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Digital Image Processing Based Quality Detection Of Raw Materials in Food Processing Industry Using FPGA

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Abstract

In the food processing industries the quality of raw materials like rice, vegetable, fruits etc., are identified only by the human. It is time consuming and need more human work. In this paper we proposed a system to identify the quality of the raw materials by using a system based on image processing and FPGA. In this system we get images of good quality raw material and that image is kept as reference image and stored in FPGA. For every time of food processing the raw material images are compared with reference image. Image processing is performed by using MATLAB. The image comparison is implemented in FPGA. Using this system we can identify the quality of raw materials before processing. This proposed system is better and highly accurate compare to previous quality identification methods and improve the quality of the final food product.

Keywords: *Image Acquisition, Image-Preprocessing, VLSI, Verilog, comparator, FPGA*

1. Introduction:

Food products like rice and vegetables are consumed in daily diets, are a major source of antioxidants and they are a seasonal crop and their availability is limited during certain seasons. The vegetables, fruits, rice and dhal are processed in food processing industry. The final product of the industry is in good condition only when the raw materials are in good quality. So all the industries need to be check their raw materials. In the season time the raw materials are low cost in the market so the products are stored and sold in unseason time. On that time the quality of that raw materials may be differ from fresh quality due to some carelessness in storage process. In order deliver good quality of processed food products the quality of the food raw material should be checked. Moreover high labor cost for identifying good and bad raw material in industries is the main obstacle and also time consuming. Therefore it is very important to identify the quality of raw material for the purpose of its usage by an automatic

sorting machine for various necessities in industries. To overcome this problem, image processing method in industries has become a major issue in recent years. Using MATLAB software as a tool in image processing and FPGA, we can find the quality of raw materials. Finally after collecting several data bases, we have proposed certain range. With these ranges we can identify the quality of raw material, whether it is good or bad in quality. The proposed work is photographs (rice, vegetable, fruits etc.) taken through web camera. The field images are compared with the Standard images already stored in the FPGA. Identification action is initiated when both images matches. Before the image comparisons the image must be processed for improving the process to be high accurate.

2. Proposed system

The procedures involved for quality identification are image acquisition, pre-processing and FPGA implementation for image comparison.

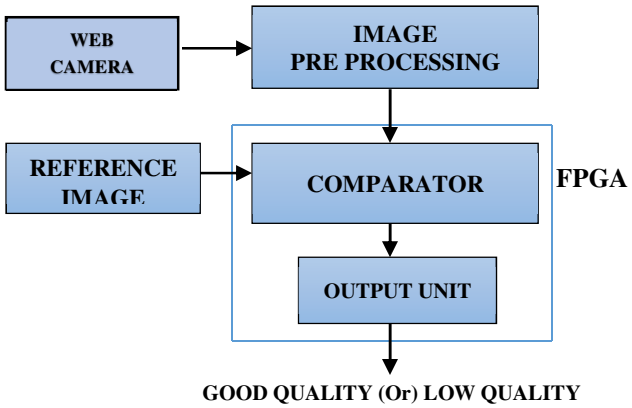


Fig.1. Proposed block diagram for food quality identification.

We consider one apple based food processing industry. The quality of the final product is bases on the quality of apple inward to the processing. In the inward quality control section the quality of each apple is going to be checked by compare the images of each apple with reference apple image

3. Image acquisition.

The first stage of vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement.

3.1 RGB image.

Image is represented in three different matrices corresponds to red, green and blue. This RGB image indicates RGB colour levels in each pixel of the image.

Fig. 2.Image taken from camera

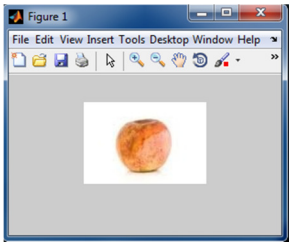


Fig.3. RGB input image.

