

Image Processing in Improving the Scan Results of Identity Cards and Family Cards with Noise with the Median Filtering Method

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Abstract

In the digital era, identity documents such as Identity Cards and Family Cards play a crucial role in administration and public services. The process of scanning these documents often results in images with noise that can interfere with data accuracy and identification. This research aims to improve the quality of scanned images by using the median filtering method to reduce salt and pepper noise. Median Filtering was chosen for its ability to preserve edges and details in images, which is crucial for identity documents such as Identity Cards and Family Cards. In this study, the system developed to enhance scanned images was implemented and tested. Evaluation results show that the Median Filtering method is effective in removing noise without damaging the edges and fine details of the images. The evaluation indicates that this system is effective in producing images that meet the quality standards required for official administration and identification. This research is expected to contribute to the development of digital image enhancement technology for identity documents, thus improving accuracy and reliability in public services.

Keywords: *Digital Images, Median Filtering, Identity Cards and Family Cards, Image Enhancement.*

1. Introduction

In the development of technology in the current digital era, in the administrative aspect of government and public services, identity documents such as identity cards and Family Cards play a very important role. Identity cards and family cards are often used as a requirement in conducting official transactions, especially in public services. Administrative requirements in official transactions will usually be requested in digital form. So an innovation or application such as a scanner is needed to scan documents into digital form.

Scanners are usually used as input devices on computers that aim to scan real documents into digital form. However, not all of these scanner processes can produce digital images with good quality, there are times when the results of the scanner experience some disturbances so that the results become blurry and so on.

One of the main problems most commonly found in document scans is the presence of noise in the scanned images. This noise can usually be in the form of small grains, lines or other patterns that can interfere with the analysis of the document. In the scan results of identity cards and family cards, the presence of noise can cause inaccuracies in data that can lead to errors in document identification and verification.

2. Theoretical Foundations

2.1. Digital Image

Images can be in the form of two-dimensional images in the form of photos and paintings, but there are also those in the form of 3 dimensions, namely sculptures. Images can be formed through the combination of points, lines, planes and colors to create an object inspired by physical or human objects.[2] The digital image itself is an image with two variable functions, namely x, y whose value will be digitized both by special coordinates called image sampling and through a gray level called graylevel quantization.[7].

2.2. Elements of Imagery

Some of the elements contained in the digital image include:

1. Brightness is the light emitted by pixels from an image that can be processed by vision.
2. Contrast is the difference or distribution of brightness and darkness in an image.
3. Contour is a state caused by a change in intensity in neighboring pixels.
4. Color is the perception captured by the visual system at the wavelength of light reflected by the image.
5. Shape is the intrinsic character of a 3-dimensional object for the human visual system.
6. Texture is a special distribution of grayness in a set of neighboring pixels.[7]

2.3. Color Concept

The main color in image management consists of 3 (three) elements, namely red (R), green (H), and blue (B). If the main colors are combined, it will produce other colors. The concept of color space is that each pixel has a color expressed in RGB, so it is a combination of R-values, G-values, and B-values that cannot be separated from each other. The color described with RGB is a mapping that refers to the wavelength of RGB. The mapping produces shades of color for each of the R, G, and B. Each of the R, G, and B is discrete on a scale of 256, so the RGB will have an index between 0 and 255. With RGB color cube mapping, 3 basic colors can be mixed to get a new color.[6]

2.4. Contrast

Contrast Imagery Contrast expresses the distribution of lightness and darkness in an image. Low-contrast imagery is characterized by having most of the composition of the image be light or mostly dark. From the histogram, it can be seen that most of the grayness degrees are clustered together or occupy only a small part of the range of possible grayness values.[6]

2.5. Pixels

In each pixel there is more than one point on an image, but each part forms a box that is the smallest part of the image (cell). Where Pixel is the single and smallest component of an image. Later each value of the pixel will show the same average value for all parts of the cell.[9]

2.6. Noise Definitions

Noise is something that can interfere with the quality of the image. Noise can be caused by several things, namely the processing process that is made inappropriate, physical (optical) disturbances in the fishing gear, and also dirt in the image. There are several types of noise, namely Gaussian Noise, Speckle Noise, Salt & Pepper Noise, and Uniform Noise. There are many ways and methods in image processing that can be used to reduce or even eliminate noise.[7]

2.7. Filtering

In this study, the author utilizes the Median Filter method to enhance image quality. Median Filtering is a non-linear digital filtering technique that operates by selecting a specific region of the image, defined by a predetermined mask size (commonly a 3x3 matrix). The pixel values within this region are evaluated, and the central pixel is replaced with the median value of the surrounding pixels.[5]

$$F(x,y) = \text{median} \{g(s, t)\} \dots \dots \dots [7]$$

$$(s, t) \in S_{xy}$$

Explanation:

$F(x,y)$ = Output of the Median Filter

$\{g(s, t)\}$ = sub-image $S_{(x,y)}$

$S_{(x,y)}$ = the region covered by the filter

3. Implementation and Discussion

3.1. Analysis of the Median Filtering Method Testing

Median filtering is a non-linear filtering technique used to remove noise from an image while preserving edge values and other sharp features. Below is a sample of the data from an identity card (KTP) that has been scanned and converted into RGB pixel format.



Fig. 1: Scanned Image of Identity Card

The pixel values from point (1,1) to point (100,15) of an 800x1280 pixel image in the original image are as follows:

Table 1. Testing of R Pixel Values

x/y	7	8	9	10	11
1	135	133	135	131	129
2	137	135	136	132	131
3	139	137	136	134	134
4	139	138	136	135	136
5	137	136	131	131	134

The pixel values shown in the table above will be convolved with a 3x3 kernel matrix using median filtering. The calculation process is as follows:

Median filtering value at g(2,2)

135	133	135
137	135	136
139	137	136

$$F(x,y) = 133,135,135,135,136,136,137,137,139$$

$$F(x,y) = 136$$

The median value at g(2,2) is 136, so the value 135 is changed to 136 and then set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

➔

135	133	135	131	129
137	136	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at g(3,2) is determined.

