Measuring Dimensions and Flatness of Tiles using Digital Image Processing

Deepti Tiwari [1], Amol Tamgole [2] and Rohan Ighe[3]

[1]*Electronics and Telecommunication Dept., Savitribai Phule Pune University, India*
E-mail: deeptitiwari7000@gmail.com

[2] *Electronics and Telecommunication Dept., Savitribai Phule Pune University, India*
E-mail: Amol2tamgole@gmail.com

[3] *Electronics and Telecommunication Dept., Savitribai Phule Pune University, India*
E-mail: rohanighe21@gmail.com

Abstract

Quality control in ceramic tile industry is the crucial step of manufacturing process to insure the tiles will maintain their structural integrity when installed on ground or on any other surfaces. Ceramic tiles should not crack, bend or break entirely under normally applied pressure on them. This can only be avoided by ensuring good quality control.

We present an optimized approach of quality control in ceramic tile industry for smaller businesses. Currently there are two ways available for Quality Assurance which mostly rely on third party inspection using experienced supervisors with keen eye or simply installing expensive machinery specifically designed as per quality control requirements which is expensive. The goal of this system is to catch a middle ground between these two by being as affordable and as accurate as possible. This system uses digital image processing to measure the dimensions of the tiles, Flatness and also as many unintended design defects as possible. We hope to achieve minimal hardware via digital image processing ultimately making the product Affordable, Reliable and Compact.

Keywords— Measuring , Dimensions ,Flatness Digital Image Processing

1. INTRODUCTION

The tile production is the process which is fully automated. The automated process helps us to detect the tile visually. The process can help us to get the actually idea of dimensions of the tile and its flatness the process also help us to detect the defect in short time period. This paper is concerned with the problem of automatic inspection of tiles using Digital Image Processing .It must be noted that the defects related to dimension, flatness and its visual appearance has been largely overlooked .Humans are able to find the defects which are easily visible .Defects are viewed as in-Homogeneities in regularity and orientation fields. there are two distinct conceptual approaches.:

i)structural defects

ii) perturbations in the dominant orientation.

Each of the method mentioned above are use for variety of pattern and defects. On the other hand, in “obvious” cases most naïve observers agree that the defect is there, even when they cannot identify the structure. Such a monitoring task is of course tedious, subjective and expensive but it is based on a long experience and can utilize the huge appreciation and recognition abilities of the human brain. Any machine vision system will never advantageously replace the visual inspection if it is not able to:

1. Analyse the colour of the product with reliability.
2. Detect every type of manufacturing defects, with at least the same accuracy as the human eye.
3. Measure with high precision the dimensions of the tiles

In defect detection the entire surface f the tile is taken into the consideration. The goal is to give the statistical analysis of the tile production. So to achieve the goal we are using image processing. The image acquisition is achieved directly on line, in the real time .The image analysis algorithm should be fast enough to follow the production rate.The paper aims to create a Visual system that is capable of detecting the surface defects for the tiles.

2. METHODOLOGY

This project aims to create a visual system that is capable of detecting the surface for tiles. This will ensure that the end product i.e tile is free from the defects .This process will be effective , efficient and cost effective.

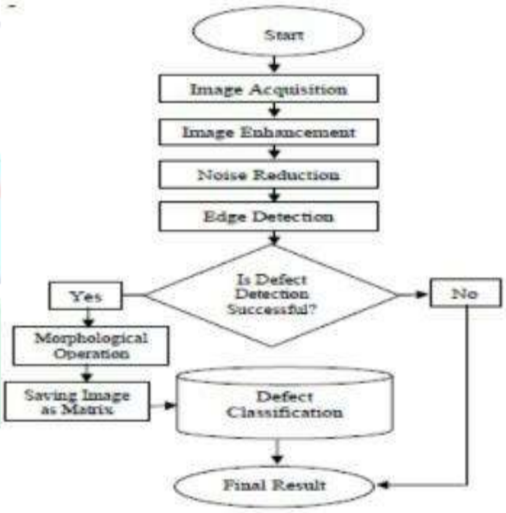


Image Acquisition And Capturing

2.1Image acquisition :

In this process the digitalized image is obtained from real world source. This also introduce the random changes in the pixels.