4. Pre-processing.

Due to unwanted background, noise, poor resolution of image and climate variations in the image,the image acquisition is insufficient for identifying the images. So the images should be preprocessed. The preprocessing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image preprocessing is the technique of enhancing data images prior to computational processing. The preprocessing is performed by the following steps.

i. Background subtraction.
ii. RGB to gray conversion.
iii. Gray to binary conversion.
iv. Filtering

4.1 Background subtraction

Extraction of foreground object is a performed in background subtraction.it reduces the data processing amount because the foreground is removed. The object of the food product is only processed.

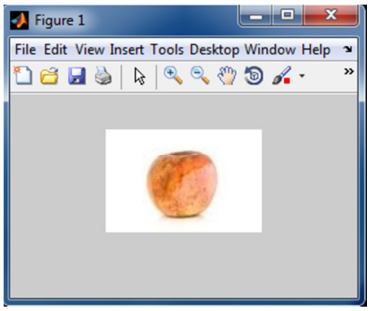


Fig.4. Image after background subtraction.

4.2 RGB to gray conversion

A grayscale (or gray level) image is simply one in which the only colors are shades of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel. In fact a `gray' color is one in which the red, green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a image. Often, the grayscale intensity is stored as an 8-bit integer giving 256 possible different shades of gray from black to white. If the levels are evenly spaced then the difference between successive gray levels is significantly better than the gray level resolving power of the human eye.

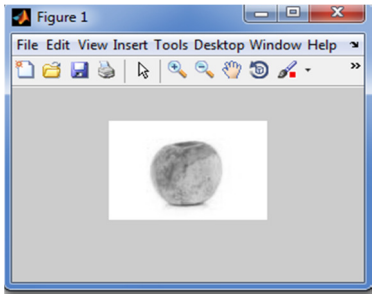


Fig.5. Image after RGB to gray conversion.

4.3 Gray to binary conversion

Black and white colour is used for binary image. Binary image is a digital image it has two assigned pixel values. The gray image of food products is converted into binary image is stored as single bit 0 or 1.

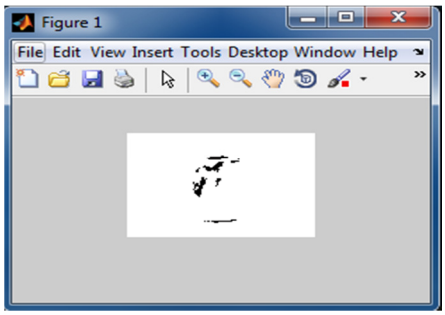


Fig.6. Image after gray to binary conversion.

4.4 Filtering

In image processing filters are mainly used to suppress either the high frequencies in the image, smoothing the image, or the low frequencies, enhancing or detecting edges in the image. An image can be filtered either in the frequency or in the spatial domain. The first involves transforming the image into the frequency domain, multiplying it with the frequency filter function and re-transforming the result into the spatial domain. The filter function is shaped so as to attenuate some frequencies and enhance others. For example, a simple low pass function is 1 for frequencies smaller than the cut-off frequency and 0 for all others. The corresponding process in the spatial domain is to convolve the input image f(i,j) with the filter function h(i,j). This can be written as

$$G(i,j)=h(i,j)\ \Theta\ f(i,j)$$

The median filter is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image. The median filter considers each pixel in the image in turn and looks at its nearby neighbors to decide whether or not it is representative of its surroundings. Instead of simply replacing the pixel value with the mean of neighboring pixel values, it replaces it with the median of those values. The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. (If the neighborhood under consideration contains an even number of pixels, the average of the two middle pixel values is used.) Table 1 illustrates an example calculation.

123	125	126	130	140
122	125	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

Table.1 Neighborhood values 115,119,120,123,124,125,126,127,150.

Median value 124.

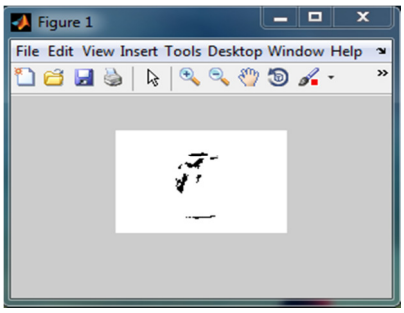


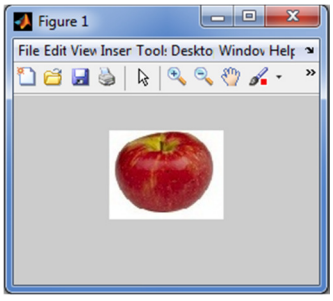
Fig.6. Image after filtering.