133	135	131
135	136	132
137	136	134

$$F(x,y) = 131,132,133,134,135,135,136,136,137$$

$$F(x,y) = 135$$

The median value at g(3,2) is 135, so the value 136 is changed to 135 and then set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

➔

135	133	135	131	129
137	136	135	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at g(4,2) is determined.

135	131	129
136	132	131
136	134	134

$$F(x,y) = 129,131,131,132,134,134,135,136,136$$

$$F(x,y) = 134$$

The median value at g(4,2) is 134, so the value 132 is changed to 134 and then set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

135	133	135	131	129
137	136	135	134	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(2,3)$ is determined.

137	135	136
139	137	136
139	138	136

$F(x,y) = 135,136,136,136,137,137,138,139,139$

$F(x,y) = 137$

The median value at $g(2,3)$ is 137, so the value 137 remains 137 and is set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

135	133	135	131	129
137	136	135	134	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(3,3)$ is determined.

135	136	132
137	136	134
138	136	135

$F(x,y) = 132,134,135,135,136,136,136,137,138$

$F(x,y) = 136$

The median value at $g(3,3)$ is 136, so the value 136 remains 136 and is set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

135	133	135	131	129
137	136	135	134	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(4,3)$ is determined.

136	132	131
136	134	134
136	135	136

$F(x,y) = 131,132,134,134,135,136,136,136,136$

$F(x,y) = 135$

The median value at $g(4,3)$ is 134, so the value 135 is changed to 134 and then set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

135	133	135	131	129
137	136	135	134	131
139	137	136	135	134
139	138	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(2,4)$ is determined.

139	137	136
139	138	136
137	136	131

$F(x,y) = 131,136,136,136,137,137,138,139,139$

$F(x,y) = 137$

The median value at $g(2,4)$ is 138, so the value 137 is changed to 138 and then set as the new matrix

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134

135	133	135	131	129
137	136	135	134	131
139	137	136	135	134
139	137	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(3,4)$ is determined.

137	136	134
138	136	135
136	131	131

$F(x,y) = 131,131,134,135,136,136,136,137,138$

$F(x,y) = 136$

The median value at $g(3,4)$ is 136, so the value 136 remains 136 and is set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134



135	133	135	131	129
137	136	135	134	131
139	137	136	135	134
139	137	136	135	136
137	136	131	131	134

Next, the median filtering value at $g(4,4)$ is determined.

136	134	134
136	135	136
131	131	134

$F(x,y) = 131,131,134,134,134,135,136,136,136$

$F(x,y) = 134$

The median value at $g(4,4)$ is 134, so the value 135 is changed to 134 and then set as the new matrix.

135	133	135	131	129
137	135	136	132	131
139	137	136	134	134
139	138	136	135	136
137	136	131	131	134



135	133	135	131	129
137	136	135	134	131
139	137	136	135	134
139	137	136	134	136
137	136	131	131	134

After completing the median filtering process using the 3x3 kernel matrix, the result of $F(x,y)$ will display an improved image compared to the original. Below is the updated matrix resulting from the median filtering process with the 3x3 kernel:

Table 2. Updated R Pixel Values

135	133	135	131	129
137	136	135	134	131
139	137	136	135	134
139	137	136	134	136
137	136	131	131	134

3.2. Results of Method Implementation on Data

The implementation of median filtering on scanned identity cards and family cards has demonstrated improved quality. This method is effective in removing salt-and-pepper noise without damaging critical details in the image data. Median filtering helps restore the visual quality of scans that may be distorted by suboptimal scanner quality or scanning conditions. By reducing visual artifacts, median filtering facilitates the verification and reading of documents. Below is the MOS (Mean Opinion Score) scale for the implementation of median filtering on the data:

Table 3: Test Results

No	Data Name	File Size (kb)	Quality	Image Perception
1.	Ktp1_Noise	614	Good	Image is interpreted and readable
2.	Ktp2_Noise	308	Good	Image is interpreted and readable
3.	Kk3_Noise	334	Fair	Image is readable but still has noise
4.	Ktp4_Noise	662	Good	Image is interpreted and readable
5.	Ktp5_Noise	283	Good	Image is interpreted and readable
6.	Ktp6_Noise	247	Good	Image is interpreted and readable
7.	Kk7_Noise	539	Fair	Image is readable but still has noise
8.	Ktp8_Noise	184	Good	Image is interpreted and readable
9.	Ktp9_Noise	250	Good	Image is interpreted and readable
10.	Kk10_Noise	1.175	Good	Image is interpreted and readable

3.3. System Performance in Reducing Noise

In this phase, an analysis of the system's performance is conducted. The implementation results demonstrate that the system effectively reduces or eliminates salt-and-pepper noise present in the images. The system's performance has proven to be highly efficient, aiding in the verification of information within the images.

4. CONCLUSION

After the discussion in the previous chapters, the researcher has drawn several conclusions about the system designed by implementing the median filtering method for image enhancement, including the following:

1. The median filtering method has proven effective in reducing salt-and-pepper noise in scanned identity cards and family cards, resulting in improved visual quality with 90% accuracy during testing.
2. In this research, median filtering was implemented by performing convolution using a commonly used 3x3 kernel matrix. The original image was first converted into RGB pixel format, then processed through median filtering to produce an improved image with better quality.
3. This system successfully generated images that meet the quality standards for official documents. With the applied quality, the scanned identity card and family card images meet the necessary visual criteria for official administration and identification purposes.

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