The tile image is taken with the help of camera and stored into the computer, then Image processing and morphological operation are done on the image.

2.2 Image capturing:

The image captured is converted to binary , gray scale image which would be suitable for the detection of defects.

Here various tricks are used like Edge ,Morphology , noise ,smoothing process and histogram equalization are used. The unequal lighting and space sensitivity of TV camera CCD are corrected and analyzed.

2.3 Image Enhancement

Actually, image enhancement technique is to make the image clearer so that various operations can be performed easily on the image. For this, at first the captured image is converted to the gray level image.

2.4 Edge Detection

An edge may be regarded as a boundary between two dissimilar regions in an image. These may be different surfaces of the object, or perhaps a boundary between light and shadow falling on a single surface. In principle, an edge is easy to find since differences in pixel values between regions are relatively easy to calculate by considering gradients. Many edge extraction techniques can be broken up into two distinct phases:

- Finding pixels in the image where edges are likely to occur by looking for discontinuities in gradients.
- Linking these edge points in some way to produce descriptions of edges in terms of lines curves etc.

2.5 DEFECT CLASSIFICATION

There are various defect that we come across when we inspect the tile some of the defects are:
1.Crack 2.Spot 3.Pin hole 4.Flatness

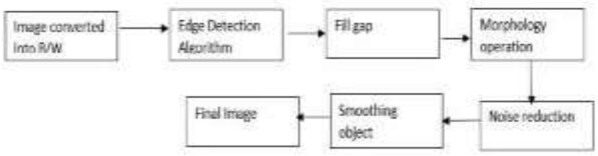
3. Algorithms

Algorithms to detect the defects

3.1 FONT OF THE MANUSCRIPT

Algorithm to Determine Crack

Defects Let c_length as the range of crack.
Step 1. Check every pixel coordinate (i, j) from left to right up to the last pixel element.
Step 2. If any (i, j) has value 1 then
(a) Consider its adjacent eight pixels and find which are 1.
(b) If any adjacent pixel has value 1 then Current pixel coordinate will be updated to it.
(c) Apply the backtracking process to find out all connected pixels and count the length.
Step 3. Apply step 2 to all pixels and for each pixel find out the length of connected pixels.
Step 4. Counting all length of the connected pixels found from step 2 and step 3, find out the maximum number and set it to c_count.
Step 5. Finally, apply step 2 to specify the crack defected pixel coordinates so that other types of defects are not affected to it.
Step 6. If c_count > c_length, then make decision that crack is found, otherwise crack is not found. The same operations have been applied to the other kinds of defects detection algorithms but without the same arrange and the number of processing cycles to the images. Figure shows the Spot, Longitudinal Spot, and Depression Spot detection algorithm



3.2 SPOT DEFECT:

This are the defect that forms a hole on the surface during manufacturing dur to extra pressure. This are also formed when there is access amount of material left on the surface and we try to remove it forcefully at time it may lead to such type of defect.

Algorithm to Determine Spot

Defects Let, matx as size of spot, row as the maximum number of image pixels along any row and col as the maximum number of image pixels along any column.

Step 1. Let, start=(matx/2)+1; Here start is the middle element of (matx*matx) . Step 2. Check every pixel coordinate (i, j) from left to right up to the last pixel element. for row consider the range from start to row-start+1 for column consider the range from start to col-start+1 (a) If any pixel coordinate (i,j) is 2, then
1)Considering it as the middle element and check the total (matx*matx) elements around it to find out how many 2 exists into these region.
2)Let, the total number of 2 is equal to s_length.
3)If s_length = (matx*matx), then Make decision that spot defect is found and exit From loop. (b) Otherwise, switch to next pixel coordinate at step 2. Step 3. After searching every pixel coordinate, if there is nos_length matches to (matx*matx), then make decision that spot defect is not found.

