ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A STUDY ON LINE DETECTION USING IMAGE FILTER ON PC-BASED MACHINE VISION SYSTEM

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DOI: 10.5281/zenodo.400837

ABSTRACT

Recently, according to the industrial development, automated system using machine vision technology of based on image processing has been used in many fields. In particular, the more advanced automated, study on the effect of image filters is required because utilization for machine vision system is increasing. So, this study proposed about technique of image process and image filter in machine vision system. In this study, PSNR, edge count by noise removal and filter processing time were measured as outcome indicators, in order to measurement conditions of line detection, processing time and improvement of accuracy. As for the study result, Minimum filter increased to the PSNR and reduced to the edge count but took a long processing time. On the other hand, cross-shaped median filter for all indicators showed the best performance that increased to the PSNR, reduced to the edge count and shorter to processing time.

KEYWORDS: Machine vision system, Image filter, Line Detection

INTRODUCTION

Humans are basically visual creatures. In addition, more than 90% of the information about the environment depends on the eyes, so the image that the human eye sees is an important part. This information will have to accept human characters, graphics, audio, sound, still images, video and various representation. As such, today, unlike in the past, the format that accepts information is stored or transmitted in the form of multimedia combined with digital technology [1].

Digital image processing, which processes images in a multimedia form using a computer, is commonly used in industrial fields and can be easily seen. Image processing is the process of electronically acquiring images through a camera or a scanner and then applying them to computers and algorithms for various purposes Image processing technology, which is rapidly developing in recent years, will effectively influence the nation's competitiveness in the future by high-speed information communication network corresponding to hardware and software corresponding to hardware and effective constructing of the information corresponding to the software. In addition, an automated system using image processing based machine vision technology has been used in various fields according to recent industrial development. Especially the more advanced automated for a machine vision system it is necessary to study the effect of increasing the image filter.

World market for industrial machine vision systems had already overtaken the PLC market in 1994 its market share was 34% in the United States and Japan 30%, Europe 23% and other 13% and more [2]. In Korea, considering the market situation, the portion of the electronics and electronics industry is expected to be larger due to the large proportion of semiconductors. In other words, as technology advances and markets grow, the performance of vision systems is rising and prices are falling. Machine vision systems are increasingly being introduced in more industries, or even a situation which is being introduced is the development of vision systems for surface inspection of the surface inspection of fruit and bread. The introduction of machine vision in the domestic packaging industry has been relatively low, but considering this trend, it is expected to grow more rapidly in the future [3].

Therefore, this paper, we propose a common technical study of the effects on industrial image processing technology and image filters in machine vision systems that are used in the design. In this paper, we propose a method for machine vision system design, introduce PC-based image processing method using the matrox board and acquire image of image filter which is important in inspection process and propose effective method.

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MATERIALS AND METHODS

Overview of Technology

The machine vision system can be used in various fields such as foreign matter inspection, character recognition, size measurement, count, position adjustment, thickness measurement. The main components are cameras, lenses, lights, processors, and software. When generating light from the light, is transmitted to the camera, light is reflected through the lens and reaching the specimen, the light source to the camera are converted into electronic signals. And, the converted signal is input to the processor and outputs the result according to the rules determined by the algorithm of the software. Therefore, each of the components in order to properly configure the machine vision system they must be properly selected and integrated [3].

PC-based machine vision system configuration for experiment - H / W configuration

The lens used in this study was set up 1 magnification lens according to the working distance (WD) between the measurement stage and the lens and the measurement area. The camera selected 'resolution 659 * 494' according to the resolution of the measurement area, and color was selected B/W (black & white) by acquiring the grayscale image.

Model	TL20C-110R
Magnification	1x
WD	110mm
Maximum compatible CCD	1/2
Mount	C Mount

Figure 1. Lens specification

Model	MV-BV20A
Resolution	659 * 494
Frame Rate	60fps
Pixel Size	9.9 * 9.9 um
CCD	Sony 1/2"
COLOR	B/W

Figure 2. Camera specification

Flowchart of software system

The study was applied in the same order below.

