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Detecting the Authenticity of 2022 Emission Banknotes Based on Watermark with the Canny Edge Detection Method

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A B S T R A C T

Money is a legal means of payment circulated by the government in a country, either in the form of banknotes, gold, silver or other valuable metals which are designed and printed with certain shapes and images. Detecting is a way of checking something using certain techniques. With advances in information technology and easy access to information, many criminals misuse it. Image processing is increasingly developing its function in systems for recognizing unique objects, such as watermarks on rupiah banknotes. In image segmentation there are also several methods, for example canny edge detection. Canny edge detection is a method that produces a different image appearance by displaying a relief effect in it. The aim of this research is to detect the authenticity of watermarked banknotes using the canny edge detection method. The process of using the method above includes image acquisition, gray scale operations, morphological operations, then smart edge detection. There are 8 images used in this research consisting of nominal banknotes of 1,000, 2,000, 5,000, 10,000, 20,000, 50,000, 75,000 and 100,000. The final result of the canny edge detection process is a collection of pixels that are used to determine whether an image has a watermark or not. From this research, the accuracy of the watermark detection program on banknotes using the canny edge detection method to detect the authenticity of money was 75%.

Keywords:
authenticity detection, paper money, canny edge detection

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INTRODUCTION

The progress and development of technology in the current era of society is very rapid [1]. The development and progress of each field cannot be separated from the role of technology, especially information technology [2]. With the increasingly rapid growth and development of technology, in

essence every development must have good and bad impacts, like two sides of a coin, both of which are interrelated [3] [4]. So good ethics and morals are needed so as not to fall into all kinds of crimes that exist.

Historical evidence shows that as long as physical money exists, it can be counterfeited [5]. The rise of money counterfeiting makes people anxious because people do not yet know the characteristics of the authenticity of money. Several mass media such as newspapers and television also reported this. Crimes against currency or counterfeiting banknotes are serious crimes in the criminal law system. Socialization regarding how to distinguish between real money and fake money is very important, there are many security features on large denominations.

Banks help prevent counterfeiting by designing, producing, and circulating banknotes that have advanced security features[9]. The characteristics of the authenticity of money can be determined from the material, design and color, as well as the technique used in printing the money [10]. Various anti-counterfeiting approaches and measures have been developed on banknotes to address counterfeiting. Some of the actions available on banknotes include watermarks, security threads, and holograms[11]. There are several special characteristics that differentiate real money from fake money, one of which is detecting the presence or absence of a watermark on banknotes [12]. Therefore, to help recognize and identify the presence of watermarks, image processing technology is needed.

Image processing or what is usually called image processing is a process of analyzing and processing data based on digital images, from this processing it can improve the quality of an image so that it is easy for computers and humans to interpret it [13] [14]. Images and videos can be processed with digital images [15]. In digital image processing, edge detection is an image processing method by identifying edges on image objects which then displays boundary lines connected to the image object [16][15]. Each edge detection method has its own advantages and disadvantages in detecting objects in an image [17][18]. One example is edge detection using the Prewitt method which produces smoother images than other methods [15].

If seen from the previous background, the researcher aims to determine the application of image processing courses to detect the authenticity of banknotes issued in 2022 based on watermarks using the Canny edge detection method. Detecting the Authenticity of Banknotes Based on Watermarks with Digital Image Processing is a similar research. This research uses an 8 rupiah denomination banknote whose denomination is different from the 2022 edition or the 2022 edition. Using 8 images to test will bias the level of accuracy [19] [20].

METHODOLOGY

This research uses an experimental method that arises from the causes and effects of an event. The application used is Matlab for watermark detection. The research stages can be seen in the following picture.