5. FPGA Implementation

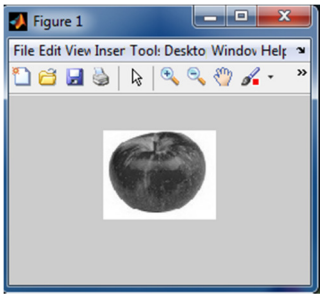
The binary values of the image is given to the input of FPGA. Already the reference image is stored in FPGA. In this system SPARTAN 3E is used for hardware implementation. Using Verilog implementation these two binary image pixels are compared and detect the quality of the raw material. If the two bits are equal, the comparator produce high (binary1) output. Then the system indicates the given raw materilla is high quality food. If the comparator output is low (binary 1) then the system indicates the given raw material is low or bad quality.

In FPGA the image of good quality raw material is stored. Before store the image of good quality raw material the image preprocessing is performed to get the binary values of the images. The processed images of the good quality raw material is shown in fig 7.The filtered binary image is stored in FPGA.

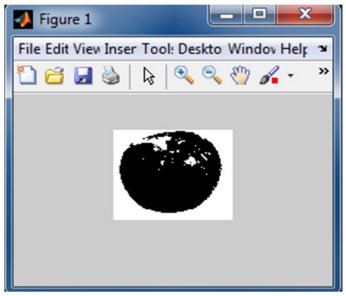
The binary value of reference image is created by using MAT Lab. The binary values are stored in the FPGA. The Fig 7 shows the steps to generate binary image.



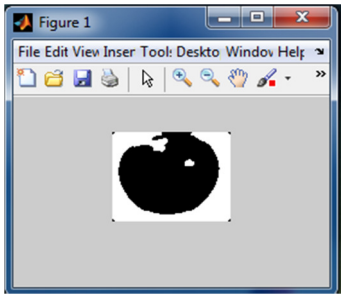
Input image



RGB to gray

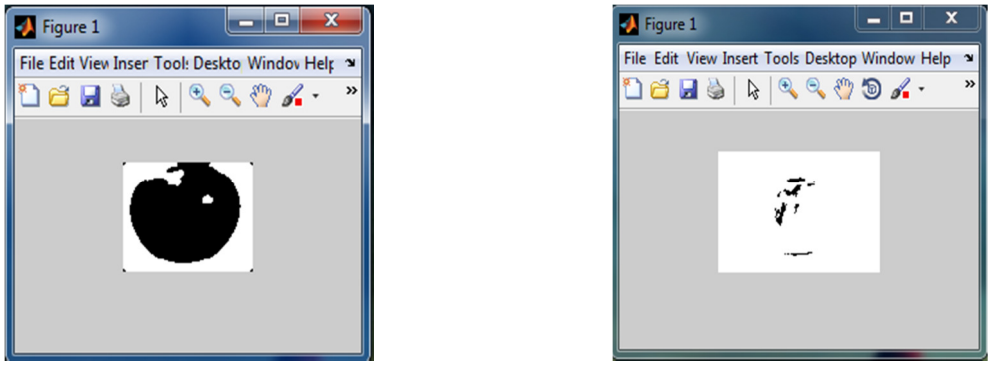


Gray to binary



Filtering

Fig.7. Image processing steps for storing good quality food product.



Good quality Low quality

Fig.8. Binary images of good quality and low quality food products are going to be compared in FPGA.

These two images are compared in FPGA. The simulation results are shown in fig 10.FPGA based image comparison is very high speed than traditional software based approach. Processing element of this system is shown in Fig.9. Hardware circuits are represented in fig.10. The IC layout diagram shown in fig.11.