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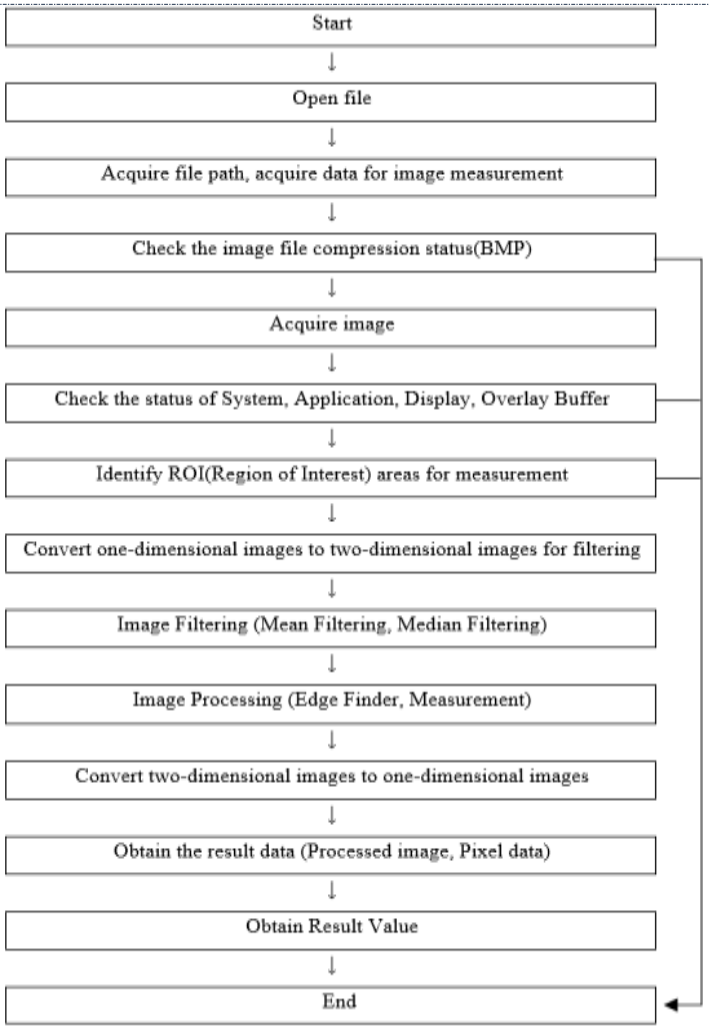

Figure 3. Flowchart of software system

Evaluation method

In order to improve the condition, measurement time and accuracy in the process of analyzing the image data, it is advantageous to measure the surrounding images except for the measurement object. Therefore, the evaluation of the measurement results was performed by the number of edges of the image, the Peak Signal to Noise Ratio (PSNR) and the processing time. MSE (Mean Squared Error) is the difference between the original image and the improved image. The reason for using the MSE (Mean Squared Error) is that it is easy to perform mathematical analysis and is easy to calculation. The formula is as follows.

- MSE = E $[(X - X\hat{})^2]$
- E means the $\frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}$ [4].
- X means the coordinates of the original image [4].
- X ^ means the coordinates of the transformed image [4].

RMSE (Root Mean Squared Error) is the value calculated for MSE (Mean Squared Error) root. It is often used to indicate how far apart individual observations are from the center. The formula is as follows.

- RMSE = E $[(X - X\hat{})^2]$

PSNR is the peak signal value for noise. The formula is as follows.

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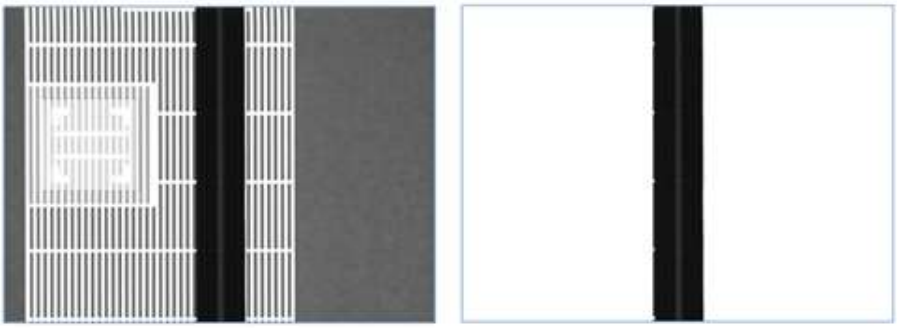
- PSNR = 20log10 (255/r)

That is, the smaller the value of MSE (Mean Squared Error), the smaller the difference between the two images. And, the filters for calculating the result of a small figure can be regarded as a noise removing effect even better filter. The higher the value of PSNR (Peak Signal to Noise Ratio) is good filter performance [4].