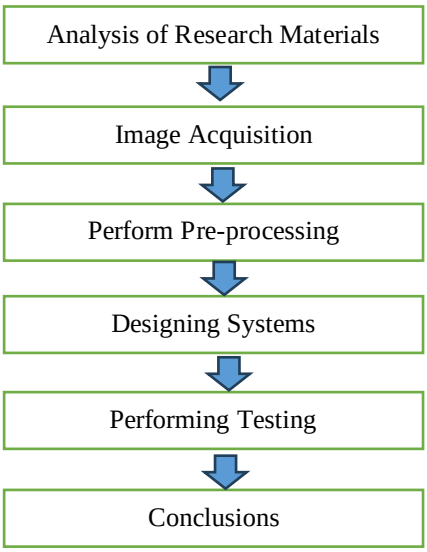

Figure 1. Research Stages

To detect genuine banknotes based on watermarks using quantitative methods. Then you have to follow the following steps. Analysis of Research Materials: Using 2 banknotes, one genuine and one not, with a nominal value of Rp. 100,000 and just use a flash light from a smartphone to provide lighting from outside. Image Acquisition: Capture watermarked photos taken using a smartphone. Pre-processing: Resize to mask noise using supporting software. System Design: Create a watermark detection program using a GUI in Matlab. Testing: Carry out process analysis with image results from the program. Drawing Conclusions: Providing final conclusions from the results of the tests that have been carried out.

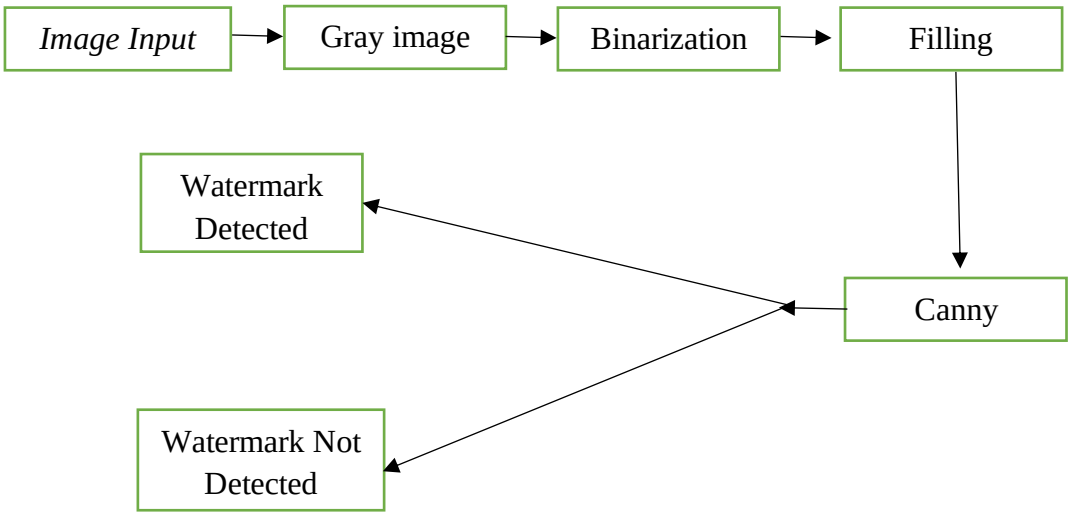

Figure 2. Method Algorithm

1. Image Input

Image input refers to an image or picture of money that will be analyzed to find out whether the money is real or fake. This process usually involves image processing techniques and feature analysis to recognize special signs that differentiate real money from fake money.

2. Gray Image
   Gray-scale images can be used to detect counterfeit money as a simpler representation of the image of money. Basically, a grayscale image is an image that has only one color channel (brightness), with each pixel having a single brightness level ranging from 0 to 255 (in 8-bit format). However, keep in mind that using grayscale images also has some disadvantages. Some color-dependent false flags may not be well detected in grayscale images, and some additional color information may be lost.
3. Binarization
   Changes the image depth to 1 and 0 where each pixel only has two values, namely black or white. In the context of counterfeit currency detection, binarization is often used after grayscale images to clarify the differences between objects (e.g., security elements on money) and the background. The binarization process helps clarify features in the image that will be used in detecting counterfeit money, such as security lines, watermarks, or other security elements. With binary images, advanced analyzes such as contour detection or feature extraction are easier to perform.
4. Filling
   Fill operations in image processing are used to fill empty areas or holes in objects in the image. The goal is to repair objects that are imperfect or have holes. This is useful in many image processing applications, such as medical image enhancement, image restoration, or object segmentation.
5. Canny
   Canny edge detection is a popular technique in image processing to detect the edges of objects in images with high accuracy. One requires the use of thresholding to look for edges and irrelevant noise. Canny edge detection is often used in various image processing applications, such as object segmentation, pattern recognition, face detection, and so on.
6. Watermark Detected/Not Detected
   Watermarking is one method used to protect copyright and image integrity. However, as technology develops, the watermark method is also followed by techniques for spreading and removing watermarks. Therefore, robust watermark protection and detection remains an active research area in image processing.