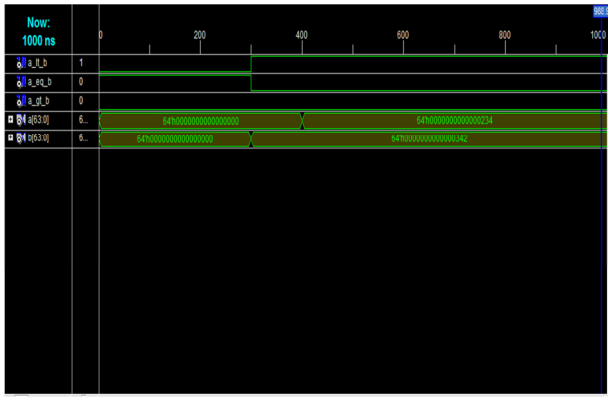


Fig.10. simulation Results

Fig.11.FPGA Implementation unit.

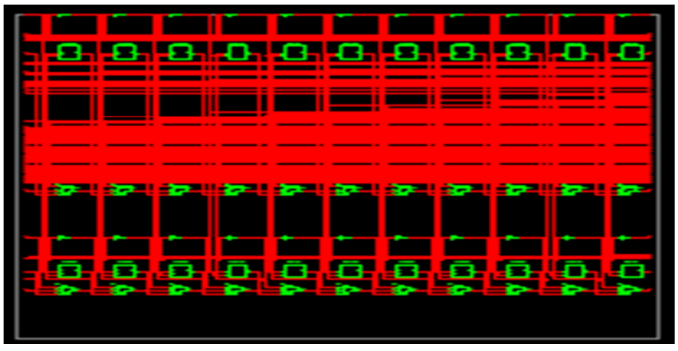


Fig.12. Processing Element

6. Conclusions

In this work we can find the quality of raw materials using a new methodology for designing high speed image comparison by using FPGA. This system reduced comparison time and identify the quality of the raw materials with high accuracy. This system is very much useful in food processing industries, individuals, government. This quality identification is performed for various food products like oils, dhal, fruits, etc

References

[1] G. Dourtoglou, T. Dourtoglou, A. Antonopoulos, E. Stefanou, S. Lalas, C. Poulos, "Detection of Olive Oil adulteration using principal component Analysis Applied on Total and Region FA Content", J. Am. Oil Chem. Soc. 80, 203-208, 2003.

[2] Zhang Tao, Yu Feng-ping and Quan Hao-jun," An Optimized High-Speed High-Accuracy Image Matching System based on FPGA", Proceedings of the IEEE International Conference on Information and Automation,China June 20 – 23 2010.

[3] A. K. Jain, "Fundamentals of Digital Image Processing" Prentice Hall of India, First Edition,1989.

[4] Rafael C.Gonzalez and Richard E. woods, "Digital Image Processing", Pearson Education, Second Edition,2005.

[5] Delores M.Etter,"Introduction to Matlab",2010

[6] Ms.Chinki Chandhok et al.," An Approach toImage Segmentation using K-means Clustering Algorithm", International Journal of Information Technology (IJIT), Volume – 1, Issue – 1, August 2012.

[7] Gastelum-Barrios et al.," Tomato quality evaluation with image processing: A review", African Journal of agriculture Research vol.6 (14),pp.3333-3339,18july,2011.

[8] A. Justin Diraviam, Dr.S.P.Victor, G.Rajakumar, Dr. K. Rajappan and Dr.D.Manimegalai "Replacing Various Analog Signal Sensors with Digital Cameras" International Journal of Computer and Electrical Engineering, Vol.3, PP84-92 No.1, February, 2011.

[9] Son am Saluja et al.," A Study of Edge-Detection Methods", International Journal of Advanced Research in Computer And Communication EngineeringVol. 2, Issue 1, January 2013.

[10] G.RajaKumar, Dr.D.Manimegalai, "Analysis and Implementation of DIP based Online Control and Monitoring System for Displacement in Control Valve" IEEE Proce.of International Conference on Communication Control and Computing Technologies-ICCCCT 10, PP –397-403, October 8th & 9th 2010.

Bibliography

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