Original image Evaluation criteria image

Figure 4. Evaluation standard images

RESULTS AND DISCUSSION

Image processing was applied to the original image by applying image filtering technique. The result is as shown below.

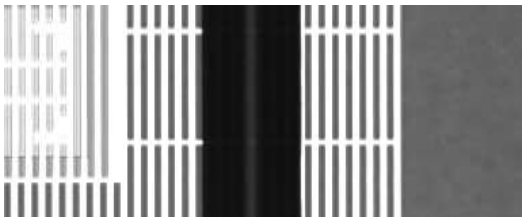


Figure 5. Original ROI (Region of Interest) image

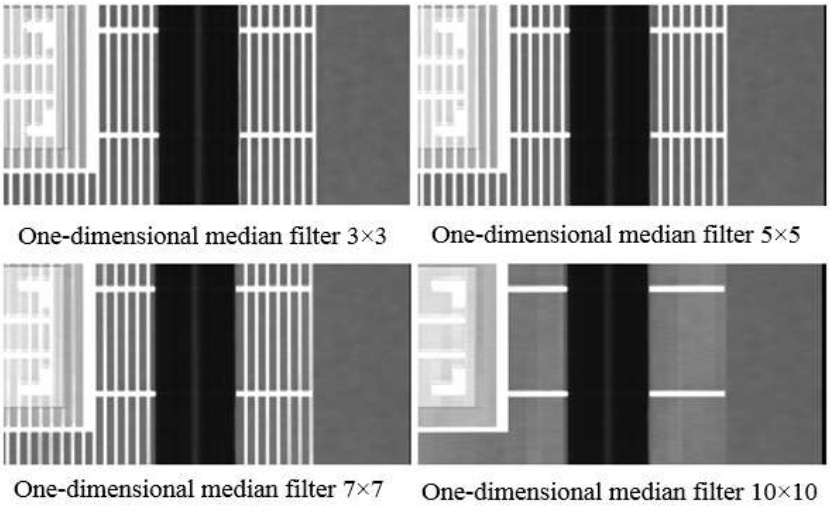


Figure 6. Results of appling for one dimensional median filter

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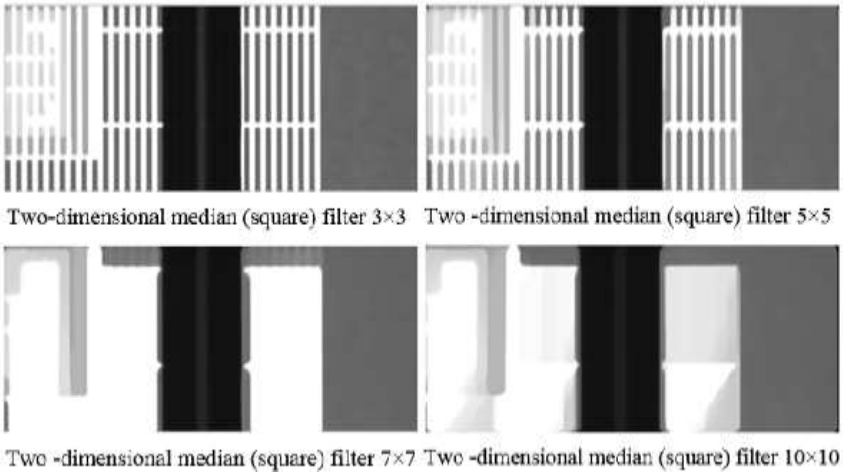

