Designing Image Correction Software with the Wavelet Method

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Abstract. Images can be produced by tools such as cameras, satellites or scanners. The process of transferring images from these devices can cause interference in the form of noise. Damage to photos or images is something that cannot be avoided, where this damage is usually caused by a time factor, a factor in someone's accidental handling of a photo, or other external factors. This will cause the photo to be cured until information loss or artistic value occurs. Image processing is a solution to handle or manipulate an image, in other words in image processing is also offered a technique to deal with the problem above, because handling an image or photo that is damaged is also a process of manipulation of that image. One method of image repair due to noise is through a filtering process by dividing the image into four parts of the actual size, namely the filtered image and the other part are the details of the image where this process reflects the performance of the wavelet transformation method. The results of the trial using the software show the number of filter coefficients affecting the results of filtering with wavelet transformations, where the more the number of filter coefficients daubechies the smaller the visualization of contrast. Repeated decomposition of the image on the wavelet transformation will erode the original image, this is caused by the more pixel values transformed by both the low-pass-filter and high-pass-filter processes.

1. Introduction
Image repair is one branch in digital image processing that is often needed in various applications such as in the fields of medicine, multimedia, and in satellite imagery. As technology improvement, more and more methods are used for image develop. In the image processing process if it is carried out under conditions of light in the initial image or because of damage in storage memory, it will obtain a number of areas in the image (pixels) containing noise [1]. This noise certainly reduces the beauty of an image. To overcome this, steps need to be taken to reduce image noise. One way to overcome this problem is by applying a wavelet transformation algorithm to output images without noise [2][3][4].

In this study, the image repair process was carried out using the wavelet method. Types of wavelet master filter were used, namely haar, daubechies 4, and daubechies 6. The steps in the image repair
process are as follows, discrete wavelet transforms [5], that decomposing the input image using the wavelet algorithm. Then the decomposition (wavelet coefficient) is multiplied by two and placed in a matrix that is twice the size of the input image at the top corner, while the other matrix elements are filled with zero, after the inverse wavelet transformation process is generated, the value for output image. The above process utilizes two filter functions, namely low-pass filter (scaling function) and high-pass filter (wavelet function), and in the discussion that will be carried out on software against the five wavelet master filters used.

2. Related Works
Wavelet transforms produce a number of sub-images consisting of short images and detailed images [6]. Development for the case of 2-D dimension signals (2-D image signals), is usually done by applying a bank filter separately to the image signal [7][8]. Usually a Low-Pass and High-Pass are used. Image matrix multiplication with a low-pass-filter matrix produces a signal commonly referred to as an approach image (approximation image), and the image matrix multiplication with a high-pass-filter in a specific direction produces detailed images. The emergence of digital television, digital cameras, mobile phones and computer graphic development, can not be separated from the progress in signal processing and digital technology, which is supported by a number of discoveries in mathematics. Before the wavelet transformation era, most specialists used the Fourier transformation technique [9][10].

3. Research Methodology

3.1. Collecting Data Method
Data collection is carried out by the author in library research where the author takes materials and sources related to the topics discussed by looking in books, articles, lecture material, and websites that are on the Internet[11][12]. The types of data collected consist of:
1. Primary data, namely data obtained from websites that discuss image correction, especially regarding wavelet transformations.
2. Secondary data is data derived from books that discuss image correction techniques and indirect wavelet transformations.

3.2. Analyzing Systems
This application was developed using the Rapid Application Development (RAD) methodology with the following stages [13]:
1. Collect various data and information related to the program to be designed.
2. Planning is the stage of planning the application design that will be created and collects the algorithms used in designing the application.
3. The prototype is to make the user interface form based on the planning stages above.
4. Analysis is analyzing the prototype that is designed if there are errors then make corrections.
5. Design is designing prototype improvement using one programming language that supports RAD. At this stage of design if there are discrepancies, steps can be repeated in the prototype and analysis section.
6. Implementation is implementing a prototype that has been designed, doing testing and repair.

3.3. System Development
In the requirements analysis part of the system is decomposed on what needs are needed so that the compression application can be designed and available any facilities. The interface design is done to design the user interface for functions as mentioned above [14][15][16]. The interface design will be done in the IDE (Integrated Development Environment) of Visual Basic 6.0. After the process of indentifying of the model, then the next step is the estimation.
4. Result and Discussion

4.1. Software and Hardware Specifications
To test the implementation of Wavelet Transformation software hardware and operating system specifications are used on PC computers with the following specifications:
1. Processor Intel Pentium IV 2,26 GHz
2. Memory SDRAM 256 MB
3. VGA Card Geforce 2MX 64MB
4. Windows XP Professional Operation System

The image used in the design of this transformation can be in the form of bmp or jpeg format, so it is expected that the image to be transformed is also an image with bmp or jpeg format [17].

