a height of 1m in a good lighting condition limit day time, it is then cropped to the size of 256x256 and the image is given to the porous counting system. Then the resultant count obtained through the system is compared to the manual ground truth count obtained from the company. A test result is then generated.
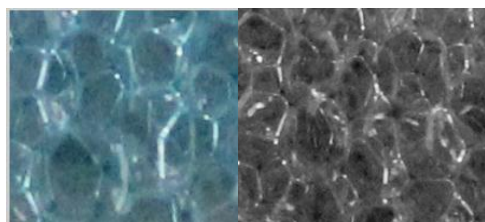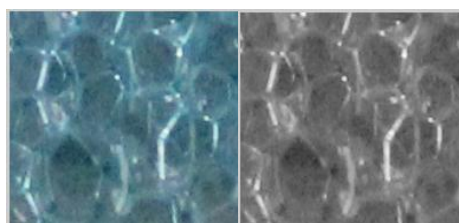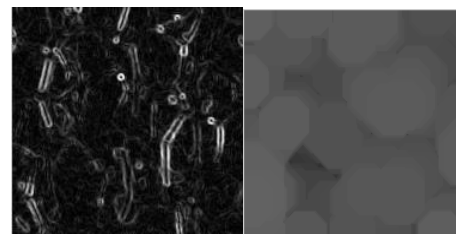

(i) Original image   (ii) Gray image
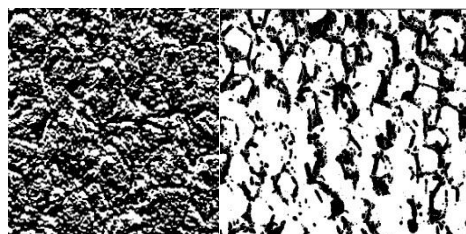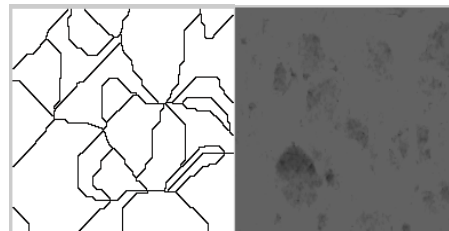

(iii)Gradient image   iv)Segmented image

The above image represents the results obtained from PCSS
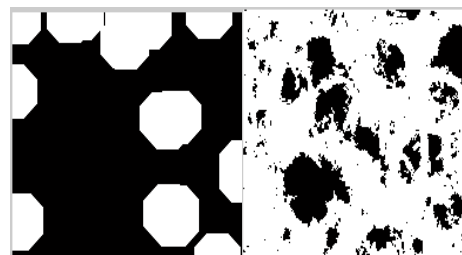

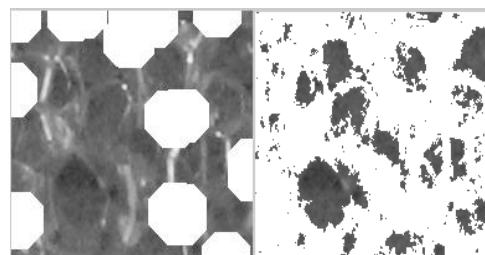(a)Original image   (b) Gray image

(c)Gradient magnitude   (d)Opening

(e)watershed image   (f)Opening reconstruction

(g) internal marker   (h)external marker

(i,j) superimpose with original

The above image represents the results obtained from PCWS

The experimental result is compared with the test samples of sponge image and the performance analysis is evaluated and the result is compared with the manual count.
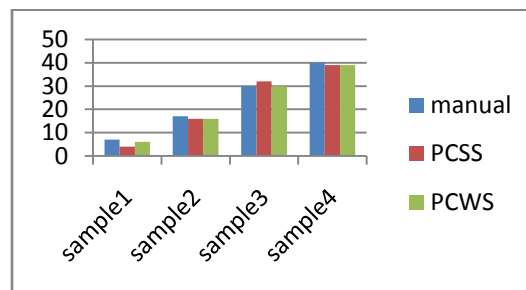

Fig 2: Performance analysis

The table given below show the results obtained from the samples taken, the original result and the system count is displayed.

Sponge Samples	Manual Count	PCSS	PCWS
Sample1	6-7 PPI	4 PPI	6PPI
Sample2	15-17 PPI	16 PPI	16PPI
Sample3	30 PPI	32 PPI	30PPI
Sample4	38-40 PPI	39 PPI	39PPI

VI. CONCLUSION AND FUTURE WORK

In this method to detect porous in sponge and porous count has been done using watershed segmentation. Watershed segmentation is dependent on marker which in turn depends on the value. Various samples of sponge image have been tested and better results up to 80% of the actual result are obtained from PCSS. By means of PCWS 100% of the results is obtained. Our results clearly demonstrate the effectiveness of the proposed method in terms of both absolute performance and comparative performance against the state-of-art. As a future work automated inspection of porous count using video can be done.

VII.REFERENCES

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