Figure 7. Results of appling for two dimensional median (square) filter

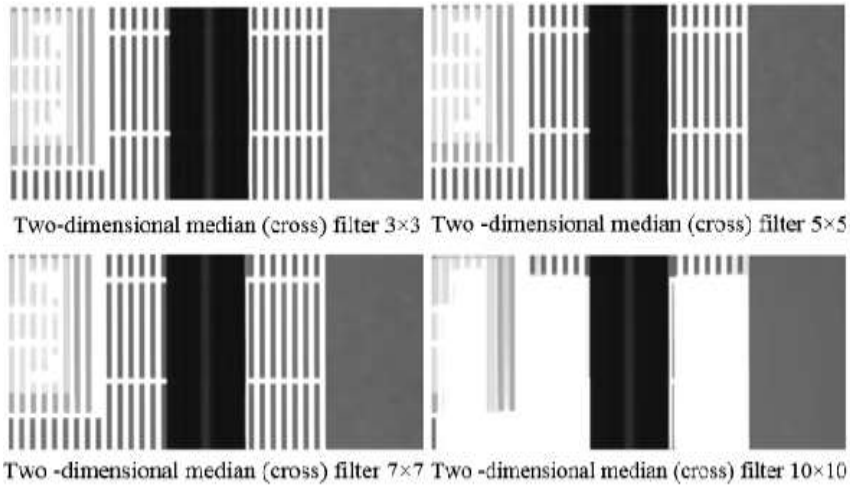

Figure 8. Results of appling for two dimensional median (cross) filter

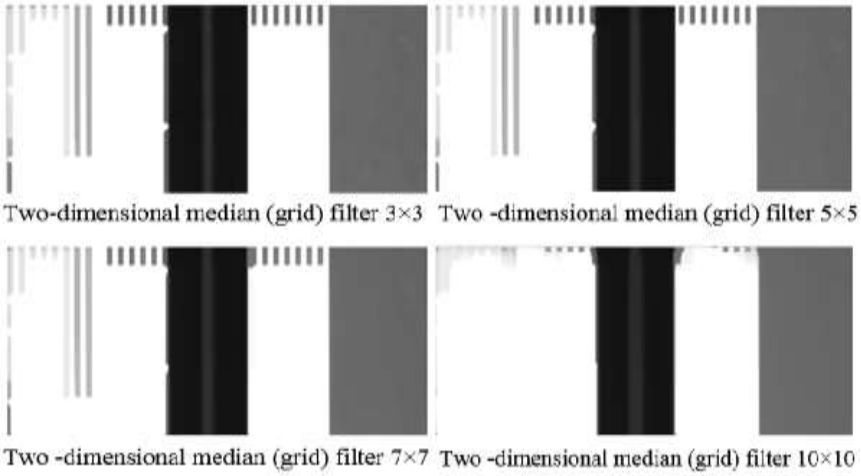

Figure 9. Results of appling for two dimensional median (grid) filter

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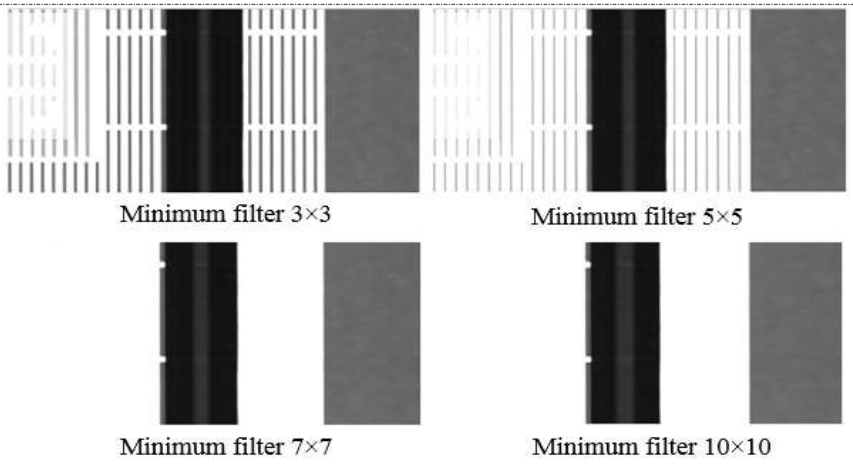