RESULTS AND DISCUSSION

1. Data
   At this stage we want to provide details of the materials used, namely nominal money of 1,000, 2,000, 5,000. 10,000, 20,000, 50,000, 75,000, and 100,000. Currently the money is in good condition and is not scratched or folded. And additional equipment is also used such as night lights to avoid light from outside and of course keep light from inside. This research also uses Matlab as an image processing application.

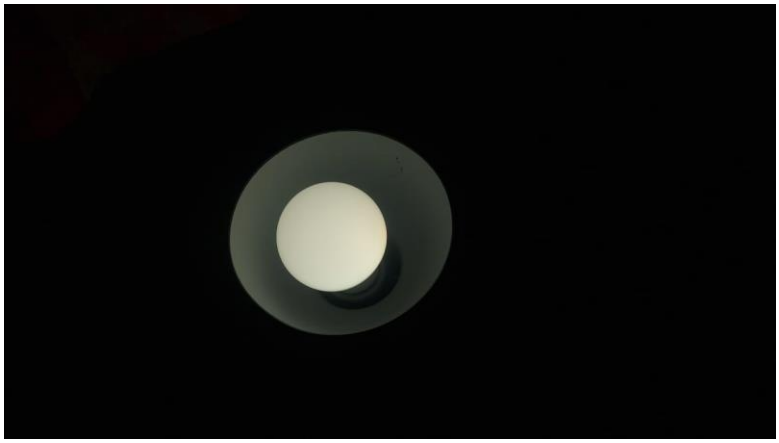

Figure 3. Nightlight for Image Capture

2. Image Acquisition
   In this section we take a picture of money. To take it, just point the money at the lamp that has been prepared. The data used is a portion of money with a watermark taken using a cellphone camera.

Figure 4. Image Capture of Money

3. Pre-Processing
   In this pre-processing process, images are obtained that are used for the system to be created, which includes cropping, image size compression and image segmentation. The process of cropping and compressing image size is done manually using Photoshop support software. Image cropping is done using supporting applications such as Photoshop.

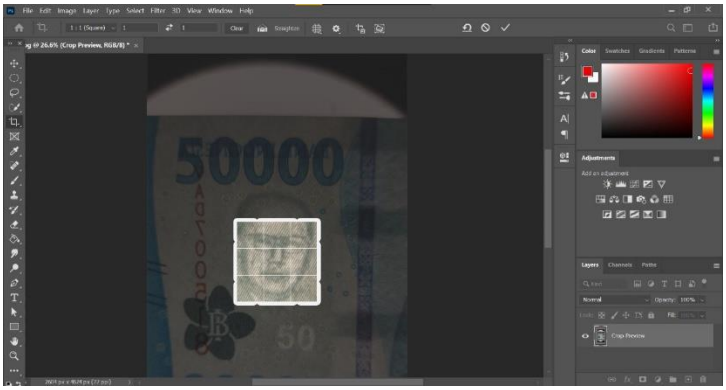

Figure 5. Cropping and resizing process in Photoshop

4. System planning

   The first step in creating a watermark detection program is to design the program's appearance using a GUI in Matlab.