4.2. Menu Design
Interface is a media interaction between the computer and the user. In graphical-based operating systems (graphic user interfaces or GUIs) such as Windows, the interface of software is usually a window. Through this window the user can interact with the software used for manipulating interests according to the purpose and capabilities of the software.

In designing the menu of this software has standardization as in the other user interface windows, which consists of the file menu, Process and about, where the file menu as usual consists of sub menus edit, save, and others. Whereas in the processes, it is includes the sub-menu of the decomposition and reconstruction process, and finally on the menu about covering the tutorial or designing the researcher [18].

4.3. Form Design
The design of the program (software) for image processing needs, especially the implementation of wavelet transformations, includes the placement and compilation of objects contained in the Visual Basic form. The form that was designed in advance was made a basic design to make it easier when making the actual design in Visual Basic.

The form of this program consists of five forms, namely: the main form, login form, form displays input and output images, form selection process and transformation process (properties), and the form of performance comparison results between the five wavelet master filters used:
1. The main form contains the main display program, menus, where application users (users) can do things like, open image files, close, and so on.
2. The login form contains confirmation for the user, whether the user has the right to use the application. This is made to anticipate the confidentiality of applications from people who are not entitled to use them.
3. Display form consist of input and output images, used to put newly opened images so that they can be processed. This form is also at the same time as a display output of image processing (the result of decomposition).
4. The wavelet transformation form (properties) option, in the form of a form that contains options for the wavelet method that will be used to process the image.
5. The comparison results form, in the form that contains a comparison of the results of the transformation of the three methods used. There are two comparisons of this method, namely: the time needed, and the error value (appeal value) of MSE.

Before the user uses the application, then the user is first confirmed about access rights, by displaying the password form as shown in the following picture:
After the User completes the access rights and according to the name and password received, the next form display will appear stating that the login has been successful to be implemented as shown in the following picture 2:

![Figure 2. Successful login](image)

4.4. Image Decomposition Process

When we have found the source of the image to be processed, on the main form we can choose the filter coefficient we use, where the coefficients available on the program form consist of three coefficients namely Daubechies 2, Daubechies 4 and Daubechies 6, then we activate the icon on Daubechies 2 coefficient so we can see the process as shown in the decomposition process 1 and 2.

In this process also provided an information form that tells whether the decomposition process has been completed or not, where the information form also appears in line with the progress bar provided. It can be seen in Figures 3 and 4.

![Figure 3. Decomposition Process (1)](image)
4.5. Program Application

Each image needs to be rectified to correct geometric errors in the data retrieval process, whether caused by curvature of the earth's surface and satellite movements, or instrument errors and vehicle instability, if geometry correction is not carried out then length, circumference and so on cannot be measured [19].

The aim of geometry correction is to correct the geometric distortion by placing the image elements in planimetric positions (x and y) as they should, so that the image has an appearance that is more in line with the actual conditions on the earth's surface so that it can be used as a map. There are things that become why images need geometric correction [20] [21].

a. Remote sensing images experience geometric distortion.

b. Remote sensing images experience digital number errors as a result of atmospheric interference.

c. The number of noise in the image such as striping, bad line, line drop and salt and paper which is due to limited imaging, such as signal signal interference or satellite damage.

In this application, using the wavelet transformation is applied only to noise which is salt and paper removal [22] [23].

5. Conclusion

From the results of the trial and analysis of the results can be concluded as follows:

1. Transformation of this image is done or useful for sending data, for example if the data has a large number of pixels or the size of a matrix that has a large scale then in the processing process can occur the image will be damaged for example noise arises. So as to prevent this, it is necessary to do a decomposition process to find the smallest image size to the specified level. So that the size of the image gets smaller then the results obtained will be better and to meet the needs of users who want to get a large and good quality image, then it is again processed by reconstruction or by wavelet-spline-bicubic.

2. The filter reconstruction used is a standard filter just by using the Haar and Daubechies 2 filters, because it is invertebel which has the same properties in the decomposition process. Whereas by way of wavelet-spline-bicubic the reconstruction process can be done by the process of carrying out a standard approach, where the color is on the image pixel. The purpose is estimated by using an average of 16 pixels which corresponds closest to the initial image pixel.

3. The decomposition process makes the image better but the output results are small. For reconstruction using only two filters because they are invertebels, two types of filters are haar and
daubechies 2. While wavelet-spline-bicubic can be done because it is based on the approximation of wavelet calculations.

4. The number of filter coefficients affects the results of filtering with a wavelet transformation, where the more the number of filter coefficients is daubechies, the contrast visualization gets smaller.

5. Repeated decomposition of the image in the wavelet transformation will remove the original image caused by the more values of the pixels transformed by the low-pass-filter and high-pass-filter process.

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