Figure 10. Results of appling for minimum filter

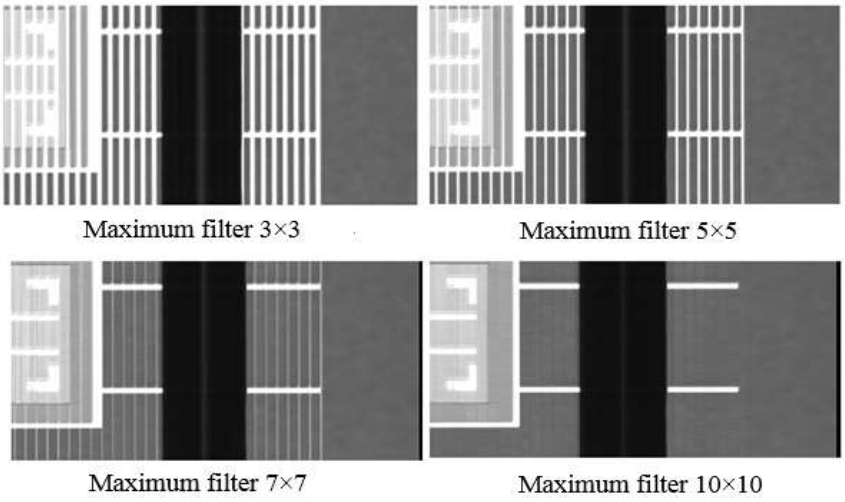

Figure 11. Results of appling for maximum filter

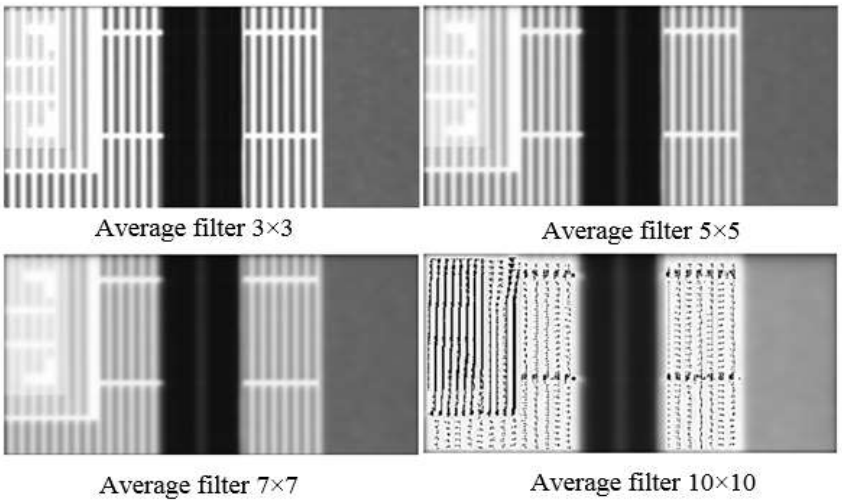

Figure 12. Results of appling for average filter

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The evaluation results of the number of edges, the peak signal to noise ratio (PSNR) evaluation and processing speed are shown in the table below.

Table 1. Performance outcomes

Categories	N * N	PSNR*	Edge Count	Second
One dimensional median filter	3	38.97	42	0.05
	5	39.12	34	0.08
	7	38.98	36	0.11
	10	36.84	10	0.16
Two dimensional median(square) filter	3	40.9	46	0.14
	5	41.12	32	0.39
	7	42.55	9	1.17
	10	41.9	11	4.58
Two dimensional median(cross) filter	3	40.86	57	0.08
	5	40.91	57	0.14
	7	40.97	56	0.19
	10	43.13	17	0.31
Two dimensional median(grid) filter	3	43.26	17	0.23
	5	43.32	17	0.56
	7	43.36	16	1.05
	10	43.83	4	2.94
Minimum filter	3	42.36	51	0.13
	5	43.43	6	0.42
	7	43.94	3	1.34
	10	44.05	3	4.83
Maximum filter	3	42.2	37	0.13
	5	43.28	44	0.39
	7	43.36	17	1.05
	10	43.98	13	4.63
Average filter	3	40.41	56	0.06
	5	40.08	34	0.14
	7	39.86	25	0.19
	10	43.71	89	0.31

* PSNR : Peak Signal to Noise Ratio

CONCLUSION

In this paper, we simulate and derive the results about median filter. In the simulation, 640*480 images were used for the experimental images, for image filter evaluation, a median filter, a min-max filter, and an average filter with 3×3, 5×5, 7×7, and 10×10 squares were simulated. As a result, the peak signal to noise ratio (PSNR), the number of edges, and the processing time were obtained and analyzed. As a result of analysis, it was confirmed that the peak signal to noise ratio (PSNR) value of the minimum filter increased and the number of

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edges decreased. However, there was a problem that the processing time was long. On the other hand, the median grid filter showed the best performance in all the indexes due to the increase of the peak signal to noise ratio (PSNR) value, the decrease of the number of edges, and the short processing time. However, this processing time is somewhat difficult to apply to the field. Therefore, it is necessary to study the method to improve the algorithm and reduce the filtering time in order to be introduced in the future industrial field.

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