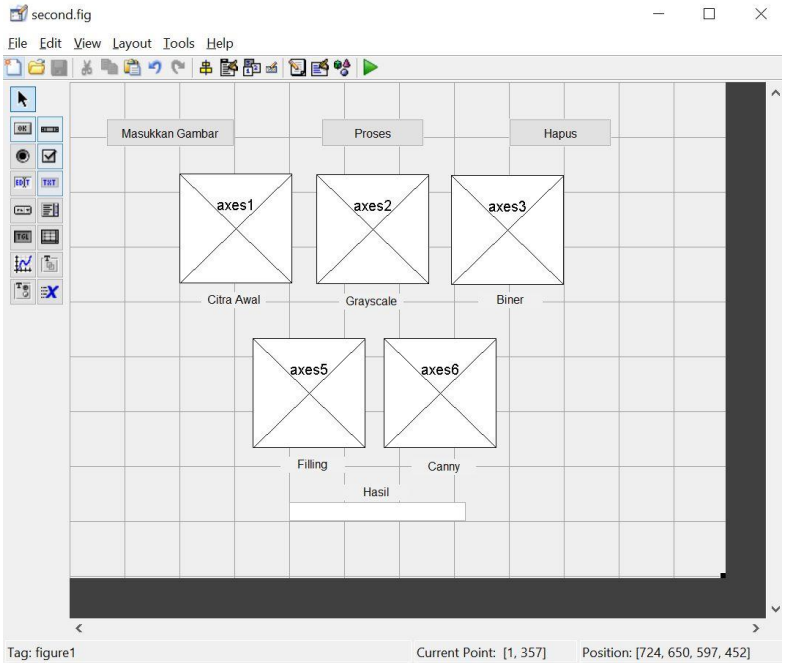

Figure 6. Initial Program Display

The process button functions to run watermark detection. The input image that will be processed first appears in the initial image section with RGB colors. After pressing the process button, the process stages will appear, namely greyscale, binarization, filling, and canny with an output that will display the results of the watermark detection process in each available column according to the information stated in the image display. When running the process button, information is also obtained whether the watermark on the money image being processed is detected or not in the form of a text message.

5. Testing

   Based on the results of trials that have been carried out to detect watermarks, the process can be analyzed where the resulting image from the program starts from the input image as the initial

image which will be processed by digital image processing. The result of the watermark is 'Watermark detected'.

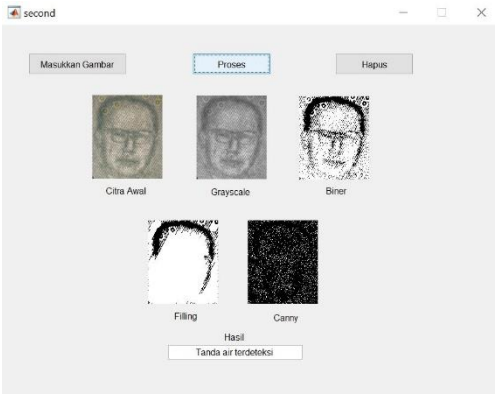

Figure 7. Display of the processed image

Table 1. Watermark Detection Testing with Canny Edge Detection

Nama Folder	Jenis Citra (Rp)	Jumlah Citra	Hasil Deteksi	
			Terdeteksi	Tidak Terdeteksi
Citra Uang	1.000	1	1	0
	2.000	1	0	1
	5.000	1	1	0
	10.000	1	1	0
	20.000	1	1	0
	50.000	1	1	0
	75.000	1	0	1
	100.000	1	1	0
Akurasi			75 %	

Based on Figure 7, it can be seen that the program can detect watermarks, but the edge detection results are still less than optimal due to the placement of the watermark overlapping with signatures and other images, and also the level of accuracy has not been detected. and the lighting is too bright, so that each nominal amount of money basically has a different texture.
Based on research by Agung Rilo Pambudi et al entitled Detecting the Authenticity of Watermark-Based Banknotes with Digital Image Processing which detects the authenticity of old year rupiah banknotes that are watermarked, the success rate is 85.71%.

CONCLUSION

Based on the results of the research that has been carried out, the following conclusion is obtained that the way to distinguish the authenticity of banknotes based on the watermark image is through digital image processing, namely through the image acquisition process, pre-processing, system.

design and testing so that you can find out whether or not there is a watermark using clever edge detection. . The results of clever edge detection can be seen in Table 1. Where the results of detecting the authenticity of banknotes reached a success rate of 75%.

REFERENCES

[1] U. Policy Recommendations for the Health Sector, B. Setiaji, P. Kodrat Pramudho, P. R. Health Effort Policy BKPK Ministry of Health, and P. Master Study, "USE OF DATA AND JOURNAL BASED INFORMATION TECHNOLOGY," Journal of Health Science Research Innovation, vol. 1, no. 3, 2022.