3.3 PIN HOLE DEFECT DETECTION

It is easier to detect the Pin-hole defects. That by applying some morphological operations directly to the input image followed by SDC morphological operation (morphology operations specialized for gray scale images). Finally in this algorithm the image passes to Noise reduction processing to get a clear image for the defect. Figure 6 shows the Pin-hole defect detection algorithm

Algorithm to Determine Pinhole Defects

Let, p_count as a variable for pinhole count, c_range as the range of corner, e_range as the range of edge and row as the maximum number of image pixels along any row and column as the maximum number of image pixels along any column.
Step 1. Set, temp_a =c_range , and temp_b=e_range
Step 2. Divide the total searching area for pinhole into three regions.
Step 3. For left side region, for row consider the range from temp_a+1 to rowc_range-1 for column consider the range from temp_b+1 to c_range
(a) Check every pixel coordinates whether it is 0 or not.
(b) If it is true then (i) For each coordinate (i,j) check all of its eight neighbours.
(ii) If (i,j-1), (i,j+1), (i-1,j), (i+1,j) position values are 1 and the rest are 0, then P_count will be incremented by 1.
Step 4. For right side region, range for row is from temp_a+1 to row-c_range-1 and range for column is from coltemp_a+1 to col-e_range. The rests are same as step-3.
Step 5. For other middle side elements, range for row is from temp_b+1 to row-e_range and range for column is from col-temp_a+1 to col-c_range. The rests are same as step-3.
Step 6. Finally, check value of p_count. If p_count>0, then pinhole is found, otherwise not found.

3.4. FLATNESS DEFECT DETECTION

Here we have performed various operations in order to check the quality of the tile. But as we know that when there is a large production of the tiles the flatness of all the tiles does not remain same there are variations in it .This variations are caused due to excessive material left on the surface or uneven cutting .In order to overcome this defect we can use laser sensor

There is a laser on both the side of the tile i.e vertically and horizontally there will be a light sensor on the other end .If light (laser beam) strikes to the sensor without any obstruction then the surface is flat . If the laser beam does not strike the sensor then the tile does no have seven i.e smooth or flat surface.

4.0 DETECTION METHODS

The significant field of computer vision is to detect major objects under complex background by reducing the time and cost. The image detection methods are classified into two types namely space domain method and frequency domain method. The segmentation algorithm segments the images and removes the unwanted features such as the optic disk. Pre-processing is the first step which is done using filtration method such as adaptive median filter. Colour enhancement can be performed by changing the intensity mapping rate and by using histogram equalization techniques

4.1 BLOB DETECTION ALGORITHMS

To detect regions or points in digital image processing blob detection method is used mainly based on mathematical functions. The regions or points which have perceptible difference with their surroundings is called blob."Blob is the region which can be either brighter or darker than the neighborhood, or may be the same colour in the video or image. Blob detectors can be classified as:
(1) differential methods which are derivative functions based on the position
(2) methods based on finding the local maxima and minima of the function .

4.2 OPTIC DISK AND MACULA DETECTION

An unified method used for Optic disk and macula detection is the Generalized Motion Pattern Techniques (GMP) [11]. The location of OD (Optic disc) and macula helps in determining the severity of the disease and need for intervention. For instance, the nearness of a bright/dark lesion to macula indicates a higher likelihood of impaired vision and hence calls for immediate medical attention. Such precise location is also needed in registering images acquired across patient visits and assessing disease progression. In general the detection of OD and macula from colour retinal images has been treated as two separate problems, with OD detection receiving more attention than macula detection. OD detection methods typically exploit the appearance info, such as colour and roughly circular shape.

4.3 CSCR DETECTION AND ELIMINATION TECHNIQUE:

To detect the particular region the first step is to remove the unwanted noise. This can be performed by the following steps:
1. Image intensity adjustment: in which we make intensity value as a reference colour and compare it to the retinal image intensity in order to change the original retinal image intensity colour to the reference intensity color.
2. Since there is a disparity in colour intensity that might influence the result of optic disc detection and elimination we need to solve non uniform illumination problem. In this step we apply principle component analysis PCA.
3. Colour enhancement intensity is applied in this step to adjust the intensity gray level by rearrange this intensity and make the optic disk clearer and brighter than the other foreground and background of the retinal image.
4. CSCR segmentation: in which we apply general threshold value that is obtained from the histogram of the enhanced image.
5. Since the optic disc represents the central region from which the blood vessels stem we apply a filter and morphological operators to remove all residuals remaining from the blood vessels and that crossing the optic disc boundary. To make the optic disk boundary more clearly we apply dilation followed by erosion processes.
6. After optic disc segmentation, we apply the same technique for the retinal fundus and optic disc boundaries elimination to find out the optic disc boundary values denoted in x and y coordinates. Principally, to find these values we compute the (OD) diameter value.
. 7. After obtaining the OD boundary values in x ,and y axis's, we introduce a polynomial function to draw and eliminate the optic disc on the original image. In this step we use roipoly Matlab function to specify a polygonal region of interest (ROI) within the image. The roipoly function returns a binary image that can be used as a mask.