[2] B. B. Wahono, "Designing Information Technology Governance to Improve Health Information System Services (Case Study of the Jepara District Health Service)," SIMETRIS Journal, vol. 6, 2015.

[3] G. Lisanawati, "Cyber Child Sexual Exploitation in the Perspective of Protection against Cyber Crime," Pandecta Research Law Journal vol. 8, 2013, [Online]. Available: http://journal.unnes.ac.id/nju/index.php/pandecta

[4] I. Novia Putri, "Implementation of Microcontrollers and Ultraviolet Rays in Counterfeit Money Detection Tools," Scientific Journal of Computer Science, Faculty of Computer Science, Al Asyariah Mandar University, vol. 8, no. 1, 2022, [Online]. Available: http://ejournal.fikom-unasman.ac.id

[5] L. Mann and S. Roche, “Recent Trends in Banknote Counterfeiting.” 2022.

[6] C. A. Madundang, "Legal Regulation Regarding Counterfeiting Rupiah Currency According to Articles 244 to Article 252 of the Criminal Code," Lex Privatum, vol. 4, no. 4, pp. 5–13, Apr. 2016.

[7] E. Maximiliaan Surea, K. Kunci, A. Criminal Actions, and K. International, "Reasons for a Criminal Action to Become in the Category of International Crime." Juristic Journal, Vol 1. No. 2, 2022.

[8] Zulkarnaen, "Cash Counterfeiting and Homeland Security Stability," Journal of Police Science, vol. 14, no. 3, pp. 210–218, Dec. 2020.

[9] M. Ball, “Recent Trends in Banknote Counterfeiting.” RBA Bulletin, 2020.

[10] Z. Lubis, S. Annisa, and A. Najmita, "Designing Artificial Neural Network Applications for Detecting Banknote Authenticity," 2020.

[11] M. H. Alshayeji, M. Al-Rousan, and D. T. Hassoun, “Detection method for counterfeit currency based on bit-plane slicing technique,” International Journal of Multimedia and Ubiquitous Engineering, vol. 10, no. 11, pp. 225–242, 2015, doi: 10.14257/ijmue.2015.10.11.22.

[12] Y. Ramadhan Nasution, "MONEY NOMINAL RECOGNITION TOOLS FOR THE BLIND IMMEDIATE USING COLOR AND ULTRAVIOLET SENSORS," JISTech, vol. 4, no. 1, 2019.

[13] D. Sathik and Nr. Shabnam Parveen, “FEATURE EXTRACTION ON COLORED X-RAY IMAGES BY BIT-PLANE SLICING TECHNIQUE,” 2010.

[14] A. Rahayu, "Analysis and Implementation of the Zhang-Suen Method in Skeletonizing Images to Reduce Redundancy," JURIKOM (Journal of Computer Research), vol. 7, no. 1, p. 156, Feb. 2020, doi: 10.30865/jurikom.v7i1.1946.

[15] W. Supriyatin, "Comparison of Sobel, Prewitt, Robert and Canny Methods for Edge Detection of Moving Objects," ILKOM Scientific Journal, vol. 12, no. 2, pp. 112–120, Aug. 2020, doi: 10.33096/ilkom.v12i2.541.112-120.

[16] A. Salam, H. Sunandar, and I. Saputra, "IMAGE EDGE DETECTION ANALYSIS USING KRISCH AND UNSHARP MASKING METHODS ON CT SCAN IMAGES," 2018.

[17] Sukatmi, "KOPERTIP: Scientific Journal of Information and Computer Management," KOPERTIP: Scientific Journal of Information and Computer Management, vol. 1, no. 1, pp. 1–4, Feb. 2017.

[18] I. Ummah and N. Yannuansa, "ANALYSIS OF OBJECT EDGE DETECTION IN IMAGE PROCESSING," National Seminar on SAINSTEKNOPAK Ke, vol. 4, pp. 118–122, 2020.

[19] R. Rokhana et al., “Convolutional Neural Network for Femur Fracture Detection in B-Mode Ultrasonic Images,” 2019.

[20] T. Bariyah and M. Arif Rasyidi, "Convolutional Neural Network for Multi-Label Classification Method on Batik Motifs Convolutional Neural Network for Multi-Label Batik Pattern Classification Method."