4.4 BOUNDARIES AND AREAS DETECTIONS A MATLAB

function can be used to trace and find out the area of Boundaries. Area detection is mainly used to simplify the measurement of the exudates size. This function can trace the exterior boundaries of objects, and also boundaries of holes inside these objects, in the binary image.. E. SIZE MEASUREMENT For Size measurements the method used are poly area function and pixel method is used for complicated shape. Depending on the measurement size we can able to determine the severity of the macula as compared to normal image. Once the segmentation and detection methods are applied the next step is to measure their sizes, and compare them to the background size of the image. Based on that, we can identify the diseases severity which can be observed by ophthalmologists. The approach introduced to this measurement is by utilizing mathematic operation represented in polyarea MATLAB function. Since the coordinates of the interest area (exudates lesion) are obtained from boundary function, they can be fed up to the polyarea function to compute the exudates size. Area = polyarea(X, Y) Where Area = Area of polygon (area of exudate) (X, Y) = Coordinate values in x, and y direction for boundary position.

5 CONCLUSION

Here we have used various algorithms to detect the defects related to the dimensions and appearance of the tile .Here we have also used laser to detect the flatness of the tile.

6 REFERENCES

1. Vincent LEBRUN,"Quality control of ceramic tiles by machine vision," Flaw Master 3000, Surface Inspection Ltd. 2001.
2. C. Boukouvalas, J Kittler, R Marik, M Mirmehdi and M Petrou, "Ceramic Tile Inspection for Color and Structural defects." I.E.E.E. Transactions on Pattern Analysis and Machine Intelligence, vol. 14, no. 1, March 1998.
3. Stewart Coe, "Automatic tile inspection." Surface Inspection Limited, International Ceramics, Bristol, U.K., Issue 1, 2000.
4. Costas Boukouvalas, Francesco De Natale, Josef Kittler, and Roberto Salgrai. "An Integrated system for Quality Inspection of tiles." University of Surrey, Guilford, GU2- 5XH, England, 1999.
5. Yonghuai Liu and Macros Rodrigues, "A novel machine vision algorithm for a fast response quality control system." Department of Computer Science, the University of Hull, Hull, HU6 7RX, UK 2001.
6. Martin Coulthard, "Measuring and Classifying Tile Shades."

Chairman, Surface Inspection Ltd, Great Britain, Jan., 2001.

7. Song K Y, Petrou M, and Kittler, "Texture crack detection." Machine Vision Applications, to appear Jan., 1995.

8. Esko Herrala, "SIMON; Spectral Imaging for On line Sorting." Specim, Spectral Imaging Ltd., Finland, August 1998.

9. Tony Lindeberg, "Edge Detection and Ridge Detection with Automatic Scale Selection." Department of Numerical Analysis and Computing Science, Royal Institute of Technology, International Journal of Computer Vision, S-10044 Stockholm, Sweden, Jan., 1996.

10. Mark E. Lehr and Keh-Shin Li, "Template basis techniques to Pattern recognition." University of California Riverside, Department of Statistics Riverside, California, USA, Vol. 2825, 1996.

11. Todd Reed and H. Wechsler, "Segmentation of textured images and gestalt organization using spatial / spatial-frequency representations." I.E.E.E. Transactions on Pattern Analysis and Machine Intelligence, vol. 12, no. 1 Jan., 1990.

12. W. Wen, and A. Xia, "Verifying Edges for visual Inspection Purposes." School of Mechanical and Manufacturing Engineering, School of Mathematics, The University